Federal Aviation Administration's

R&D Review

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Perspective

The New Research Division Manager Shares Her Vision

Victoria Cox
Manager, Research Division

Welcome to the newest member of the Office of Aviation Research. Victoria Cox is the new manager of the Research Division (AAR-200) within the Office of Aviation Research. In a recent interview, Vicki shared her vision for R&D, the challenges ahead, and her role in the process.

Q What is your new role as the manager of AAR-200?

A: The Research Division serves primarily as the strategic manager of the FAA's R&D program. My job is to develop recommendations for agency investments in National Airspace System (NAS) R&D, assess and evaluate the R&D program, and foster cooperative R&D activities with academe, industry, and other government agencies.

Q What are your immediate priorities for AAR-200?

A: My immediate priority for AAR-200 is People. The office has been without a permanent manager for over 2 years. I have been gaining an understanding of the staff's duties and responsibilities and have come to appreciate the unique capabilities and talent present in AAR-200. I have also begun to develop strategies to take full advantage of that talent and to bring aboard the right people to fill vacancies as they arise - people who are skilled, knowledgeable, motivated, open to the unique opportunities FAA has to offer, and who will complement the excellent team presently on board.

Q From your perspective, what are the R&D challenges currently facing the FAA/AAR?

A: From my perspective, the biggest challenge currently facing FAA/AAR is the decreasing budget and finding ways to do more with less. The challenge is to identify and eliminate potential overlaps and leverage research and development work being accomplished by other agencies. Since I came from the Department of Defense (DoD), I believe there may be opportunities to take advantage of and to leverage DoD research and adapt it to the needs of civil aviation.

Q What do you see as the role of aviation research in the future?

A: I believe a key role of the FAA's R&D program is to support the achievement of the goals that will be established by the national vision for the transformation of the national air transportation system, which is currently being formulated by the FAA, industry, and other government agencies. The key to achieving these goals will be Research - for a transformation to occur, we need to develop and embrace the new technologies that are vital for air mobility and economic growth. In the short- and long-term, investments in aviation research and development strengthen the NAS and the economy.

Q What is your vision for the organization?

A: I'd like to get a better understanding of the organization before proposing any

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Critical Research for Aviation's Future

R&D Communications Manager
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If you are a researcher from industry, academe, or government and would like to submit any FAA research related articles/photographs for future publication in the R&D Review, or to be added to the R&D Review mailing list, please contact:

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long-term changes. During the 3 months I've been here, I have gained a better knowledge of what contributes to the strength and success of the Agency's R&D program and the Office of Aviation Research. I am eager to learn more. However, I believe that a key vision for any R&D organization is to reflect the best that American brainpower, creativity and innovation can offer.

Q Where do you see the organization 5 years from now?

A: Five years from now I would like to see better leveraging of DoD and other resources to help us achieve the national vision for 2020-2025. I would also like to see a process being implemented that leads to increased insertion of R&D products into the NAS.

Q Prior to coming to the FAA, what did you do?

A: Prior to this position, I was Director of International Technology Programs in the Office of the Director, Defense Research and Engineering. Except for a year-long rotation to the Office of the Deputy Under Secretary of Defense for Science and Technology as DoD Laboratory Liaison, I had been involved in international R&D since 1994. I was the Chief of Physics and then Scientific Director of the European Office of Aerospace Research and Development, London, from 1994-1998 and was Director of the Air Force Research Laboratory International Office after that. Before that I managed a variety of R&D projects and organizations for what is now the Air Force Research Laboratory. Earlier I worked as a Physicist with NASA, managing and operating space environmental effects laboratories.

Q How do your new responsibilities differ from what you were doing in the past?

A: My previous positions encompassed responsibilities that were different in focus from those of the Aviation Research Division.. As Director of International Technology Programs, I had oversight of DoD international science and technology activities. The position also gave me excellent perspective on the state of international R&D across a broad spectrum of military technologies. My new responsibilities focus on domestic civil aviation research and development. However, an international perspective is important here as well; and I hope to be able to apply my international experience as well as my DoD R&D experience in this position.

Q Why did you seek a position with the FAA?

A: This position provides an excellent opportunity to become involved in a new range of R&D activities. Unlike my previous endeavors, which tended to focus on specific areas or projects that fed into the overall DoD R&D picture, this position covers the "big picture" of aviation R&D. That's an exciting position to be in.

Q What do you feel you bring to the Office of Aviation Research?

A: With my experience as a NASA bench scientist and manager of Air Force R&D programs and organizations, I bring a strong background in aerospace R&D. I also bring an international and defense perspective to the table along with a receptiveness to new ideas and ways of doing things. Perhaps, most importantly, I bring a lot of enthusiasm for my new duties in the Office of Aviation Research. ■

Standards in Aviation Research

Final Commuter/Regional Transport Airplane Crash Test

The FAA is committed, by 2007, to reduce the U.S. fatal aircraft accident rate by 80 percent from its 1994-1996 3-year average. To achieve this long-term goal, FAA's researchers are currently developing ways to increase protection for both occupants and crew during an accident.

Accident reports indicate that in many survivable accidents, loose seat attachments, falling overhead bins and ceiling panels seriously injured passengers. "Understanding the behavior of the cabin interior is critical to occupant survival" explains Gary Frings, FAA Crashworthiness program manager. "Through our crashworthiness research, we hope to establish cabin interior standards that will protect passengers and crew in the unlikely event of an accident."

Before new standards can be set, however, the agency needs to obtain comprehensive knowledge about structural safety issues and continuing airworthiness criteria for all types of aircraft. As part of this ongoing work, FAA's crashworthiness researchers are currently evaluating impact/survivability requirements for commuter aircraft. To obtain data, the FAA initiated a full-scale vertical impact test program for commuter airplanes (14 CFR 23 and 25) using the FAA's Dynamic Vertical Drop Test Facility located at the FAA William J. Hughes Technical Center in Atlantic City, New Jersey.

The drop test facility consists of two 50-foot vertical steel towers connected at the top by a horizontal platform. An electrically powered winch raises or lowers the test aircraft and has a lifting capability of 37,500 pounds. The facility enables researchers to obtain empirical data to assess the impact response characteristics of airframe structures including seats, overhead stowage bins, and auxiliary fuel tanks, as well to assess the potential for occupant impact injury.

Figure 1. ATR42-300

This research program began over 10 years ago with the drop test of a Metro III aircraft in April 1992, followed by a Beech 1900 airplane test in October 1995. Both of these tests represented 19 passenger commuter airplanes. In August 1998, researchers dropped a Shorts 3-30, a 30-passenger regional transport airplane. After these tests, researchers gathered information from data channels installed on the aircraft. These channels measured G-forces, loads, velocities, as well as other effects of the drop. The test results are helping to determine the impact characteristics of the airframe, seats, overhead bins, and occupants in a realistic environment.

This summer, the largest and final, in a series of commuter drop tests is scheduled to take place. Researchers plan to drop an ATR42-300 regional transport airplane, configured to weigh approximately 36,000 pounds when dropped. This weight represents the maximum gross takeoff weight of the airplane when in revenue passenger service (figure 1). This airplane is typical of the commuter airplanes most commonly found in service today.

As researchers get ready for this summer's test, they have spent months carefully instrumenting the aircraft with sensors located throughout the structure. They are also equipping the plane with dozens of accelerometers located on the floor, seat tracks, side-walls, overhead stowage bins, and other locations to determine the fuselage response to the drop.

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Standards in Aviation Research - *continued from page 3*

Instrumented Hybrid II anthropomorphic test dummies will occupy several of the seats on board. The data collected from the dummies will help determine passenger injury potential. In addition, several high-speed film cameras will record the aircraft during the drop test from several exterior angles, providing a panoramic view of the simulated crash. Additional cameras are mounted inside the aircraft to record the structural response.

Figure 2. B737 Fuselage Section with Overhead Stowage Bins

Because this will be the last drop conducted to obtain information on commuter aircraft, researchers are creating a computer model for the ATR42-300 to help predict crash damage to commuter aircraft, crash gravity loads sustained by the aircraft structure, gravity loads transmitted to the seats, and the resultant forces experienced by the seated occupants. The results of the drop test will be used to refine and validate the model.

"This computer model will allow researchers to augment test data by simulating crashes of other commuter aircraft under a wide range of conditions, "explained Frings. "Such an effort will help with future mitigation concepts and with estimating safety benefits."

These commuter tests are just one part of a larger crashworthiness program. Researchers are also studying and conducting vertical impact tests on a series of transport category fuselage sections (figure 2).

Through these tests, researchers determine the impact response characteristics of things such as overhead bins, auxiliary fuel tanks, and seats installed to assess the adequacy of their design standards and regulatory requirements. As with the commuter tests, researchers developed and validated computer models of previous drop tests of B737 fuselage sections (figure 3). Computer models are certainly more cost effective than the arduous task of assembling and outfitting an entire aircraft or fuselage for a physical drop test and will ultimately enable engineers to better predict crash damage, aircraft loading, and the resultant forces experienced by the occupants.

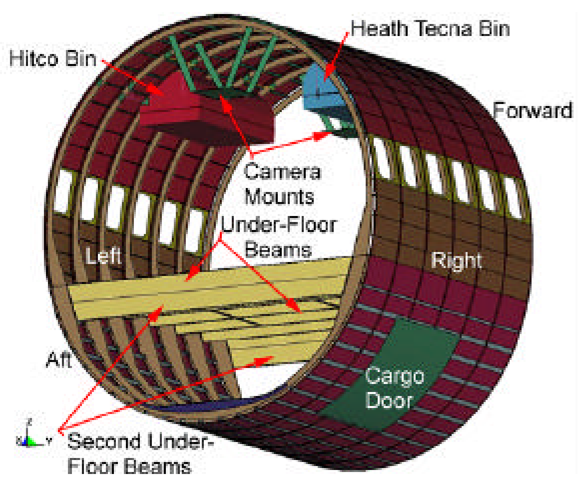


Figure 3. Computer Model of B737 Fuselage Section with Overhead Stowage Bins.

For additional information about the FAA's Crashworthiness Program, please contact Gary Frings, at (609) 485-5781 or via email at gary.frings@faa.gov. ■

For more information about the events celebrating the 100th anniversary of the Wright Brothers' and the Centennial of Flight, please visit: www1.faa.gov/education/index.htm.

Visibility

A Human Factors Research Grant

The FAA's Human Factors Research and Engineering office recently awarded the University of Nevada-Reno a research grant for Visibility in the Aviation Environment. Under the auspices of this grant, educational materials and research will be developed to assist in the reduction of accidents caused by problems of visibility in the air and on the ground. This grant will address four critical areas: continued flight into reduced visibility and/or "flat light;" failure to detect other aircraft and obstacles in the aviation environment; failure to use resources; and the need for improved education and training for the aforementioned areas.

According to Mark Rodgers, Human Factors Research and Engineering program manager, "Accident data reveals that sometimes the pilot is unable to recognize unsafe visual conditions and take the immediate actions necessary. Or, sometimes, pilots of accident aircraft are not adequately acquainted with the available technology; either advanced equipment installed in the aircraft, or ATC services. Hence, it is critical that we understand and help pilots overcome the challenges associated with visual limitations under conditions of low visibility."

Current literature indicates that accidents related to visibility account for a large portion of the total fatalities in aircraft. The University of Nevada-Reno research will help determine new strategies for pilots to optimize the use of available technology and services. Researchers under this grant will expand past studies through the use of innovative simulation technology and advancements in the understanding of the physiology and limitations of visual function.

Of particular interest is research of contrast masking and flat light, since these visual hazards in the aviation environment have not been previously quantified. Results from this research effort will provide written documentation to educate and improve pilot recognition and performance under non-optimal visual conditions, which will ultimately reduce accidents related to poor visual conditions.

For more information on this and other Human Factors activities, please visit, http://www.hf.faa.gov. ■

Top photo: Poor Visibility while in the air.
Bottom photo: Good Visibility while in the air.

JUST A MINUTE

We want to know what you think...

- **Are you a first time reader of the R&D Review?**
- **What do you think of the articles?**
- **What topics would you like to see in future newsletters?**
- **Would you like to be on our mailing list?**

Please submit your brief responses online to: http://research.faa.gov/aar/survey_info.asp

Welcome New Members

REDAC Welcomes Five New Members

Established by Congress in 1989, the FAA's R,E&D Advisory Committee (REDAC) reports to the FAA Administrator on research and development issues and provides a liaison between the agency's R&D program and similar efforts within industry, academia, and other government agencies. As part of its duties, the Committee:

- Provides recommendations on the FAA's research portfolio and budget priorities;
- Coordinates the FAA's research, engineering and development activities with industry and other government agencies; and
- Considers aviation research needs in capacity, system safety, aircraft safety, aeromedical research, aviation security, future technology, and the national airspace system—present and future.

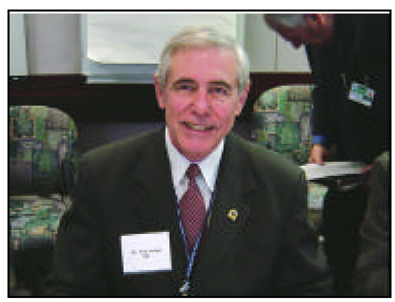
A maximum of 30 members serve on the REDAC for 2-year terms. They represent corporations, universities, associations, consumers, and other government agencies. The FAA's Director of Aviation Research, Dr. Herm Rediess, serves as the executive director of the committee. The full committee meets twice during the year, typically in April and in September.

The REDAC also has 5 standing subcommittees, which meet regularly throughout the year: Air Traffic Services; Airports; Aircraft Safety; Human Factors; Environment and Energy.

Subcommittee memberships include REDAC members as well as other subject matter experts. At the April 2003, meeting, the Committee welcomed five new members:

Sarah Dalton is Director of Flight Operations Development at Alaska Airlines. She has 10 years of experience related to increasing the aviation system efficiency and is a member of the Air Traffic Services and Human Factors Subcommittees.

Ray LaFrey currently oversees the MIT Lincoln Laboratory Air Traffic Control Mission Area. This FAA, NASA and DoD sponsored research and development encompasses surveillance, navigation, communications, and weather sensing. Since joining the Laboratory in 1969, he designed digital and analog instrumentation systems in support of optical communications. During the 1980's he managed the development and flight-testing of a GPS navigation set for small aircraft. He was the leader of a technical team supporting development of a joint U.S.-Russian satellite navigation capability for civil aircraft, and a member of REDAC's Air Traffic Services Subcommittee.



Paul Polski is with the Transportation Security Administration (TSA) as the Chief of Staff for the Assistant Administrator & Chief Technology Officer. In this position, he has a broad array of responsibilities in establishing, coordinating and managing business operations and processes for this vital new technology management, research, evaluation, acquisition and deployment enterprise.

Jerry Thompson is an internationally respected aviation industry leader and the founder and Chairman of Jerry Thompson and Associates (JTA). In his 20 years with FAA, he founded and directed the FAA Systems Engineering Service, established the principles, practices and organizational structure

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Cabin Safety

Designing the Fireproof Cabin of the Future

The FAA's fire safety program is making tremendous strides in improving cabin safety and increasing the chances of passengers to survive not only a crash, but also the aftermath of fire and smoke. Working with industry and academe, Agency research has already resulted in the: redesign of passenger seats to withstand greater impact; strengthening of fuel tanks to reduce the risk of rupture on impact; reinforcement of cargo and baggage compartments with flame-resistant materials to prevent burnthrough fires; and the requirement to carry fire extinguishers; smoke detectors; heat-resistant slides, emergency floor lighting; and an independent power source for public address systems. As a result of these efforts, postcrash fire fatality rates are decreasing. But more can and is being done to protect passengers.

In fact, the technical advances currently being made by FAA's Fire Resistant Materials program are on track to create a fireproof cabin by 2010. Agency researchers are combining aggressive milestones and proactive technology to identify and develop materials for a cost-effective, fireproof passenger aircraft cabin. In combination with other fire-safety system improvements, ultra fire resistant materials will eliminate catastrophic inflight fires and provide a minimum of 10 minutes of passenger escape time – critical minutes in a postcrash fire.

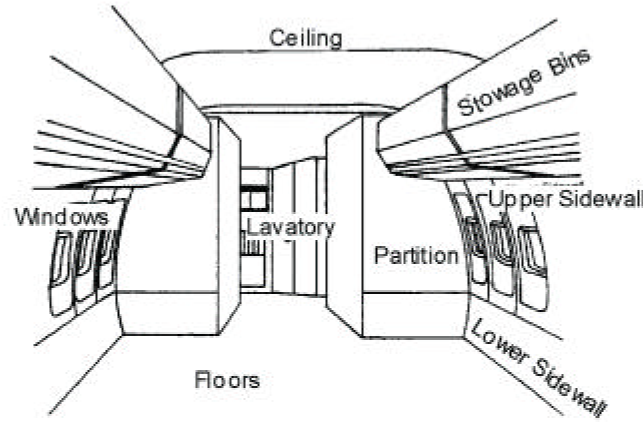

Figure 1. Flammable Cabin Components

"A majority of passengers survive the initial impact of an aircraft accident," explains Dr. Rich Lyon, FAA's Fire Research Materials program manager. "However, 40 percent of those passengers often do not survive the postcrash fire. Current aircraft contain several tons of combustible plastics used for cabin interior components (see Figures 1 and 2) and the FAA's research program is finding ways to mitigate this potential hazard."

As part of this research program, FAA's researchers are working to understand the relationship between ignition and fire growth, and the relationship of these to the chemical composition of plastics, so they can design ultra fire resistant materials that will not ignite or burn. They have found that even if plastics are forced to ignite, for example by a small flame or Bunsen burner, they will go out (self-extinguish) when removed from the flame if their heat release rate is below a certain "critical" value. Thus, both stages of fire development, ignition and growth, depend on the heat release rate – a quantity that is easily measured in fire calorimeters – instruments that sense the heat flow from the chemical reactions of combustion.

In the past, fire calorimeter testing to measure heat release rate required a minimum of several pounds of plastic from which to make test specimens.

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Welcome New Members- *continued from previous page*

that are the basis for the FAA's current systems engineering efforts. He led the team that prepared the original FAA NAS Plan and created the remote maintenance monitoring based methodology and techniques in use by the FAA's maintenance organization. Jerry is also the Chairman of the REDAC's Air Traffic Services Subcommittee.

Dave Watrous is the President of RTCA, Incorporated. He has been with RTCA since 1989, serving initially as Executive and Technical Director, and as President since 1991. He has many years of proven executive and program management experience, plus the perspective of an instrument- and commercial-rated pilot.

For additional information on REDAC activities, please go to http://research.faa.gov/redac.asp or contact Gloria Dunderman at gloria.dunderman@faa.gov. ■

Noise & Emissions Mitigation
FAA's Newest Center of Excellence

A study conducted by the General Accounting Office (GAO) in 2000 noted that 29 out of 50 airport officials believed aircraft noise remained the most serious environmental issue. About 25 percent of the U.S. commercial service airports are in areas of non-attainment for national clean air standards. This 25 percent includes 43 of the top 50 airports around the country.

The National Science Technology Council states "environmental issues are likely to impose the fundamental limitation on air transportation growth in the 21st century." The aviation community has made tremendous strides mitigating the impact of noise and emissions, primarily through source reduction technology. However, we have picked all the low hanging fruit, and making further advances will prove increasingly challenging. To meet these challenges, this year, the FAA is establishing its 6th research center, the *Air Transportation Center for Excellence for Aircraft Noise and Aviation Emissions Mitigation.*

This new Center will concentrate R&D efforts on aircraft noise and aviation emissions issues, such as: the socio-economic effects of noise and emissions and their mitigation; noise abatement flight procedures; compatible land use management; airport operational controls; and the scientific basis for assessing atmospheric and health effects of aviation emissions. While in the area of noise NASA focuses on advanced technology, Center partners will focus on three elements of the balanced approach, namely flight procedures, land use, and controls. In addition, the COE will address human impacts – such as children's ability to learn in a high-noise environment or metrics and methods to assess relative impact of aviation emissions.

By working with U.S. colleges and universities augmenting internal resources, COE cooperative agreements are resulting in significant contributions to the advancement of aviation science and technology. Carl Burleson, Director of the FAA Office of Environment and Energy (AEE), is sponsoring the FAA's newest COE. Dr. Lourdes Maurice, the FAA's Chief Scientist and Technical Advisor for Environment and Energy, Thomas Connor, Noise Division Manager, and Curtis Holsclaw, Emissions Division Manager, will provide technical leadership.

The interrelationship between noise and emissions is a critical element of the COE. Dr. Maurice stated, "As we push the edges of technology to meet public expectations, aerospace systems will become more complex, and interdependencies between noise and aviation emissions, amongst aviation emissions, and economics will drive the science agenda. And this philosophy will drive the Center." She also stated that international collaboration would be a key theme. "The U.S. does not have the sole market in good ideas, we want to seek quid-pro-quo partnerships at home and abroad to stimulate and enhance our knowledge base," she said. Workforce development is the third key theme. Dr. Maurice believes that the COE will become a breeding ground for future employees, not only of the FAA, but also our key stakeholders.

Excellence

The FAA sponsored a COE informational meeting to discuss the direction of the Noise and Emissions Center and to formulate future research on May 6, 2003. Over 75 representatives from 45 institutions freely exchanged ideas with FAA, DoD, NASA, and representatives from industry.

Dr. Herman Rediess, FAA's Director of Aviation Research notes "the turnout for this meeting is indicative of how the aviation community views the work being done by our Centers of Excellence. The FAA has long had a successful partnership with the nation's academic research community, working with U.S. colleges and universities to foster research by both faculty and students that have made significant contributions to the advancement of aviation science and technology. This research has provided the agency and the industry a high return on its investment."

Congress authorized the Air Transportation Centers of Excellence under the Federal Aviation Administration Research, Engineering and Development Authorization Act of 1990. As required by that legislation, the FAA uses a highly competitive process to establish national aviation research centers. Institutions considered for selection as a COE must demonstrate not only technical ability, but must also meet congressionally mandated criteria:

- Ability to serve regional needs for improved air transportation;
- Demonstrated availability of research resources to support Center research;
- Leadership capability in solving air transportation issues;
- Established current air transportation programs; and
- Ability to disseminate research results.

Through COEs, the FAA augments internal research capabilities by accessing academic research, and hastens the application of this work to benefit the aviation community and the flying public. Furthermore, by creating a network of premier research centers throughout the United States, the agency assumes a proactive role in developing a repository of current knowledge and a new pool of professionals trained in aviation technologies. The agency helps to finance graduate education, fosters cooperative and innovative FAA/university/industry research, and thereby makes a strategic commitment to improve the national airspace system.

In an attempt to redefine the way it does business, The FAA is combining efforts and encouraging a richer and more diverse approach to problem-solving methodologies. Allowing for a greater range of involvement now and in the future, academic and industry partners can influence the accelerated deployment of common approaches and coordinated solutions. The selection of the new COE will be made in September of 2003.

For more information about the Centers of Excellence program and the new COE for Aircraft Noise and Aviation Emissions Mitigation, contact Patricia Watts, FAA Centers of Excellence Program Director at (609) 485-5043, or visit the COE web page at www.coe.faa.gov. ■

Runway Safety

EMAS Does It Again

For the second time the prototype engineered material arresting system (EMAS) at New York's John F. Kennedy International Airport (JFK) stopped a plane from overrunning the runway. In June, a cargo plane, carrying 3 crew members, overran a runway while arriving at the airport, but no one was hurt, said a spokesman for the Port Authority of New York and New Jersey, which runs the airport.

"EMAS is proven technology that has saved lives over and over again," said Dr. Herm Rediess, FAA's Director of Aviation Research. Developed by the FAA, the Port Authority of New York and New Jersey, and Engineered Systems Company (ESCO) of Ashton, PA, EMAS, made of water, foam, and cement, deforms readily and reliably under the weight of an aircraft tire.

As the tires crush the material, the drag forces decelerate the aircraft, bringing it to a safe stop. Four years ago, the arrestor bed technology also safely stopped an American Eagle commuter plane that overran a runway at the airport. All 30 onboard walked off the aircraft; damage to the aircraft was minimal.

Because the bed is proven technology, the Port Authority recently installed a second-generation arresting system at New York's LaGuardia airport at runway 22 overrun safety area. This installation will uses a 35-foot setback, rather than the typical 100 feet or more. Over the next year, the bed will be extended gradually to full length, 275 feet, and will convert to a fully functional bed next summer. This will culminate a 2-year R&D effort to solve both jet blast and weatherability issues that created problems for the first generation beds.

EMAS is now being installed at airports around the country, significantly enhancing the safety of the flying public. EMAS is currently at airports in Minneapolis/St. Paul, MN, Little Rock, AR, Rochester, NY, and Burbank, CA. In 2002, ESCO installed EMAS at Baton Rouge, LA, New York (JFK), NY, and Binghamton, NY (2 beds). This year, in addition to the LaGuardia installation, a second bed is also being installed at Little Rock, AR. Six additional EMAS are currently under design and FAA review. International interest is also increasing.

Generally, the cost to install an EMAS ranges between $2 million and $4 million, plus site preparation, for U.S. installations. Airports can apply to the FAA for Airport Improvement Program (AIP) grants to help defray the cost of the system. ■

Combining Efforts

Working Internationally to Improve the Global Aerospace System

The FAA and EUROCONTROL held its periodic Research and Development Committee (R&D Committee) meeting June 19 and 20 in Budapest Hungary. Funded by the FAA, NASA, EUROCONTROL, and EUROCONTROL's member states, the Committee serves as a coordinating mechanism for ongoing cooperative air traffic management research. Presently, these organizations share research work in 13 air traffic management areas, with several more research areas planned. The planned work in each area is documented by an "Action Plan," which is updated annually.

Attendees at this meeting reviewed ongoing research in the following areas:

- air traffic safety
- wake vortex separation standards
- aviation environmental impact models
- air traffic management operation models
- automatic dependent surveillance applications
- digital aeronautical voice telecommunications networks
- air traffic management decision support tools
- air traffic related performance requirements, operational concepts and system designs
- air traffic services system architecture
- air traffic separation standards models
- air traffic services operational concepts
- airborne separation concepts
- human error in air traffic management studies

In addition, presentations by John Scardina (ASD-1) and Alessandro Prister and Shanda Cordigley (EUROCONTROL) provided information on efforts to define the capabilities available in 2010-2015, resulting from procurements/developments currently funded. As a result, U.S. and EUROCONTROL representatives will become more involved in architecture activities to help ensure compatibility of these future capabilities and associated air traffic management operations.

Redeiss, van Doorn, Marchand, and Graham

Herm Rediess (AAR-1) and Jan van Doorn (EUROCONTROL), co-chairs of the R&D Committee, proposed that the Committee work together to develop a joint research framework based on the requirements that will come from the 2025 air transportation system planning activities. The framework will focus on research areas that will result in a global, interoperable air transportation system – the vision of both the U.S. and European 2020 - 2025 development programs. Herm Rediess, Dres Zellweger (NASA) and Jan van Doorn agreed to develop a more detailed proposal for the next Committee meeting, a video conference to be held November 19, 2003.

LIang, Jehlen, and Zellweger

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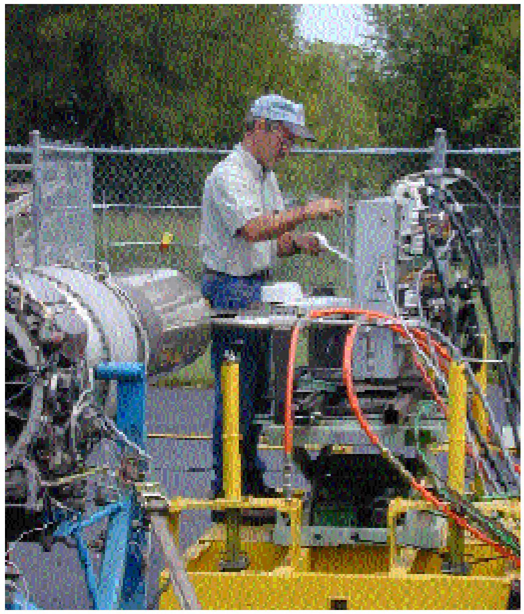
In the Air

Hazardous Air Pollutants

Aviation-related emissions, particularly hazardous air pollutants (HAPs), are a growing concern among FAA's Office of Environment and Energy, airport authorities, and the surrounding communities. According to the U.S. Environmental Protection Agency (EPA), 14 of the 188 air pollutants considered hazardous to human health are present in the exhaust of aircraft and airport ground support equipment.

In recent years, several air quality-monitoring studies have focused on emissions from aircraft and airport operations, and their effect on local and regional air quality. Both proponents and opponents of airport expansion, as well as state and local environmental agencies, have conducted these studies, with conflicting or mixed results.

To address concerns on air quality, FAA's Office of Environment and Energy reviewed publicly available information to determine the state of the science on assessing hazardous air pollutants from aircraft and airport-related activities. Ultimately, this review will assist the FAA's development of guidelines and methodologies for assessing and mitigating hazardous air pollutants in a consistent and uniform manner.



Readying equipment for hazardous air pollutant sampling of a jet engine

From this initial review, FAA learned that: (1) most monitoring efforts to date have been relatively short-term (i.e., 3 days to a few weeks) and there have been no long-term or permanent programs; (2) the levels of hazardous air pollutants on or near airports are not significantly different than those measured in other areas of the urban environment; and (3) in most cases, the data collected on and off the airport properties cannot differentiate those pollutants that are generated by airport operations from those associated with non-airport sources (e.g., motor vehicles, stationary sources, etc.).

Our review of the current state of knowledge concerning hazardous air pollutants from aircraft engines also yielded several interesting observations. Among them: First, considering the amounts of fuel burned, energy generated, and by-products of combustion produced, there are relatively low concentrations of hazardous air pollutants emitted from aircraft exhaust. Second, depending on the engine power settings, which vary by an order-of-magnitude (or more) from taxi/idle to full takeoff thrust, by-products of combustion chemically react differently inside the engine and in the plume to yield different types of compounds and pollutant levels.

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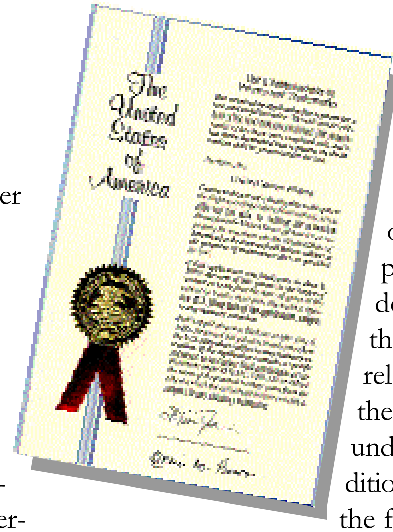
The Office of Aviation Research will be releasing a **Special Edition** of the **R&D Review** this fall.

This edition will highlight the *Civil Aerospace Medical Institute* (CAMI), one of FAA's research facilities that conducts *critical research for aviation's future.*

FAA Technology Transfer

Technology Transfer, Patents, and Beyond



The FAA's Technology Transfer Program is responsible for some incredible, cutting edge technological advancements. Cooperative Research and Development Agreements (CRDAs), issued through this program, enabled the development of an arresting system that stops planes from overrunning the runway - which saves lives. Program participants played a key role in the creation of a pavement test facility that, among other things, ensures the safe compatibility of airport runways and new aircraft types; and they developed an infrared radiant energy deicing system for aircraft with considerably less harmful effects on the environment than conventional chemical deicing. And, these are just a few of the scores of successful projects that technology transfer fueled.

As a general definition, technology transfer is the process by which existing knowledge, facilities, and/or capabilities developed under federal research and development (R&D) funding is used to fulfill public and private needs. The technology transfer process generally involves the marriage of technical R&D resources, such as federal laboratories or federal research programs, technology users, such as businesses, universities, or other government agencies, and the mechanisms to connect the resources with the users to facilitate the movement of technology from one organization to the other.

Some of the mechanisms that make technology transfer possible include: CRDAs, licensing, technical meetings, trade shows, and information dissemination. While the FAA uses a number of these mechanisms to share its R&D findings and resources, most FAA technology transfer occurs through the following:

CRDAs - which allow the FAA to share facilities, equipment, services, intellectual property, personnel resources, and other cooperation with private industry, academia, or state/local government agencies; and

Small Business Innovation Research Contracts - which encourage the initiative of the private sector and the FAA to use small businesses to meet Federal research and development objectives.

As part of its commitment to assist industry through technology transfer, the FAA encourages the commercialization of its R&D products or results, known as intellectual property. Among the most transferred intellectual property are inventions, which may be protected by patents. Part of the FAA's responsibility under Technology Transfer is to support and encourage inventors to patent their ideas and technologies. As a result, the FAA has its own portfolio of commercially viable, issued patents, based on the work of its scientists and engineers.

In one of its recent successes, the FAA granted Dow Chemical Company a non-exclusive license for the use of its patented microscale combustion calorimeter discussed in more detail in this issue of R&D Review. The technology enables researchers to use only a milligram of sample plastic to determine the heat release rate of the material under fire conditions. This is the first license of DOT/FAA-owned technology ever executed by either the Department of Transportation or the FAA. DOW is using the microcalorimeter to develop more fire resistant plastics for consumer electronics and electrical equipment.

FAA researchers also hold patents for a number of innovative technological advances, including:

Groundspeed Measurement System - a method of measuring the ground speed of an aircraft on final approach by evaluating the Doppler shift of a ground-based radio signal at the aircraft.

Moving Target Indicator Velocity Discriminator - allows radar systems to reject and/or filter out low velocity "clutter" like radar echoes from ground targets, precipitation, clutter filter residue and other radar scatterers.

Helium Smoke Generator - a device that mixes theatrical smoke with air and helium to produce cold, visible, ascending smoke for testing purposes.

Minimum Area Smoke Evacuation Nozzle - a fire hose nozzle designed to penetrate an aircraft cabin to dispense fire fighting agents quickly and accurately.

Cabin Safety - Continued from page 7

Commercial plastics are readily available in pound quantities, but, because of their high cost, new and/or experimental polymers/plastics are only made in milligram (one millionth of a pound) quantities by universities and research laboratories. To overcome this challenge, the FAA needed a rapid test capable of measuring the heat release rate of milligram-sized samples of new, potentially fire resistant plastics.
To solve this problem and to accelerate the discovery of new ultra fire resistant plastics, Rich Lyon invented and patented a Microscale Combustion Calorimeter. This calorimeter requires only a milligram of sample to determine the heat release rate of the material under fire conditions.

To date, FAA researchers have tested hundreds of different commercial and research materials in the microscale combustion calorimeter and assigned a flammability value to each part of the chemical structure. As a result, industry and university research partners are now combining the more fire retardant chemical structures into single polymer molecules. This molecular engineering approach, commonly used for drug design, has resulted in “smart” polymers that are tough and flexible under normal conditions, but that instantly transform into rigid, noncombustible materials in the heat of a fire. Researchers have used computer simulations to study the chemical transformations of the smart polymers in a “virtual fire” to identify the mechanism of fire resistance. Consequently, researchers have now designed a family of smart polymers that they synthesized in small quantities.

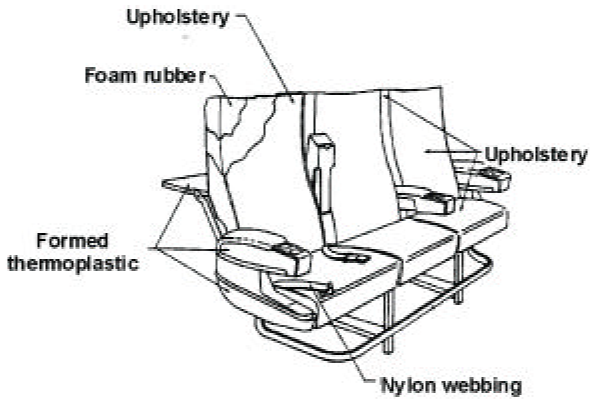
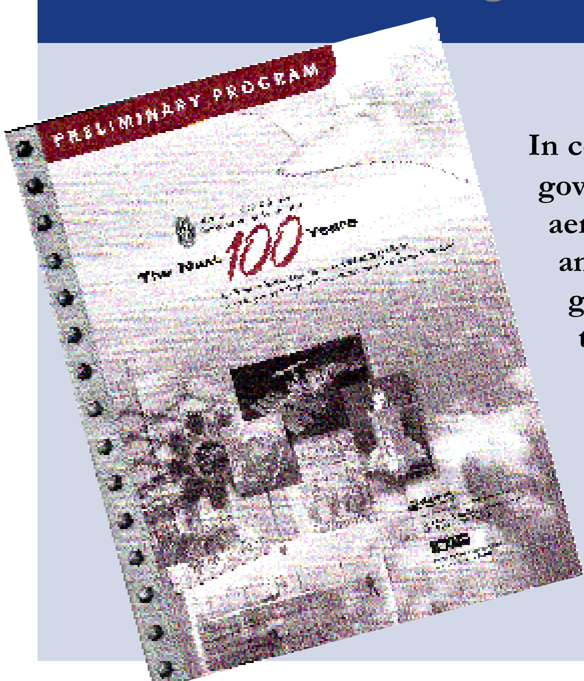


Figure 2. Flammable Seat Components

Following successful testing, these new fire-resistant plastics will be cast into decorative films, drawn into textile fibers, and molded into impact-resistant cabin and seat parts that are expected to have ten times lower heat release rate than current cabin materials. The FAA’s goal is, by 2010, to develop prototype cabin components fabricated from combinations of fire-resistant materials that have a near-zero heat release rate. When deployed, such a fireproof cabin will ensure increased survivability. ■

The Next 100 Years



In commemoration of the centennial of flight, world leaders from government, industry and academe joined together to honor the aerospace industry at the International Air & Space Symposium and Exposition - The Next 100 Years. This exhibition laid the groundwork for the next century of flight. More than 400 technical presentations from leaders of the Federal Aviation Administration, NASA, the American Institute of Aeronautics and Astronautics (AIAA), and other aerospace communities came together to exhibit their expertise in commercial, general and military aviation. The exhibition took place in Dayton, Ohio, July 14-17, 2003.

Combining Efforts - continued from

The 5th USA/Europe Seminar on Air Traffic Management Research and Development followed the R&D Committee meeting on June 23-27, 2003. Jointly sponsored by the FAA and EUROCONTROL, these seminars help create and reinforce working and personal relationships between the leading experts and researchers in the air traffic management R&D community, as well as provide a means to share available research results and reach consensus on major issues. This year's seminar featured a selection of 70 papers covering the following topics:

- Decision Support Tools
- Human Factors
- Air-Ground
- Traffic Flow Optimization
- Metrics
- Weather
- Safety

For additional information on the program, please visit http://atm2003.eurocontrol.fr/ or contact the seminar co-chair, Sabrina Saunders-Hodge, at sabrina.saunders-hodge@faa.gov. ■

Patents - Continued from page 13

Portable Radar or Beacon Emulator - emulates a radar set, using a conventional personal computer rather than specialized equipment. Special software and hardware enables the computer to calculate continuously data for antenna scans, store data, and create an onscreen radar video display.

Wing Tank Liner - limits the amount of fuel that can be spilled in the event of a crash and ultimately reduces the possibility of fire and explosion.

Adiabatic Expansion Nozzle - a nozzle that expands the choice of compounds suitable for extinguishing fires inside the aircraft cabin. Firefighters previously could not use Halon replacement compounds on cabin fires because they exhibited high vapor pressure when released from a normal fire extinguisher nozzle. This patented nozzle enables the use of these previously unusable compounds by lowering the temperature and discharge pressure of the agent.

Heat Release Rate Calorimeter for Milligram Samples - based on an earlier patent, this calorimeter measures the heat release rates of extremely small samples, on the order of one to 10 milligrams, of potentially fire resistant plastics. As a result, researchers are able to accelerate the discovery and creation of new ultra fire resistant plastics. (For a more detailed review, see Fireproof Cabin article in this issue.)

Patented Calorimeter

Device and Method to Measure Mass Loss Rate of an Electrically Heated Sample - discussed in detail in the previous R&D Review, disseminated in May 2003, under the cargo compartment detection project, this technology enables the re-creation of an artificial smoke source while providing exceptionally precise measurement of the mass loss rate of a sample of combustible material.

As evident by these patents, FAA researchers continue to make bold steps improving the safety of the National Airspace System. It is the FAA's sustained interest in Technology Transfer that serves as one of the many reasons these advancements are being accepted and used by our industry partners.

For additional information on the FAA's Technology Transfer program, contact Deborah Germack, Technology Transfer Program Manager, at 609 485-9820 or via email at deborah.germak@faa.gov. You can also visit the Technology Transfer website at: http://www.its.tc.faa.gov/technology transfer. ■

In the Air- continued from page 15

In addition, we found that researchers predict aircraft emissions of hydrocarbons will decline from current levels as turbine and internal combustion engines will likely become more efficient and less polluting. Since most hazardous air pollutants are a subset of total hydrocarbons, they will likely follow this same downward trend. And, while measurements of such pollutants in the exhaust of commercial and general aviation aircraft is very limited or non-existent, available data suggests that aircraft engines are not large generators of these pollutants.

Several knowledge and data gaps have been identified from the FAA's review. According to Dr. Lourdes Maurice, FAA's Chief Scientific and Technical Advisor for Environment and Energy, "our research reveals that current monitoring studies do not take into account the length of time that people (either airport patrons, employees, or nearby residents) may be exposed to pollutants. Such exposure patterns are very important when assessing the potential effects of pollutants on human health or the environment. Perhaps, more importantly, there is no data qualifying long-term, chronic exposure to these pollutants, which may pose the most pressing health and environmental concerns."

The limited availability and accuracy of emission factors for hazardous air pollutants are among the greatest potential limitations in developing accurate emission inventories or dispersion modeling at specific airports and surrounding areas. Although a number of organizations, such as the EPA, the U.S. Air Force, and the California Air Resources Board, have monitored in varying degree airport-related emissions, most of the sampling has been of a limited nature and is not representative of the type or extent of emissions associated with commercial aviation.
Current information seems to suggest that several factors, namely the concentration of pollutants in the ambient air and direct, long-term

exposure to some of these pollutants could potentially impact human health and the environment. To estimate concentration and therefore, potential exposure, researchers have used different atmospheric dispersion models. These models can provide a faster and less costly alternative to monitoring, and are particularly appropriate for predicting future-year scenarios. However, the limited availability of appropriate aircraft engine emission data poses potentially significant uncertainties with this approach.

Of the currently available dispersion models, researchers discovered that the FAA's Emissions & Dispersion Modeling System (EDMS), specifically developed to assess air quality at and around airports, could be a useful tool in the estimation of hazardous air pollutants. Although EDMS has not been used extensively to estimate hazardous air pollutants (e.g., hydrocarbon species and non-volatile organic compounds), its capability to estimate carbon monoxide, hydrocarbon, and nitrogen oxide emissions from aircraft serves as a good basis for future enhancement.

In fact, the FAA Office of Environment and Energy is currently developing assessment methodologies and modeling guidelines to enhance EDMS' capability to estimate hazardous air pollutant concentrations around airports. Once this work is finalized the FAA will be better positioned for conducting standardized assessments of hazardous air pollutants for airport-related projects.

Filling the knowledge gap in assessing airport-related hazardous air pollutants will also require new test data and information, the development of scientific assumptions, and the application of sound judgment. Because the assessment of these pollutants is a complicated undertaking, the FAA Office of Environment and Energy is actively working with the aviation, scientific, regulatory, and environmental communities to effectively address concerns presented by hazardous air pollutants.

To view or download a copy of the report, entitled: *Selected Resource Materials and Annotated Bibliography on the Topic of Hazardous Air Pollutants (HAPs) Associated with Aircraft, Airports, and Aviation*, or for additional information on the FAA Office of Environment and Energy's emissions research program, please go to *http://www.aee.faa.gov/emissions/airindex.htm* ■