Airport & Aircraft Safety R&D Notes

FAA Airport & Aircraft Safety R&D Division July-September 2002

TOGAA Awarded Administrator's Gold Medal

At the Sixth Annual FAA/NASA/DoD Aging Aircraft Conference, Mr. Nicolas Sabatini, Associate Administrator for Regulation and Certification, AVR-1, acting on behalf of the FAA Administrator, presented the members of the Technical Oversight Group on Aging Aircraft (TOGAA) with the FAA's Award for Superior Achievement. The award, known as the Administrator's Gold Medal, acknowledged TOGAA's exceptional public service, dedication, and superior achievements. For nearly 15 years, the distinguished members of TOGAA have dedicated themselves to assisting the FAA attain the goals and objectives of the FAA Aging Aircraft Program.

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After the 1988 Aloha Airlines accident, Mr. Anthony Broderick, who was the Associate Administrator for AVR-1, quickly realized that the FAA would need and benefit from independent advice and technical guidance of industry experts regarding aging aircraft issues. TOGAA immediately began providing essential guidance on five specific activities related to transport airplanes: (1) Service Bulletins (SBs) to maintain structural integrity, (2) Corrosion Protection and Control Program (CPCP), (3) generic structural maintenance program guidelines, (4) Supplemental Structural Inspection Documents (SSIDs), and (5) damage tolerance (DT) of repairs. Their role was later expanded to include reviews of research DT rulemaking for transports and aging issues for commuters, rotorcraft, engines, propellers, and cargo conversion modifications.

Led first by TOGAA Chairman, Dr. James Mar, then his successor Mr. Ernest Bryan, and now current Chairman, Mr. Charles Tiffany, TOGAA provided outstanding guidance and support for the FAA's Aging Aircraft Program. Without these staunch advocates of aircraft safety, the aviation community would still be years away from implementing essential changes to aircraft design, certification, and maintenance practices. Thanks to their efforts, the very effective damage tolerance philosophy for aircraft design and maintenance is being

further strengthened with additional fail-safe provisions. Thanks to TOGAA's unrelenting advocacy, the same philosophy is now being incorporated into regulations governing commuters, rotorcraft, and turbine engines. Collectively, these achievements have significantly enhanced aircraft safety and are by any reasonable measure truly exceptional accomplishments, especially for a group of experts who are officially supposed to be retired.

After a final meeting with Nick Sabatini later this fall, TOGAA will officially dissolve. In keeping with 15 years of advocacy, individual members expressed their intent to stay in touch with their colleagues in the aviation community.

ASTM Test: Octane Rating General Aviation Piston Engines

Because of the 1990 Clean Air Act Amendments, the Environmental Protection Agency (EPA) no longer allows gasoline that contains lead to be produced. However, since an unleaded fuel suitable for general aviation aircraft has not been developed yet, the EPA made an exemption, allowing the oil companies to continue to produce 100 low-lead fuels. To develop a new fuel that is both safe and efficient, manufacturers will need to know what standards the fuel needs to meet.

For more than ten years, FAA researchers in the William J. Hughes Technical Center's Unleaded Aviation Gasoline Program have been active participants in the industrywide effort to develop an unleaded aviation gasoline for spark ignition piston aircraft engines. The Coordinating Research Council (CRC) High Octane Unleaded Aviation Gasoline Subcommittee was formed from aircraft user groups, engine manufacturers, airframe manufacturers, petroleum producers, specialty chemical companies, laboratories, universities, and regulatory agencies to facilitate this effort. Replacing the current leaded fuel requires extensive testing in many different areas including performance issues, fuel specifications (e.g., distillation curves, vapor pressure, content), and materials compatibility. The CRC subcommittee identified the motor octane requirement of the current engine fleet as the initial fuel development target. To this end, the Airport and Aircraft R&D Division located at the FAA William J. Hughes Technical Center, as an independent engine test facility, was tasked with determining the octane rating of four engines known to be the most sensitive to octane rating. A fuel that met the octane requirement of these engines would then satisfy the octane requirement of the overwhelming majority of the piston engine fleet.

The consensus of the CRC committee was that a universal engine octane rating procedure be developed, including knock detection and analyses methods. The goal was to ensure consistency of data between separate test facilities.

The FAA personnel used their extensive experience in testing piston aircraft engines to develop a test procedure for the octane rating of naturally aspirated aircraft engines. The procedure was designed to determine the minimum motor octane required so knocking does not occur. The procedure specifies environmental conditions; engine operating temperatures and pressures, engine power settings, fuel blending and handling procedures, knock detection instrumentation, and a process for determining combustion instability levels. The parameters of the test were defined to simulate the most severe engine conditions that would be experienced in flight. After

reviewing tens of thousands of cylinder pressure waveforms generated in their test facility, FAA researchers were able to develop a numerical analysis technique to quantify the combustion instability of an individual cylinder pressure cycle.

Two standard procedures were developed based on the FAA work: a standard procedure for octane rating normally aspirated aircraft engines and a standard procedure for turbocharged aircraft engines using unleaded reference fuels. The procedures were distributed to the CRC members for comment and review. After some iteration, the final procedures were agreed upon.

Since any future unleaded fuel would eventually require an ASTM standard, the FAA procedures for octane rating naturally aspirated and turbocharged aircraft engines with unleaded reference fuels were submitted to ASTM. Previous ASTM standards dealt with octane rating leaded fuels using leaded reference fuels. The final procedures were modified and circulated to the ASTM D-2 subcommittee on aviation fuels for their comments. Major comments were addressed and the procedures then went to ASTM for balloting. Negative votes were addressed and were either incorporated into the procedure or rectified with the voter. The normally aspirated standard practice was accepted and assigned ASTM D 6424-99. Currently, the turbocharged procedure is in the ASTM balloting process.

Stewart Byrnes, AAR-460, (609) 485-4499 and David Atwood, AAR-460, (609) 485-4986.

TOGAA Reviews FAA Aging Aircraft R&D

In late July, AAR-400 personnel briefed the Technical Oversight Committee on Aging Aircraft (TOGAA) on the status of the Aging Aircraft Research Program. The two-day program review covered structural integrity issues, inspection systems development and validation, and aircraft loads monitoring and analysis. TOGAA's comments to Nick Sabatini, the Associate Administrator for Regulation and Certification, AVR-1, were very supportive of the program and its personnel:

> "It is gratifying for TOGAA to observe the continuing maturation of the Aging Aircraft Research Program. Especially noteworthy is the development of a cadre of engineers that possess technical expertise and knowledge of great potential value to the other engineers within the FAA and to other segments of aviation. The quality of the R&D has consistently improved over the past decade that TOGAA has been conducting reviews at the Tech Center. We strongly encourage the Tech Center to continue to develop their in-house capabilities through the continued acquisition of high quality people, expansion of engineering laboratories and equipment, technical training, performing hands-on research and interfacing with other government and industry research organizations."

TOGAA praised the development of AAR-400's Full-Scale Aircraft Test Evaluation Research Facility (FASTER) and suggested that AAR-400 develop an in-house capability to develop, test, and evaluate one or more advanced nondestructive inspection (NDI) technologies, such as thermosonics.

TOGAA was pleased to see the implementation of a formal process for specifying R&D in direct support of regulatory needs. However, TOGAA cautioned against too narrow a focus on

short-term R&D. Longer-term (more fundamental) research may tend to be neglected, since the stakeholders in the research specification process are likely to focus only on near-term problems when establishing the research needs and priorities. TOGAA believes that AAR-400 should also predict future needs and devote a portion of the funding for the longer-term research. TOGAA cited the assessment of the damage tolerance capability of integral structure as an example of this type of R&D. This will be TOGAA's last review of the FAA's Aging Aircraft Research Program. AAR-400 management and personnel wishes to thank TOGAA for their sage advice and wishes them well in their retirement.

Christopher Smith, AAR-480, (609) 485-5221.

The FAA's Annual Turbine Engine Rotor Integrity R,E&D Program Review

The FAA Airport and Aircraft Safety R&D Division hosted an annual program review in August on behalf of the sponsor, the FAA Engine & Propeller Directorate. The review included technical presentations on the progress and plans of active research activities funded by the Propulsion & Fuel Systems and the Aging Aircraft Programs that support the overall rotor integrity requirements established by the sponsor. There were also presentations on related programs sponsored by other organizations, such as NASA and Rolls Royce.

Some of the presentations that were of particular interest were:

- A review of the Turbine Rotor Material Design Project that is developing a probabilistic damage tolerance rotor design risk assessment software tool was given by members of the research team from Southwest Research Institute, General Electric Aircraft Engines, Pratt & Whitney, Honeywell Engines, and Rolls Royce Corp.

- Investigations intended to develop an understanding of the origin of dwell time fatigue in titanium alloys were presented by researchers from the Ohio State University and Princeton University.

- Developing improvements in the melt quality of rotor-grade titanium and nickel alloys were made by representatives from the Sandia National Laboratory Specialty Metals Processing Consortium.

- The Engine Titanium Consortium presentations on development of new and enhanced rotor nondestructive inspection tools were provided from team members from the Iowa State University, General Electric, Pratt & Whitney, and Honeywell.

The audience included members of the performing research organizations and FAA invited guests from MTU Aero Engines Germany, Pratt & Whitney Canada, Air Force Research Laboratory. Members of the FAA Engine & Propeller Directorate, the Scientific Advisor for Nondestructive Evaluation, and managers from the Airport and Aircraft Safety R&D Division also were in attendance.

Bruce Fenton, AAR-460, (609) 485-5158.

4th Workshop on Risk Analysis and Safety Performance Measurement in Aviation

The FAA's Airport and Aircraft Safety R&D Division, Risk Analysis Branch (AAR-490) and NASA Langley Research Center co-sponsored the Fourth Workshop on Risk Analysis and Safety Performance Measurement in Aviation, held in Atlantic City, August 27-29, 2002. The focus of this effort was to provide a forum for knowledge-sharing of philosophies, approaches, models, and methodologies among government organizations, air carriers, and air operators, including general aviation interests.

Over 150 attendees from Europe and North America came for the workshop, including representatives from FAA, NASA, industry, DoD, universities, and private companies. Dr. Herman Rediess, Director, Office of Aviation Research, AAR-1, began the workshop on Tuesday morning and spoke briefly about risk analysis and risk management and about the importance of workshops such as this one. The sessions then began with three general presentations on risk analysis, risk management, and risk assessment.

The final set of proceedings will be distributed on a CD.

Rosanne Weiss, AAR-490, (609) 485-4370.

FAMU Hosts First Joint COE-ACE Camp

One of the university members of the FAA's Center of Excellence (COE) for General Aviation (GA), Florida A&M University (FAMU) successfully hosted the first joint COE-Aviation Career Education (ACE) Camp in Tallahassee, Florida, during the last week of June. In the COE spirit of sharing costs through partnerships, the weeklong activities were jointly funded by FAMU and the FAA's Airport and Aircraft Safety R&D Division, AAR-400, with The Boeing Company. This joint effort enabled FAMU to offer a scholarship to each student, opening the door to many who might not otherwise have had the opportunity to attend.

Dr. Ron Lofaro, AAR-400, is providing on-site assistance at FAMU, carrying out AAR-400's commitment to support the University in developing aviation curricula and aviation safety R&D capabilities. Dr. Lofaro also worked closely with COE-GA Co-Director, Dr. V. Raju, to help develop the new COE-ACE camp outreach initiative. Dr. Lofaro is on a COE intergovernmental personnel assignment serving as a Visiting Professor at FAMU.

In addition to coordinating field trips and planning the basic camp program and agenda, Dr. Raju led an extensive recruitment effort throughout the state of Florida and into Georgia, primarily at aviation magnet schools. This resulted in another COE-ACE first, an all-female aviation camp for minority high school seniors. The FAMU camp will serve as an example for other COE-ACE camps and provide lessons learned to facilitate future efforts throughout the national COE network. It also will help FAMU recruit high school students into their new aviation program.

The COE-ACE camp concept at FAMU was designed to familiarize minority students with aviation-related areas of study at the University and potential employment opportunities in the field. Specific FAA ACE objectives are to develop awareness of the role of aviation in history, to discuss the airplane, identifying parts and the principles by which it flies, to encourage students to explore career opportunities in the field of aviation, to help students understand the role of government as it relates to aviation, and to understand the overall social-economic benefits of aviation in their lives.

The camp agenda included field trips to the Naval Air Station and the Naval Aviation Museum in Pensacola, the Tallahassee GA Flightline Operation, the FAMU-Florida State University Magnetics Lab (a part of the Joint School of Engineering), and an avionics firm in Tampa.

The camp participants also developed individual and group projects and worked on a case study. Two top students were recognized for their superior work.

Plans for additional joint COE-ACE camp programs for next summer are in progress with other Centers of Excellence partners and an FAA team made up of the COE Program Office, FAA Headquarters, FAA Alaska, New England, and Central Region representatives. Discussions are also taking place to coordinate the activities next year with the DOT Summer Transportation Institute.

Peter Sparacino, AAR-400, (609) 485-5430 or Patricia Watts, AAR-400, (609) 485-5043

COE Outreach Expanded Efforts Between FAMU and ACHS

The Centers of Excellence program expanded its outreach efforts when it provided Florida Agricultural and Mechanical University with seed money to develop programs in aviation-related fields. As part of the agreement, the FAMU was to provide scholarships to students who were interested in having a career in an aviation-related field. Initially, FAMU provided scholarships to students in Florida. The effort was expanded to include Atlantic City High School (ACHS), which will afford an opportunity for local students to pursue careers in aviation.

This year, two fully funded scholarships at FAMU were awarded to ACHS students to attend FAMU in the fall. The 2002 COE scholarship award winners beginning their studies at FAMU this fall are ACHS students Quadiir Williams and Nick Andrews. This summer, both students were co-op students in AAR-400. Quadiir worked with Dr. Richard Lyon in the fire-resistant materials lab and Nick worked for Dr. Xioagong Lee and developed two web sites.

Quadiir Williams, Chris Seher, and Nick Andrews

Patricia Watts, AAR-400, (609) 485-5043.

Exposing ACHS Students to Aviation

In the summer of 2000, Mr. Chris Seher, Director of the Airport and Aircraft Safety R&D Division, AAR-400, got a call from the vice principle at Atlantic City High School (ACHS) asking Mr. Seher if he knew of anyone at the FAA or contractors near retirement that would like a second career as a teacher or a substitute teacher. Mr. Seher discussed the matter with his staff as well as Anne Harlan, Director of the William J. Hughes Technical Center, and the Technical Center Human Resource (HR) Office at a staff meeting. A few weeks later, the HR staff called Mr. Seher and announced that they had found a way to allow federal employees to volunteer to teach at the high school on a part-time basis a couple days a month.

Mr. Seher saw the program as a way to expose high school students to technical people with an aviation background and to get them thinking about working at the Technical Center as a summer intern and as a career. Substitute teachers such as Peter Sparacino (AAR-400), who showed the students what they are learning can be applied to real-world situations in aviation, may be ultimately responsible for helping students to become interested in aviation.

Seven AAR-400 employees volunteered to participate in the program. After the volunteers attended a "Discipline with Dignity" workshop at the high school and watched the teachers teach a few lessons, the FAA employees were ready to teach. Peter, who taught geometry, made the subject interesting for the students by giving them a problem he worked on at the Ted Stevens International Airport in Anchorage, Alaska. The project, which collected data to determine the probability of wingtips touching for new and larger aircraft, provided geometry lessons through the setup of the system.

Roseanne Weiss (AAR-490), who taught advanced placement Probability and Statistics, brought in plots from previous work showing a 99.999% safety confidence interval for helicopter approaches. She used a z-test by assuming that the underlying data followed a normal distribution (i.e., bell curve). Robert McGuire (AAR-480), who taught physics, talked about his work in the drop test facility. He explained how he applied a physics equation to determine how high to raise the airplane so that it would impact the platform at a specified speed.

It is hoped that by exposing ACHS students to FAA personnel through the substitute teaching program that the students will gain an understanding of the exciting research performed at the FAA. The ultimate goal is to get students interested in technical careers, particularly careers in aviation.

The Interns Fly Away in Style

This summer, a group of college students arrived at the Airport Technology R&D Branch ready to work. These summer hires came to the William J. Hughes Technical Center under a variety of programs. Traci Stadtmueller and Joseph Cannizzaro were summer interns, Christopher Scott and Bruce Lam were interns with the FAA-Maryland Vietnamese Mutual Association Internship Program, and Nicholas Subbotin was a co-op student. The researchers in AAR-410 put them to work right away,

rebuilding and instrumenting the test pavements inside the National Airport Pavement Test Facility, measuring conspicuity of airport pavement markings; writing software code for pavement friction measuring devices; and fighting fires with our aircraft rescue and firefighting equipment. Not a bad summer job.

One of the best benefits of the summer intern program is the connection of the college experience to what awaits the student after graduation. We shared our view that the work being done at the Technical Center would make its way out into the real world. So near the end of their tour of duty, Ryan King and Jim White (both AAR-410) thought it might be a good idea to get the students out into this real world to see if it is true.

On August 8, 2002, Ryan and Jim took all five students on an inside tour of JFK International Airport. After clearing security, our good friend and partner, Jim Steven, with the Port Authority of NY&NJ, sped us around the inside of some of the most complex and fascinating pieces of aviation real estate in the world. Joe and Traci were fascinated by the construction of the cellular cement arrestor bed under construction on the safety-overrun area for runway 4R. Christopher was stunned by the number and precise arrangements of approach lights on runway 22L. Bruce will always remember the feeling of having a Boeing 747 literally filling the sky above him as it descended to runway 31R. Nick will take away the sense of awe one gets when up close to the supersonic Concorde.

All in all, not a bad day at the office.

Jim White, AAR-410, (609) 485-5138.

Jim White, Bruce Lam, Traci Stadtmueller, Joe Cannizzaro, Chris Scott, Nicholas Subbotin, and Ryan King at the runway 4R arrestor bed project at JFK Interantional Airport.

FAA-AANC NOTES

Visual Inspection Reliability Program— The AANC is currently analyzing the data collected from their most recent visual inspection study, whose goal was to explore the effects of instructions on visual inspection performance and reliability. Forty-two inspectors from seven organizations (five airlines, one cargo operator, one repair station) participated in the study, which was conducted using the FAA's B737 test bed. Six versions of work instructions were developed, based on actual airline work cards, for each of the six on-aircraft inspection tasks. These instruction versions vary in the number and types of directed call-outs. Each inspector conducted all six inspections, using each instruction type once, over the course of their two-day participation. The calls made by the inspector are being analyzed to determine the impact of varying instruction content on search strategy and inspection performance. A final report on this study is in progress.

Caren Wenner, AANC, (505) 284-5220.

Infrared Crack Detection Program— Focus of efforts to date in infrared crack detection has been on developing an understanding of the heating mechanism associated with the introduction of sound into a component with a crack defect. Comparative inspections have been done using other NDI techniques to provide a reference for infrared results. The AANC thermography system has been modified to incorporate a prototype capability of this system. Additionally, a first generation fixture and turntable have been developed to facilitate stabilization of components to be inspected. Future work will focus on the optimization of the identified variables with the goal of obtaining repeatability in inspections.

Mike Ashbaugh, AANC, (505) 843-8722.

Remote Site Aircraft Inspections— Aviation Security Research and Development Division, AAR-500, in coordination with AAR-400, requested that AANC inspect a full size fuselage and several sections of an aircraft in Tucson, Arizona. The inspections were being conducted to determine if the structures could withstand the stresses equivalent to their ultimate design strength. The aircraft inspected were a DC-9-40 fuselage and sections cut from an Airbus 300 and Boeing 747. AANC applied several conventional and two advanced NDI techniques to verify the structural integrity of each test bed. The inspections included using conventional and advanced inspection methods to detect cracks and corrosion in the first layer skin of the fuselage. It was found that all inspection areas in the Airbus 300 and DC-9 will be able to sustain loads concurrent with its ultimate design strength during the subsequent FAA testing program.

David Moore, AANC, (505) 844-7095.

Reports Corner

- Improved Barriers to Turbine Engine Fragments: Interim Report IV, DOT/FAA/AR-99/8,IV,V
- Combustibility of Cyanate Ester Resins, DOT/FAA/AR-02/4
- Reduced ALS Configuration Simulation Testing, DOT/FAA/AR-02/81
- Full-Scale Testing of Fuselage Structure Containing Multiple Cracks, DOT/FAA/AR-01/46
- Electromagnetic Effects Harmonization Working Group (EEHWG)-Lightning Task Group: Report on Aircraft Lightning Strike Data, DOT/FAA/AR-TN02/66
- Development of a Minimum Performance Standard for Hand-Held Fire Extinguishers as a Replacement for Halon 1211 on Civilian Transport Category Aircraft, DOT/FAA/AR-01/37
- Crash Simulation of Vertical Drop Tests of Two Boeing 737 Fuselage Sections, DOT/FAA/AR-02/62

- Development of a Procedure for Indoor Testing of Type IV Fluids to Replicate Natural Snow, DOT/FAA/AR-02/82

- A Methodology for the Assessment of the Capability of Inspection Systems for Detection of Subsurface Flaws in Aircraft Turbine Engine Components, DOT/FAA/AR-01/96

To see these reports and others, please visit http://actlibrary.tc.faa.gov. For help, contact Jim Lignugaris, at (609) 485-4431.

Upcoming Events

- ATA's 45th Annual NDT Forum, Hyatt Regency – Houston, TX, September 30-Oct 3, 2002. http://www.air-transport.org/public/events

- FAA Centers of Excellence Meeting, Wichita Marriot, Wichita, KS, October 21-24, http://www.niar.twsu.edu/faacoe

- Aging Transport System Rulemaking Advisory Committee Meeting, October 22-24, 2002. http://www.mitrecaasd.org/atsrac/index.html

- USAF Aircraft Structural Integrity Program (ASIP) Conference, Westin Savannah Harbor Resort, Savannah, GA, December 10-12, 2002. http://www.asipcon.com

- Sixth International Aerospace Corrosion Control Symposium, Radisson SAS Hotel, Amsterdam, The Netherlands, October 9-11, 2002. http://www.iacc2002.com

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Editor
Jason McGlynn

Airport and Aircraft Safety R&D Notes is published quarterly. For further information contact Jason McGlynn at jason.mcglynn@faa.gov.