FLIGHT SAFETY FOUNDATION
Aviation Mechanics Bulletin

JANUARY–FEBRUARY 1996

Trial of Prototype Computer-based FAA Inspector Support System Suggests Need for Further Refinement

FLIGHT SAFETY FOUNDATION

Aviation Mechanics Bulletin

Dedicated to the aviation mechanic whose knowledge, craftsmanship and integrity form the core of air safety.

Robert A. Feeler, editorial coordinator

January–February 1996 **Vol. 44 No. 1**

Trial of Prototype Computer-based FAA Inspector Support System Suggests Need for Further Refinement 1

News & Tips 13

Maintenance Alerts 15

New Products 19

Staff: Roger Rozelle, director of publications; Girard Steichen, assistant director of publications; Rick Darby, senior editor; Karen K. Ehrlich, production coordinator; and Kathryn Ramage, librarian, Jerry Lederer Aviation Safety Library.

Subscriptions: US$35 (U.S.-Canada-Mexico), US$40 Air Mail (all other countries), six issues yearly. • Include old and new addresses when requesting address change. • Flight Safety Foundation, 601 Madison Street, Suite 300, Alexandria, VA 22314 U.S. • Telephone: (703) 739-6700 • Fax: (703) 739-6708

What's Your Input?

In keeping with FSF's independent and nonpartisan mission to disseminate objective safety information, Foundation publications solicit credible contributions that foster thought-provoking discussion of aviation safety issues. If you have an article proposal, a completed manuscript or a technical paper that may be appropriate for *Aviation Mechanics Bulletin*, please contact the director of publications. Flight Safety Foundation assumes no responsibility for submitted material. The publications staff reserves the right to edit all published submissions. The Foundation buys all rights to published manuscripts. Payment is made to authors upon publication. Contact the Publications Department for more information.

Trial of Prototype Computer-based FAA Inspector Support System Suggests Need for Further Refinement

—

Robert L. Koenig
Aviation Writer

Before U.S. Federal Aviation Administration (FAA) inspectors exchange their clipboards for portable computers in the field, problems involving computer hardware, software and attitudes should be worked out with the active participation of inspectors, a recent FAA report recommended.

Despite those flaws in hardware and software, *Results of a Field Study of the Performance Enhancement System: A Support System for ASIs* suggests that computer technology offers many advantages for aviation safety inspectors (ASIs).

Moreover, the trend toward computer technology is likely to lead to more widespread use of similar systems for line maintenance. Thus, this FAA study may offer valuable information to developers of such systems for maintenance technicians. Industry maintenance data recording and storage could also be enhanced by similar portable-computer data bases.

But, although the prototype software is promising, the FAA field study found that more study is necessary to identify the best computer for inspectors, to fine-tune the software and to train inspectors in using the computers to retrieve FAA data and to record field data.

"If [FAA] Flight Standards Service [FSS] management continues to keep the inspectors' concerns firmly in mind and strives to keep inspectors involved in program development, the system will be supported by the inspectors," the report predicted.

The report, by Charles F. Layton, Ph.D., and William T. Shepherd, Ph.D., was based on the results of a national field study of FAA ASIs' experience with four models of portable computer and a prototype software developed for inspectors to use in the field.

Shepherd works for the FAA's Office of Aviation Medicine (OAM); Layton works for Galaxy Scientific Corp., based in Atlanta, Georgia, U.S. OAM sponsored the study, which was designed and supervised by the OAM and Galaxy.

The report identified many potential advantages of a finely tuned computer and data-transfer system for field inspectors. According to the report, when those inspectors now travel to airports and airlines' offices for site inspections, they normally carry two briefcases packed with books and forms, and then spend days after the inspection verifying data and completing paperwork.

A prototype electronic performance-support software, called the Performance ENhancement System (PENS), would allow field inspectors to replace those two heavy briefcases with one lightweight notepad computer.

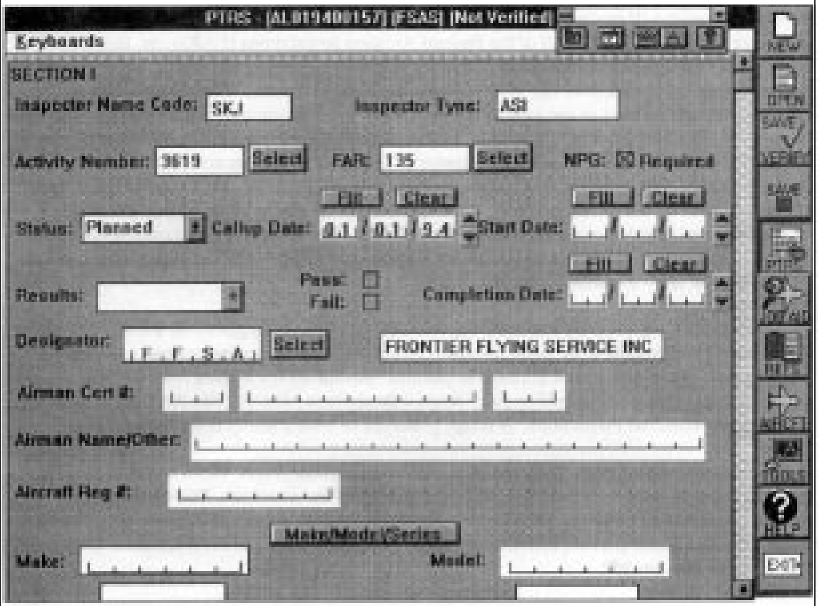
The new system could reduce paperwork dramatically by giving inspectors the opportunity to record and verify data by tapping into data bases at the time of inspections.

PENS runs on the Microsoft® Windows for Pen Computing® operating system, the platform used by three of the four computer models in the trial, as well as on Windows® 3.1. The software is designed to simplify collection of data in the field, to improve information management and to allow on-line documentation of certain data during field inspections. In theory, an inspector who uses PENS efficiently can eliminate most paperwork and bulky paper references, reduce the number of data errors, speed data entry and eliminate redundant data-entry tasks.

"The PENS software was developed as an expedient means to evaluate the efficacy of field computers," the report said. During the field study, the PENS software was frequently updated "to reflect changes requested by the inspectors."

Under the current field inspection and reporting system, FAA inspectors

PENS Prototype PTRS On-screen Interface



PENS = Performance ENhancement System
PTRS = Program Tracking and Reporting Subsystem
Source: U.S. Federal Aviation Administration

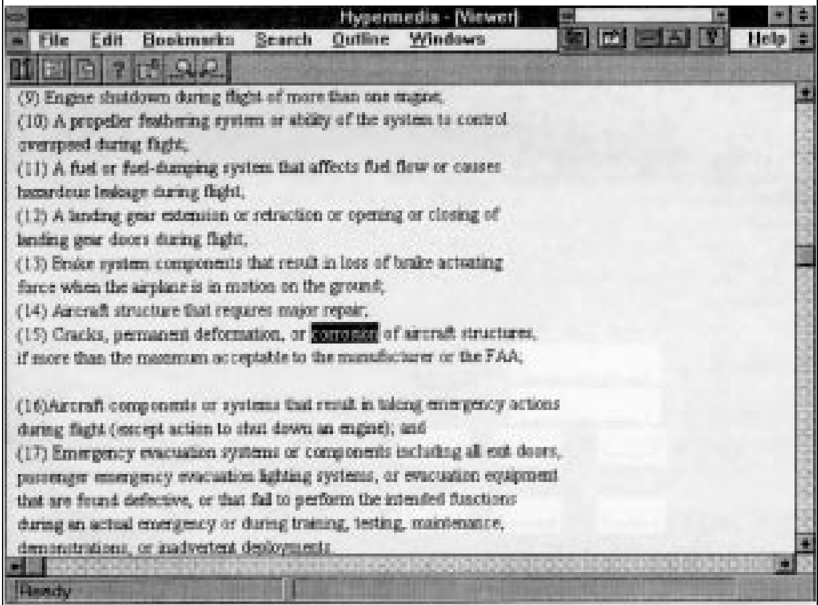
Figure 1

complete paper forms from the Program Tracking and Reporting Subsystem (PTRS), and give those forms to data-entry clerks. The clerks often make errors in transcribing them to the Flight Standards Automation System (FSAS), the FAA's inspection data base, the report said, noting that "the [U.S.] Government Accounting Office has repeatedly criticized the FAA for the quality of its data." There is also a delay, "often a two-week interval between data collection and entry into the national data bases," according to the report.

In contrast, PENS enables ASIs to collect and record their field data in the same format as the PTRS (Figure 1).

PENS includes all reference materials required to perform a given activity, the report said. Rather than consulting reference books, the ASI can call up information stored on

Example of an On-line Search Using PENS



PENS = Performance ENhancement System
Source: U.S. Federal Aviation Administration

Figure 2

hard disks or CD-ROMs. In this way, the ASI will have fast and convenient access to all the U.S. Federal Aviation Regulations (FARs), the *Airworthiness Inspector's Handbook*, Airworthiness Directives (ADs), Advisory Circulars (ACs), FAA orders and other regulatory documents.

The system will "allow the inspectors to quickly answer questions in the field," the report said. The ASI will "be able to browse through the information as if it were in a book, but he/she will also be able to ask the computer to search all of the documents that discuss a particular topic. For instance, if an airline operator asks an inspector, 'Do I have to file a report if I find corrosion on one of my planes?,' the inspector will be able to write or type the word 'corrosion' and initiate a computer search of the FARs. The computer will then display [FARs] Part 121, Subparts V, 'Mechanical Reliability Reports,' with the word 'corrosion' highlighted [Figure 2]."

The report was based on results of FAA-sponsored field tests at nine district offices across the United States from November 1993 to March 1994. Test sites were selected partly to represent varied climatic conditions, ranging from Fairbanks, Alaska (whose environment was described in the study as "extreme cold, dry"), to Fort Worth, Texas ("warm, dry"), to San Juan, Puerto Rico ("hot, humid, rainy").

The testing was designed to rate four lightweight computer models that used PENS software. The computer models tested included three "pen computers" (portable computers that allow use of a pen stylus to record some data), operating on the Windows for Pen Computing platform, and one Toshiba notebook computer, operating with Windows 3.1. Tested were the:

- GRiD Convertible (486/25 MHz CPU; 200 Mb hard drive; built-in keyboard; pen stylus);
- NEC VersaPad (486/25 MHz CPU; 80 Mb hard drive; separate keyboard; pen stylus);
- TelePad SL (386/25 MHz CPU; 200 Mb hard drive; separate keyboard; pen stylus); and,
- Toshiba Satellite T1900 (486/25 MHz CPU; 120 Mb hard drive; built-in keyboard; trackball).

Organizers sent one of each of those computers to nine FAA field offices: in Milwaukee, Wisconsin; St. Louis, Missouri; Fort Worth; Long Beach, California; Seattle, Washington; Fairbanks; Boston, Massachusetts; Harrisburg, Pennsylvania; and San Juan.

They asked four airworthiness (maintenance) inspectors at each of the nine sites to evaluate the computers. The average age of those inspectors was 49 years; they had been inspectors for an average of five and a half years; and they had used computers at some level for about the same period. Sixty percent of the inspectors owned computers.

Each inspector used one computer model for a week and then switched to a different model. At the end of each week, inspectors evaluated the computers they had used. The inspectors also evaluated the PENS software.

Because of various problems, however, only 14 of the 36 participating inspectors evaluated all four computers and the PENS software. The other participants each evaluated between one and three computers. The problems included the following:

- One of the inspectors died during the study, and another who had been on temporary assignment returned to his home FAA office.
- Evaluations from the Seattle office were nullified because

inspectors there, instead of transferring their data by computer to the FSAS, were ordered to complete paper forms and enter the data through the FSAS as well as through the PTRS forms on their computers. Because the network administrator made the inspectors double their efforts, the report said, "inspectors quickly lost any enthusiasm for the project or the computers."

The study's organizers found that they had to train many inspectors to use the Microsoft Windows operating system. Computer systems at most FAA field evaluation sites now run a limited set of DOS [Disk Operating System] applications, rather than Windows.

Each inspector received two days of computer training. The first day concentrated on file storage, DOS, Windows and "handwriting recognition," which included programming the computers to recognize the handwriting of the inspectors who used them. The second day of training was spent entirely with the PENS software.

Asking inspectors to evaluate the computer models was intended to address the following questions:

- Would inspectors use a computer in the field?
- Is a pen computer necessary, or would a notebook computer without a pen stylus be sufficient?
- Would a faster processor make a difference, and is a separate or a built-in keyboard preferable?
- Which is preferable: A lightweight computer with limited functions or a slightly heavier computer with a greater number of functions?

The majority of inspectors who took part in the study said that they supported the concept of using field computers, if inspectors received proper training and if the computers and software were specially chosen or developed to meet their needs.

The report said that inspectors do not support the use of field computers "as simple data collection devices," but rather as tools that "must support the broader information-management roles of inspectors."

The study found that some inspectors would resist an FAA mandate that inspectors always use computers in the field.

"It can be extremely difficult (if not impossible) to use a computer on some types of inspections," the report found. "The worst thing that FSS could do would be to purchase a number of pen computers, install them in the field without a properly designed electronic performance support system, and issue an edict to use them."

Most inspectors indicated that field computers would be of the greatest assistance in providing immediate access to previous data or regulatory materials during an inspection. Inspectors generally felt that using pen computers for the immediate recording of field data was of secondary importance to data retrieval.

Cold or rainy weather posed the biggest environmental barrier to the use of such computers for recording field data. Some inspectors found that computers stopped functioning when the temperature was at the freezing level or below (probably because of battery degradation), and that it was difficult to record data while wearing gloves and bulky winter coats. Others said that they feared that rain or snow would damage the computers. No problems were reported with high temperatures or humidity.

Interviews with inspectors who took part in the study indicated that none of the four computers they tested were ideal for ASIs.

In general, inspectors wanted both portability — a computer that was small and light enough to fit into a coat pocket — and the power and processing capabilities of a desktop computer.

Those desired characteristics include a color display screen, plenty of storage space on the hard disk drive, a fast processor and a CD-ROM drive. Some inspectors also expressed interest in speech-recognition attachments, for dictation, as well as magnetic-stripe or bar-code reader attachments.

"Unfortunately, the demands conflict, in that greater capabilities generally mean greater size and weight," the report noted.

When asked the question, "Would you use this computer in the field as part of your job?" inspectors generally preferred the TelePad SL (which received a 68 percent approval rating) and the GRiD Convertible (67 percent approval) over the NEC VersaPad (41 percent approval) and the Toshiba Satellite (43 percent approval).

Inspectors judged the GRiD and the TelePad to be faster than the Toshiba, and they found the GRiD to be more comfortable to use than the NEC VersaPad. Many inspectors complained that the VersaPad did not have enough hard-disk capacity, mainly because it could not handle the on-line versions of both the FARs and the *Airworthiness Inspector's Handbook*.

In addition, inspectors said that the Toshiba notebook computer was too heavy and cumbersome to be used easily while performing an inspection. The Toshiba T1900 weighed 6.4 pounds (2.9 kilograms), compared with 5.5 pounds (2.5 kilograms) for the GRiD, 4 pounds (1.8 kilograms) for the TelePad SL and 3.9 pounds (1.8 kilograms) for the NEC UltraLite.

"Because the [Toshiba] notebook computer was comparatively heavy and cumbersome, it was extremely difficult to use while actually performing an inspection," the report said. "While a pen computer could be easily operated with two hands, the notebook computer really needed a flat surface to rest it on."

But those hardware criticisms are now academic, because none of the four computer models that were tested are now being produced. Both the GRiD and the NEC VersaPad were later removed from the market, the report said. Meanwhile, the tested TelePad SL is being replaced by the TelePad 3. And Toshiba has replaced its Satellite T1900 with a new model.

Asked to assess the prototype PENS software used in the computer field tests, most inspectors said that they liked the concept of a notebook computer–based system tailored to FAA inspectors.

Three-quarters of the inspectors said that they "enjoyed using PENS," and 85 percent agreed with the statement, "I am eager to see PENS evolve to meet my additional needs."

Specifically, inspectors wanted to expand PENS to incorporate more of their forms, more references and more "performance support" features, such as a scheduling system and report and letter generators.

Despite the praise for PENS, 85 percent of the inspectors said that they "would rather use paper in the field and transcribe the forms in the office." And 52 percent of the inspectors said that they would rather use the current transmittal system (FSAS) for transcribing forms.

The report attributed the discrepancy between the general support for PENS, but the reluctance to use it, mostly to the problems encountered by inspectors in transferring data to their office data bases. Ninety-six percent of the inspectors said that they had difficulty transferring files from the computer to the network, which operated on StarLAN architecture and software.

The report concluded that the data-transfer difficulties were caused by problems with StarLAN, the network hardware connections and the software design.

StarLAN was reported to be "the single largest contributor to data hardware problems." That was because

StarLAN's architecture "greatly slowed down the data-transfer process" when other users were on the network, the report concluded.

In Milwaukee, transferring just one record to the PTRS typically took 10 minutes to 15 minutes. At other sites, it often took five minutes to 10 minutes, which the report said "is not acceptable." Shortly before the end of the field tests, the Atlanta office converted to Novell® Netware, which greatly sped up data transfer, so that it took only nine minutes to transfer an entire work program of more than 400 records.

After other offices convert to such faster network systems, the report said, "the network speed problems should no longer be an issue."

But there were also problems with the network hardware, which featured a cumbersome connection (using a Xircom Pocket Ethernet Adapter) between the computer and the network. The adapter required connections to the computer and network, as well as a separate power supply. And, after that system was connected, the computer had to be re-booted to detect the network. "It was difficult to keep track of all the steps and equipment," the report said.

Inspectors used a data-transfer utility to transfer their completed inspections to network data bases. But, because StarLAN frequently shut down their computers, most inspectors felt the need to "babysit" the file transfers. And there were numerous flaws in the data-transfer utility that had to be resolved.

"The hardware and software problems point to the need for a sophisticated data-transfer utility that runs automatically when the computer is connected to a docking station," the report said.

"The automatic utility would transfer the data in the background as soon as the computer ... logged onto the network, thus eliminating the need for inspector supervision or intervention."

Debriefings of inspectors who participated in the study helped pinpoint a number of problems that the software designers and hardware experts had not anticipated. Some of the challenges cited by the inspectors, followed by the report's proposed solutions to those problems, are the following:

Negative attitudes. A "significant proportion" of inspectors would rather not use computers in field inspections. One inspector compared computers to pagers, calling them "high-tech ball and chains."

Proposed solution: Perhaps the only good way to overcome such negative attitudes is "by repeated demonstration of the benefits" of field computers, mainly by fellow inspectors with positive attitudes.

Ramp inspection problems. Computers can be difficult to use during ramp inspections, "especially when time is short, one's hands are full with a flashlight and a mirror, and it is raining." Also, FAA regulations bar switched-on computers in aircraft cockpits during takeoffs and landings because of possible radio-frequency interference with navaids. "A switched-on computer in the cockpit is generally frowned upon."

Proposed solution: Although "inspectors should not be mandated to use computers at all times," such as during some ramp inspections, the report recommended that inspectors be shown how to take advantage of computers on base and line station inspections. Because such inspections take longer that ramp inspections, "the inspector frequently has a desk or table to work from." And because many inspectors are on the road for days or weeks at a time, the computer helps provide quick data access.

Computer role. Many inspectors will not support field computers "if they are used solely as data collection devices," the report found. "The computers would break, disappear or end up in the back of a drawer ... within two months."

Proposed solution: The "performance support" computer system that will be developed for FAA inspectors must support more needs than data collection alone. Inspectors also want to access information about previous inspections and data on operators; to use computers to manage their workload; and to be able to use automatic letter and report generators. The field computer system "must comprise a suite of tools that supports those needs," the report recommended.

Cable complexities. Many inspectors had trouble keeping track of all the peripheral attachments to the field computers — network adaptors with cables and power supplies, external floppy-disk drives and possibly portable CD-ROM drives with cables and power supplies.

Proposed solution: Using a "docking station" with a built-in network card would greatly reduce the number of needed peripherals, and would allow using full-size keyboards and monitors. For example, the TelePad 3 computer would integrate many of the peripherals. A docking station would also help resolve the objections of inspectors who did not want to use two computers, a desktop model and a portable model.

Data-transfer problems. Many inspectors had problems with the data-transfer process, including connecting the computer to the network and selecting records for transfer. Ninety-six percent of the inspectors agreed with the statement, "I had difficulty transferring my files from the computer to the network."

Proposed solution: The best way to solve the data-transfer problem would be to provide inspectors with "a docking station and a utility that automatically transfers data between the network and the field computer." That would make data transfer relatively simple.

Data-security concerns. Some inspectors said that it was more difficult to make private notes when using a computer (rather than an unobtrusive pad of paper), and they worried that company personnel at the operation being inspected might be able to gain access to the computer and read the inspector's field notes.

Proposed solution: The field computers could be configured to require log-ins, as well as password-protected screen savers, to prevent unauthorized access. And inspectors could always make private notes on paper pads and transfer the notes to the computer later.

Computers "hampering" interviews. Inspectors said some operators were less forthcoming with information because the computers made the interviews seem more official and permanent.

Proposed solution: Inspectors might be advised to use discretion in deciding when to enter notes into their computer. They might also offer to print out their notes to show to the operators being interviewed.

Handwriting recognition problems. Some inspectors had trouble training the pen computers to recognize their handwriting.

Proposed solution: More training and more frequent use of pen computers can help inspectors improve the personalized handwriting-recognition files in their computers. "PENS team members do not have significant problems with misrecognition of handwriting," the report said.

Equipment liability. Many inspectors were concerned about being liable for expensive computer equipment that is broken, lost or stolen.

Proposed solution: Administrative policies must make clear when inspectors would be liable for damaged or lost computer equipment.

Because the computer models tested in the first study are no longer produced, and the flaws in the software and data-transfer links need to be eliminated, the report recommended a second field study.

That study would be conducted at three or fewer sites — about four weeks at each site — with a new generation of lightweight computers, which have also incorporated options that were not available in the previous study. Four airworthiness inspectors at each FAA site would be assigned to help assess the computers.

"By reducing the size of the study, PENS team members can provide more training, more on-site support and greater attention to individual inspectors' concerns," the report said, asserting that a dozen inspectors is "a large enough sample size to test hypotheses with sufficient statistical power."

The main reason for assigning airworthiness inspectors (instead of operations inspectors) to test the computers is that it would make the second study parallel with the first study, which also used only airworthiness inspectors. "As a rule, it would appear that airworthiness tasks place more stringent demands on the ease of use of field computer hardware than do operations tasks," the report said.

Another possibility for the second field study would be to include eight inspectors — half of them airworthiness inspectors, and half of them operations inspectors — at each site. Such a broader study would allow researchers to "compare the needs of airworthiness inspectors with those of operations inspectors, and still maintain a sufficiently large sample size" to draw valid comparisons with the original study's results, the report said.

Despite the limitations of the present study, it "accomplished its two major objectives: Evaluate the feasibility of applying field computers to [ASI] tasks and involve the inspector workforce in this evaluation," the report said. "In the past, inspectors have had little opportunity to influence what tools are purchased or developed to support them and they appreciated the approach taken in this study: Present inspectors with potential solutions and let them evaluate the solutions, suggest improvements and guide future developments."♦

Editorial Note: This article was adapted from *Results of a Field Study of the Performance Enhancement System: A Support System for Aviation Safety Inspectors*, Report no. DOT/FAA/AM-95/31, by Charles F. Layton, Ph.D., and William T. Shepherd, Ph.D. December 1995. The 83-page document includes a 32-page report, figures, tables, a bibliography and appendices.

Training Scheduled for Handling of Dangerous Goods

Dangerous Goods International (DGI) Training Center has announced its 1996 schedule of initial and recurrent training for the shipment and handling of dangerous goods. Courses include:

- Three-day courses of initial training and a one-day recurrent training course, which are certified by the International Air Transport Association (IATA) for personnel involved in shipment of dangerous goods by air;
- A two-day course in U.S. Code of Federal Regulation (CFR) Part 49 domestic multimode transportation of dangerous goods;
- A one-day course in shipment of radioactive materials in multimode transportation; and,
- Four-day courses of initial training and a one-day course of recurrent training in IATA/CFR Part 49 hazardous materials (hazmat) shipment under U.S. Department of Transportation regulations.

Courses are conducted at various locations in the United States as well as in Mexico, Puerto Rico and Panama. Contact: DGI Training Center, P.O. Box 620199, Woodside, CA 94062 U.S. Telephone: 1-(800) 338-2291 (United States and Canada only); (415) 306-8450; Fax (415) 306-8459.

Multimedia Courses Teach Plant Safety Procedures

Roy F. Weston Inc. has released two new user-specific, multimedia, interactive training courses in CD-ROM format. The core safety instructional materials can be customized to address company or site-related requirements. The training is provided with full-motion video, graphic animation and extensive narration to enhance the student's understanding of the material.

The company's hazard communications course covers U.S. Occupational Safety and Health Administration (OSHA) standard 29 (U.S. Code of Federal Regulations [CFR] 1910.1200). The material enables the user to learn about the material safety data sheets (MSDS) that are used in the employer's actual workplace, at a pace set by the user. An additional Lockout/Tagout course shows users how to identify sources of energy in their facilities and how to use locks and tags to limit accident risk.

Concluding mastery tests contain 20 questions to 30 questions, depending on the number of learning objectives. Questions are randomly selected from a larger data base to provide students with different exams. The courseware operates in both Microsoft Windows™ and Apple Macintosh® environments. For further information, see the Weston World Wide Web site at: "http://www.rfweston.com", or telephone: 1-(800) 327-2090 (United States and Canada only); (610) 701-3680; Fax: (610) 701-3124.

ASNT Goes onto The Web

The American Society for Nondestructive Testing Inc. (ASNT) now offers information to users of nondestructive testing (NDT) technologies on the World Wide Web (WWW). The ASNT home page, NDT Link, is designed to provide up-to-the-minute information about ASNT and NDT activities around the world. It is also intended as a focal point for NDT reference information and a "cyberforum" for the exchange of NDT technical knowledge.

Information on NDT Link includes:

- NDT technical resources and information;
- Comprehensive information about ASNT services;
- A calendar of events and conferences;
- Certification programs and ASNT publications;
- Information on ASNT's volunteer structure; and,
- Links to other NDT organizations and groups using the WWW.

NDT Link's WWW address is: "http://www.asnt.org/ndt".♦

Mistaken Identification Results in Damage to Aircraft at Gate

A Boeing 747SP, operated by a major international carrier, struck a loading bridge while taxiing to the gate at Ninoy Aquino International Airport in Manila, the Philippines. The aircraft sustained damage, including a six-square-inch hole in the left-wing leading edge between the landing lights and the wing root.

The ground crew member marshalling the aircraft into the gate had been expecting the arrival of a standard B-747, the type of aircraft normally assigned to this particular flight. Instead, the airline had substituted a B-747SP on the flight and had apparently not coordinated this change with the ground crew. The marshaller was observing the nose wheel as it approached the stopping point for a standard B-747, and allowed the airplane to overshoot the markings for the shorter 747SP, resulting in the damage. The stopping point for the two types differs by approximately 39 feet (12 meters).

As in all accidents and incidents, there were several opportunities to avoid the damage:

- The captain could have reminded the ground crew that there had been an equipment change on the arriving flight;
- The wing walkers, who should have been watching the wing clearance from the ground equipment, could have alerted the marshaller before allowing the airplane to strike the loading bridge;
- The marshaller could have been more observant of the arriving aircraft and noted that it was the considerably smaller SP version of the 747;
- The loading bridge operator could have signalled the marshaller to stop the aircraft when the airplane moved beyond its normal stopping point; and,
- The operator could have included an “SP” on the nosewheel door identification markings to alert ground personnel to the difference.

Missing Bolt Illustrates Need for Double Inspection of Critical Maintenance Functions

A Beaver ultralight aircraft crashed on a practice flight in Canada, resulting in fatalities to both occupants. The preliminary investigation disclosed that the bolt on the left-wing rear attachment point was missing. The reason for the missing bolt has not been determined, but it appears that the bolt may not have been installed when the wings were last attached.

Transport Canada reported that a number of very serious ultralight accidents and incidents have resulted from carelessness or ignorance of basic assembly details. Pilots and nonprofessional technicians may not be aware of the basic quality control practice of having a second qualified individual reinspect maintenance and assembly work that is critical to airworthiness. Professional technicians who are involved in ultralight activities can perform a valuable service by informing nonprofessionals operating or maintaining ultralight aircraft of the importance of the "double inspection" concept of critical maintenance functions.

Transport Canada recommends three principles that may be pertinent for any aircraft, but are especially pertinent to ultralights, which are frequently disassembled for transport and storage.

- Before installation, inspect bolts and safety devices that attach wings and tail components to ensure that they match the manufacturer's material specifications;
- Before any flight, inspect visible high-stress points such as wings, spars, struts, tail assembly and flight controls for security and correct bolts, lock nuts, safety pins, cotter keys and lock wire as specified by the manufacturer; and,
- If the wings or other major flight components have been removed for repair or transport, have a second knowledgeable person inspect the reassembled ultralight aircraft for security and properly installed locking devices before flight.

Gear Collapses After Improper Maintenance

Shortly after takeoff on a charter flight, the pilot of a piston-powered twin-engine Cessna 310 reported that the "gear unsafe" light remained on after moving the landing gear selector to the "up" position. After moving the selector back to the "down" position, the nose-gear and right-main-down lights confirmed "down and locked," but the left main gear remained uncertain and the "gear unsafe" warning light was illuminated. The emergency extension procedure was unsuccessful.

After circling for about an hour to burn off fuel, the aircraft performed a fly-by and ground observers noted that the left main gear did not appear to be fully extended. During the landing, the left main gear gradually collapsed as the landing roll slowed through 20 knots. The aircraft came to rest about 100 feet (30.5 meters) off the side of the runway, and neither of the two occupants was injured.

Examination of the failed gear leg disclosed that the left main-gear aft trunnion pin had been inserted into the trunnion beyond the lock-wire alignment hole, but was not secured by the lock wire. The pin was free to move out of position, removing support for the aft part of the gear leg. This pin had been replaced during an inspection two days prior to the accident flight.

Emergency-light System Recharging Critical to Proper Performance

A major international air carrier recently reported that the time required to fully recharge the emergency-light system may be misunderstood. The operator found that technicians may not be aware of the specific requirements for testing and recharging of the system batteries.

Airworthiness regulations normally require that emergency-light systems be capable of providing the intended light intensity for at least 10 minutes in an emergency. Inadvertent activation of the system, or intentional activation while testing the system, can partially discharge the system and thereby degrade its performance.

Although there may be differences among aircraft types, most systems operate in a similar manner. If the emergency light switch is found in the "on" position, it is important to learn how the aircraft was powered at the time the system is found activated. If ground power (GPU) is connected normally, or the aircraft is powered by the auxiliary power unit (APU) or engine generators, there should be no problem because the battery packs are evenly recharged when the main bus is powered.

If the aircraft is not powered when the emergency lights are activated, a different situation may arise. A test of the emergency light system should be kept brief (two minutes maximum). Every second that the system remains on longer than two minutes discharges the batteries more. A typical emergency-light system requires one hour of charging for each minute of discharge to restore the batteries to full capacity. For example, if the emergency-light system is discharged for more than 10 minutes, the time required to restore the battery pack to full charge can result in major delays or flight cancellation if a spare battery pack is not readily available.

Technicians should study the emergency-light systems for aircraft that they maintain, and fully understand the charge and discharge functions of the systems. It is also prudent to maintain a fully charged battery pack on hand at overnight stations, because the system could be inadvertently activated during cleaning operations.

Synchro Indicators Can Mislead the Unwary

A major U.S. air carrier issued an alert to its maintenance technicians about malfunction reports of synchro indicators. Synchro indicators are used in many applications to indicate pressure, quantity, position, etc. The carrier found that many indicators were being removed because they "would not return to zero with power off."

Technicians and pilots need to understand how synchro indicators function. There are no return springs in a synchro indicator. The indicator is simply a slave to its transmitter, and the indicator needle moves to wherever the transmitter directs. When the power is removed, the indicator typically stays where it was at the moment the power ceased to flow, or wherever balance, vibration or gravity moves the indicator.

If a synchro indicator reads properly with power on and reacts as intended to changes in the system, there is no reason to be concerned about indications when power is off.

Precautions Help Avoid Hand Injuries

Hand injuries are the most common type suffered by aircraft maintenance technicians. To avoid such injuries, a few precautions should be followed.

- Use a vise to hold an object while work is performed;
- When drilling holes or removing rivets, make sure drill bits are sharp. Check to be sure that a hand is not behind the drill point or in a vulnerable position if the drill point slips;
- Use the proper tool when cutting or scraping. Do not pull the tool toward you;
- Be cautious when using pneumatic grease guns to lubricate aircraft. Grease injected into hands and fingers can cause serious complications;
- Keep hands away from pinch points; and,
- If you see a coworker about to do something dangerous, intervene.

Wiring Mismatch Results in Faulty Temperature Reading

A U.S. air carrier noted a repetitive report of inaccurate exhaust gas temperature (EGT) indications, with the temperature split between engines increasing at altitude. The fault was found to be on a pylon receptacle where an alumel socket was on a chromel wire and a chromel socket was on an alumel wire. This had the effect of adding additional thermocouples into the system, away from the heat of the engine. Because the mismatch was not in the pressurized fuselage (where in-flight temperatures would remain fairly constant), the temperature error tended to grow with altitude.

The correct sockets were installed for their wire types and the problem was corrected.♦

NEW PRODUCTS

Towel Provides Hand Cleaning without Soap and Water

The Dymon Co. has introduced a multipurpose hand-cleaner towel that is said to eliminate the need for soap, water, wash basin or sink. The waterless hand-cleaning system, called Scrubs, combines a liquid cleaning formula and a nonabrasive towel. The product is intended to remove dirt, grease, lubricants, adhesives, oils, tar, ink, paint and other stubborn soils.

The towels are packaged in a portable dispenser bucket, and the manufacturer says that the product can replace shop towels, dry wipes, paper towels and rags that are frequently used with paste and pumice hand cleaners.

Contact: Dymon, P.O. Box 6267, Kansas City, KS 66106 U.S. Telephone: (913) 321-5575; Fax: (913) 321-7632.

Hand-held Data Collector Aids in Engine Trend Monitoring

Turbine Trend Analysis Inc. has introduced a hand-held data collector unit (DCU) that captures in-flight engine information for analysis. The maker says that using the DCU reduces the exposure to human error in recording in-flight engine parameters and is designed to make it easier for flight crews to gather, store and transmit the data for later analysis. The DCU is said to provide accurate and timely information and to ensure arrival of the data for analysis.

Hand-held Data Collector Unit from Turbine Trend Analysis Inc.

Because the DCU is not hard-wired to the aircraft's systems it cannot interfere with existing system operations, nor does it expose the aircraft to grounding in the event of unit malfunction. Using the unit's on-screen checklist, crews are guided through the data collection and transmittal process. After the data are captured from the aircraft systems, they can be transmitted to the company's data analysis center using the companion modem over common phone lines. The unit weighs less than one pound (0.45 kilogram), and is powered by a rechargeable battery with 20-hour life.

Contact: Turbine Trend Analysis Inc., 1-(800) 297-6490 (United States and Canada).

Corrosion Protectant Designed for Heavy-duty Applications

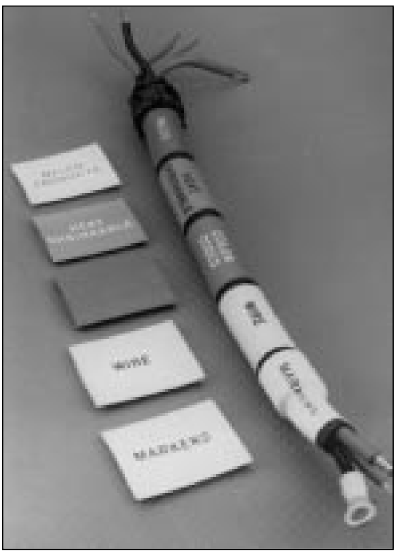
LPS Laboratories Inc. has developed Procyon Corrosion Inhibitor, which is intended for heavy-duty corrosion protection. The product forms a dry, transparent coating that is said to resist salt water, salt spray, moisture, acid, alkali fumes and other corrosive elements. According to the manufacturer, Procyon can prevent corrosion of aluminum up to 1,500 hours based on salt-spray testing.

The product is claimed to be highly effective in penetrating tight or overlapping surfaces, yet resists dripping and puddling during application. Procyon displaces water and can be used alone or as a top-coat layer applied over other LPS coatings. The company says that Procyon is safe to use on most metal, fabric, rubber and painted surfaces, and contains no aromatic solvents or chlorinated fluorocarbons (CFCs).

Contact: LPS Laboratories Inc., 4647 Hugh Howell Road, Tucker, GA 30084 U.S. Telephone: (770) 934-7800; Fax: 1-(800) 965-4321 (United Sates and Canada).

Heat-shrinkable Wire Markers Provide Identification

When repairing existing wiring or installing new wiring in the field, identifying the newly installed wires has frequently been a problem The introduction of heat-shrinkable wire markers by Nelco Products Inc. is intended to help solve this problem. The full line of markers comes in a wide range of colors and material grades. Markers can be custom hot-stamped with logos, part numbers or other identification markings, and packaged to user requirements.



Heat-shrinkable Wire Markers from Nelco Products Inc.

The markers are extruded from poly-efin, polyvinyl chloride (PVC), Teflon, Kynar, neoprene or Viton, depending on the desired rigidity, flexibility, shrinkage ratio and need for flame retardancy. For no-cost samples contact: Nelco Products Inc., 77 Accord Park Drive, Norwell, MA 02061 U.S. Telephone: 1-(800) 346-3526 (United States and Canada); (617) 871-3115; Fax: (617) 871-3117.

Spray-on Masking Protects Surfaces, Removes Easily

The 3M Co. has introduced spray-on masking liquids that it describes as the first such products designed to provide strong protection against impact, abrasion, paint overspray or weather hazards, yet remain easy to remove when the protection is no longer needed. The masking compounds are available in three varieties:

- #9600: A water-borne peelable protectant that offers durable protection during assembly, storage and shipping. The product can be easily peeled in a continuous sheet when no longer needed.

- #9650: A film-forming, water-soluble maskant that is designed to protect surfaces from paints and solvents. The product is removed by washing off with water.

- #9660: An all-weather corrosion inhibitor and protectant that is intended to protect surfaces from corrosion, rust, salt spray, dust, acid rain and other environmental hazards. This product is removed by an alkaline- or ammonia-based release agent.

All three products are said to dry in minutes to a tough protective film. Contact: 3M Marketing Communications, Bldg. 220-8W, 3M Center, St. Paul, MN 55144-1000 U.S. Telephone: 1-(800) 722-5463 (United States and Canada); (612) 733-5133.

Window Mask Tapes Protect Transparencies During Stripping

A window or windshield panel can be damaged beyond repair if not protected during paint removal. The powerful solvents used in many paint strippers can mar plexiglass. Kendall-Polyken has developed a special masking tape intended to reduce this damage exposure.

Polyken #345/347 tape meets U.S. federal specification L-T-80B and U.S. military specification MIL-T-23397B, type II, amendment 2. It is available in custom sizes as well as precut rolls. Contact: Kendall-Polyken, 15 Hampshire Street, Mansfield, MA 02048 U.S. Telephone: 1-(800) 987-3539 (United States and Canada); (508) 261-6200; Fax: 1-(800) 328-4822 (United States and Canada); (508) 261-6275.

Polyken #345/347 tape from Kendall-Polyken

Engine Monitor System Certified by FAA for PT-6A Engine

Altair Avionics Corp. has successfully concluded a U.S. Federal Aviation Administration (FAA) certification program for its CrossCheck engine monitoring system for the Pratt & Whitney (P & W) Canada PT6A-series engine. Based on technology developed for its helicopter health and usage monitoring product line, the CrossCheck system mounts on the engine, remaining with the powerplant throughout its service life. The unit, weighing only three pounds (1.4 kilograms), is mounted on the engine and can be installed in the field or during engine shop rework. The system is installed under a Supplemental Type Certificate approval, and monitors performance indicators such as turbine outlet temperature and torque, as well as turbine and compressor speeds.

The information is downloaded to a laptop computer using a Windows™-based software developed by Standard Aero. Thresholds for monitoring exceedances, cycle definitions and flight-start definitions can be programmed to fit a customized maintenance program.

Future applications to be developed include the Allison 250-series engines and the P & W Canada PW100-series powerplants. By taking advantage of advances in sensor technology, the company claims to have reduced the price of sophisticated airborne electronics to an affordable level for even the smallest aircraft operators.

Contact: Altair Avionics Corp. Telephone: (617) 762-8600.

Biodegradable Solvent Developed for Aviation

Monsanto Co. has developed a solvent that is especially formulated for use in aviation. SkyKleen is said to be environmentally benign and contains no halogenated materials. According to the manufacturer, "the product also meets the Europe-based Organization for Economic Cooperation and Development (OECD) guidelines for classification as 'inherently biodegradable' and would be expected to rapidly biodegrade in domestic sewer treatment facilities." SkyKleen can replace solvents such as methylene chloride, isophorone, glycol ethers and their acetetes, acetone and cresylic acid.

Monsanto also says that SkyKleen:

- Will help reduce volatile organic compound (VOC) emissions in maintenance shops and parts-cleaning operations where volatile solvents are currently used;
- Does not adversely affect the erosive properties or degrade the performance of phosphate ester–based hydraulic fluids at contamination levels up to 1,000 parts per million;
- Is compatible with paints and sealing materials commonly used in the aviation industry; and,
- Is very effective in cleaning hydraulic parts and pumps used in phosphate ester–based hydraulic systems.

Contact: Monsanto Co., 800 N. Lindbergh Boulevard, St. Louis, MO

63167 U.S. Telephone: 1-(800) 325-4330 (United States and Canada); (314) 694-1000.

Lightweight, Portable Eddy-current Flaw Detector Offered

Hocking has announced the availability of a full-featured phase plane eddy-current flaw detector, which is intended especially for aircraft inspection in the field. The unit weighs six pounds (2.7 kilograms) and is contained in a sturdy case.

Phasec 2000 eddy-current flaw detector from Hocking

The manufacturer says that its Phasec 2200 unit is available in both single- and dual-frequency models, with both units having a large, easy-to-read electroluminescent display. The unit is compatible with standard, mini and incrementing scanners for fastener-hole inspection. It has a frequency range of 60 Hz to six MHz, alphanumeric identification of traces and set-ups, on-screen conductivity and coating thickness measurement, and built-in help screens. The Phasec 2200 operates with alternating current (AC) or with six D-size cells.

Contact: Hocking, 50 Industrial Park Road, Lewistown, PA 17044 U.S. Telephone: (717) 242-0327; Fax: (717) 242-2606.♦

BLANK
INSIDE
BACK
COVER

Flight Safety Foundation

41st annual Corporate Aviation Safety Semimar (CASS)

Solutions Today for a Safe Tommorrow

Orlando, Florida, U.S.
April 24–26, 1996

For more information contact
J. Edward Peery, FSF.
Phone: (703) 739-6700 ext. 106
Fax: (703) 739-6708