Transport Certification

# Update

Certification Information for
the Aviation Industry and Designees

Edition 21, Fall 1996

## Human Factors Applications for Designing Cockpits of the Future

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# From the Directorate Manager . . .

***Ronald T. Wojnar***

This is our third semi-annual issue of the ***Transport Certification Update***. As the new fiscal year begins, we are looking forward to several important events that may significantly affect the working relationship of the FAA with the aviation community:

- **New Leadership in Top Ranks of FAA**. As many of you already know, Anthony (Tony) Broderick, Associate Administrator for Regulation and Certification, retired in June; and Administrator David Hinson repeatedly has made it clear that he does not intend to continue to serve as Administrator after November. As we wish both of these men good luck in their future endeavors, we anticipate that the new leaders will continue to endorse the current on-going efforts to reorganize and enhance the role of the Aircraft Certification Service.

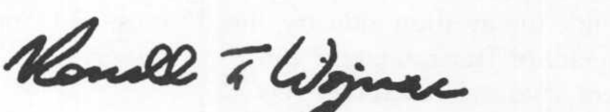
- **Continued Reliance on Designees**. One of our major goals for the coming year is to reemphasize the important roles that our designees fulfill. Designees provide over 90% of the design and airworthiness approvals required by the FAA. We will continue to provide information and training to our designees to increase their effectiveness in fulfilling their important roles in the certification process. One way that we intend to do this is by continuing to hold workshops and conduct designee conferences.

- **Issuance of "Mega-AC's."** In the forthcoming year, I expect to release a compiled issue of all current transport airplane certification policies in the form of "Mega-Advisory Circulars (AC)" for each field of technical expertise. This information should provide to airplane manufacturers a single source of all existing information regarding acceptable certification methods.

- **Integration of New National Resource Specialists**. The Director of the Aircraft Certification Service, Tom McSweeny, has selected new National Resource Specialists in several fields of technical knowledge and advice to those involved with on-going and evolving projects, both internal and external to the FAA. We've included an article in this issue to introduce these engineering and scientific experts to you.

We intend to use the ***Update*** as one way to keep you apprised of new happenings related to these events.

Once again, I hope that the ***Update*** provides useful information to you, the aviation community. Please continue to offer suggestions to me or the editors concerning your ideas to improve this publication.



Ronald T. Wojnar, Manager,
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# FAA Human Factors Team Finalizes Study on: The Interfaces Between Flightcrews and Modern Flight Deck Systems

Advances in technology have enabled increasingly sophisticated automation to be introduced into the flight decks of modern airplanes. Generally, this automation was added to accomplish worthy objectives such as reducing flightcrew workload, adding additional capability, or increasing fuel economy. To a large extent, these objectives have been achieved.

Safety also stood to benefit from the increasing amounts of highly reliable automation. Indeed, the current generation of highly automated transport category airplanes has generally demonstrated an improved safety record relative to the previous generation of airplanes. Vulnerabilities do exist, though, and further safety improvements should be made. To provide a safety target to guide the aviation industry, the Secretary of Transportation and others have expressed the view that the aviation industry should strive for the goal of zero accidents.

## Historical Evidence

On April 26, 1994, an Airbus A300-600 operated by China Airlines crashed at Nagoya, Japan, killing 264 passengers and flightcrew members. Contributing to the accident were conflicting actions taken by the flightcrew and the airplane's autopilot. The crash provided a stark example of how a breakdown in the flightcrew/automation interface can affect flight safety. Although this particular accident involved an A300-600, other accidents, incidents, and safety indicators demonstrate that this problem is not confined to any one airplane type, airplane manufacturer, operator, or geographical region.

This point was tragically demonstrated by the crash of a Boeing 757 operated by American Airlines near Cali, Columbia on December 20, 1995, and a November 12, 1995, incident (very nearly a fatal accident) in which a American Airlines McDonnell Douglas MD-80 descended below the minimum descent altitude on approach to Bradley International Airport, CT, clipped the tops of trees, and landed short of the runway.

As a result of the Nagoya accident as well as other incidents and accidents that appear to highlight difficulties in flightcrews interacting with modern flight deck automation, the FAA's Transport Airplane Directorate, under the approval of the Director, Aircraft Certification Service, launched a study to evaluate the flightcrew/flight deck automation interfaces of current generation transport category airplanes. The following airplane types were included in the evaluation:

- Boeing: Models 737/757/767/747-400/777
- Airbus: Models A300-600/A310/A320/A330/A340
- McDonnell Douglas: Models MD-80/MD-90/MD-11
- Fokker: Model F28-0100/-0070

## Creating the Human Factors Team

The FAA chartered a human factors (HF) team to address these human factors issues. The Team comprised representatives from the FAA's Aircraft Certification and Flight Standards Services, the National Aeronautics and Space Administration, and the Joint Aviation Authorities (JAA); assisted by technical advisors from Ohio State University, the University of Illinois, and the University of Texas.

The HF Team was asked to identify specific or generic problems in design, training, flightcrew qualifications, and operations, and to recommend appropriate means to address these problems. In addition, the HF Team was specifically directed to identify those concerns that should be the subject of new or revised Federal Aviation Regulations (FAR), Advisory Circulars (AC), or policies.

## How the Team Operated

The HF Team relied on readily available information sources, including accident/incident reports, Aviation Safety Reporting System reports, research reports, and trade and scientific journals. In addition, meetings were held with operators, manufacturers, pilots' associations, researchers, and industry organizations to solicit their input. Additional inputs to the HF Team were received from various individuals and organizations interested in the HF Team's efforts.

When examining the evidence, the HF Team found that traditional methods of assessing safety are often insufficient to pinpoint vulnerabilities that may lead to an accident. Consequently, the Team examined accident precursors, such as incidents, errors, and difficulties encountered in operations and training. The Team also examined research studies that were intended to identify issues and improve understanding of difficulties with flightcrew/automation interaction.

## Looking Beyond Flightcrew Error

In examining flightcrew error, the HF Team recognized that it was necessary to look beyond the label of *flightcrew error* to understand why the errors occurred. They looked for contributing factors from:

- design,
- training and flightcrew qualification,
- operations, and
- regulatory processes.

While the HF Team was chartered primarily to examine the flightcrew interface to the flight deck systems, it quickly recognized that considering only the interface would be insufficient to address all of the relevant safety concerns. Therefore, it considered issues more broadly, including issues concerning the functionality of the underlying systems.

***Human Factors Team. Top row from left: Terry Newman, George Lyddane, Sharon Hecht, Heert Tigchelaar, Steve Slotte, Gene Bolin, Francois Fabre. Bottom row from left: Dr. David Woods, Don Stimpson, Guy Thiel, Dr. Kathy Abbott, Rod Lalley, Tom Imrich, Dr. Rene Amalberti, Dr. Nadine Sarter.***

## Management of Automation and Situation Awareness

From the evidence, the HF Team identified issues that show vulnerabilities in ***flightcrew management of automation*** and ***situation awareness***.

Issues associated with flightcrew management of automation include concerns about:

- Pilot understanding of the automation's capabilities, limitations, modes, and operating principles and techniques. The HF Team frequently heard about automation "surprises," where the automation behaved in ways the flightcrew did not expect. "Why did it do that?" "What is it doing now?" and "What will it do next?" were common questions expressed by flightcrews relating their operational experience.

- Differing pilot decisions about the appropriate automation level to use or whether to turn the automation *on* or *off* when they get into unusual or non-normal situations (e.g., attempted engagement of the autopilot during the moments preceding the A310 crash at Bucharest). This may also lead to potential mismatches with the manufacturers' assumptions about how the flightcrew will use the automation and how the automation is actually used during operations.

Flightcrew situation awareness issues included vulnerabilities in, for example:

- Automation/mode awareness. This was an area where the HF Team heard a universal message of concern about each of the aircraft in its charter.
- Flight path awareness, including insufficient terrain awareness (sometimes involving loss of control or controlled flight into terrain) and energy awareness (especially low energy state).

These vulnerabilities appear to exist to varying degrees across the current fleet of transport category airplanes in the study, regardless of the manufacturer, the operator, or whether accidents have occurred in a particular airplane type.

## The Larger Pattern

Although the Team found specific issues associated with particular design, operating, and training philosophies, it considers the generic issues and vulnerabilities to be a larger threat to safety, and the most important and most difficult to address. It is this larger pattern that serves as a barrier to needed improvements to the current level of safety, or could threaten the current safety record in the future aviation environment.

It is this larger pattern that needs to be characterized, understood, and addressed.

## Deficiencies in the Current System

In trying to understand this larger pattern, the Team considered it important to examine why these vulnerabilities exist. The Team concluded that the vulnerabilities are there because of a number of ***interrelated deficiencies in the current aviation system***:

- **Insufficient communication and coordination**. Examples include lack of communication about in-service experience within and between organizations; incompatibilities between the air traffic system and airplane capabilities; poor interfaces between organizations; and lack of coordination of research needs and results between the research community, designers, regulators, and operators.
- **Processes used for design, training, and regulatory functions inadequately address human performance issues**. As a result, users can be surprised by subtle behavior or overwhelmed by the complexity embedded in current systems operated within the current operating environment. Process improvements are needed to provide the framework for consistent application of principles and methods for eliminating vulnerabilities in design, training, and operations.
- **Insufficient criteria, methods, and tools for design, training, and evaluation**. Existing methods, data, and tools are inadequate to evaluate and resolve many of the important human performance issues. It is relatively easy to get agreement that automation should be human-centered, or that potentially hazardous situations should be avoided; however, it is much more difficult to get agreement on how to achieve these objectives.
- **Insufficient knowledge and skills**. Designers, pilots, operators, regulators, and researchers do not always possess adequate knowledge and skills in certain areas related to human performance. *It is of great concern to this team that investments in necessary levels of human expertise are being reduced in response to economic pressures when two-thirds to three-quarters of all accidents have flightcrew error cited as a major factor.*
- **Insufficient understanding and consideration of cultural differences in design, training, operations, and evaluation**. The aviation community has an inadequate understanding of the influence of culture and language on flightcrew/ automation interaction. Cultural differences may reflect differences in the country of origin, philosophy of regulators, organizational

philosophy, or other factors. There is a need to improve the aviation community's understanding and consideration of the implications of cultural influences on human performance.

## System Solutions

Based on the Team's investigations and examination of the evidence, these concerns represent more than a series of individual problems with individual, independent solutions. These concerns are highly interrelated, and are evidence of aviation ***system*** problems, not just isolated human or machine errors. Therefore, we need ***system*** solutions, not just point solutions to individual problems. To treat one issue (or underlying cause) in isolation will ultimately fail to fundamentally increase the safety of airplane operations, and may even decrease safety.

The HF Team developed recommendations to address the vulnerabilities and deficiencies from a system viewpoint. Its consideration of human performance issues, however, was focused primarily on the flightcrew. It did not attempt to address human performance issues associated with other personnel involved in the aviation system, such as flight attendants, ground personnel, air traffic services personnel, or maintenance personnel.

## Needed Improvements

Because the system is already very safe, any changes should be made carefully to avoid detracting from existing safety practices. The Team believes we must improve and institutionalize:

- **Investments in people (designers, users, evaluators, and researchers).** For example, flightcrew training investments should be rebalanced to ensure appropriate coverage of automation issues.

- **Processes**. It is important to improve how design, training, operations, and certification are accomplished. For example, regulatory authorities should evaluate flight deck designs for human performance problems.

- **Tools and methods**. New tools and methods need to be developed and existing ones improved to accompany the process improvements.

- **Regulatory standards**. Current standards for type certification and operations have not kept pace with changes in technology and increased knowledge about human performance. For example, flightcrew workload is the major human performance consideration in existing Part 25 regulations; other factors should be evaluated as well, including the potential for designs to induce human error and reduce flightcrew situation awareness.

The HF Teams final report contains detailed discussions of each vulnerability and deficiency area, together with the HF Team's recommendations for addressing them and suggested approaches for implementing the recommendations.

The FAA considers this report to be the foundation for continued progress over the next several years in its treatment of human factors in the certification and operation of transport catergory airplanes. Currently, a strategic plan is being developed in order to manage the implementation of the report's recommendations. During the implementation process, the FAA intends to work with industry and the rest of the aviation community in an open partnership.

A hard copy of the report can be sent to you upon request. It's also available for viewing and downloading on the world wide web from the following FAA home pages:

Flight Standards Service: http:\www.faa.gov\avr\afshome.htm

Aircraft Certification Service, Certification of Products and Parts: http:\www.faa.gov\air\100home.htm

To obtain more information on this topic, contact the Co-chairs of the HF Team (*See Table 1*).❖

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***Table 1***

Special Topic

# Artificial Intelligence with Applications for Aircraft: An Overview

This article provides information taken from FAA's Technical Report DOT/FAA/CT-94/41, *Artificial Intelligence with Applications for Aircraft* (August 1994). That report was initiated by the FAA Technical Center's Directorate for Aircraft Safety, Flight Safety Research Branch. It provides an overview of Artificial Intelligence (AI) technology, the development environment, and proposed aviation-related applications of this technology. In addition, the report identifies safety issues and concerns over the use of AI technology in airborne systems.

## Defining AI

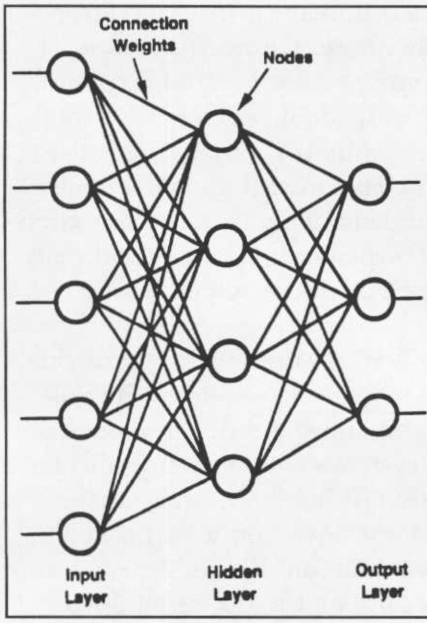
Because of on-going debate over what AI technology is and what the research goals are, it is difficult to provide an unequivocal definition of AI. Should some fields of AI technology, such as expert systems or fuzzy logic, be considered simply as software applications? Should a system without learning capability be considered an AI-based system, as some believe? Others contend that, due to fundamental differences between computers and people, the ultimate goal of the autonomous "thinking machine" will never be realized. Human qualities, such as intuition, cannot be reproduced in the confines of silicon and software. (In the Department of Defense community, AI is referred to as "Machine Intelligence.")

Debate over these issues will continue. Numerous definitions of AI technology exist. However, for the purpose of this article, AI is defined as *the subfield of computer science that attempts to use computers to emulate the way humans think and reason when solving problems.*

Defined in this manner, AI includes systems that are capable of "learning," as well as those with static databases. The part of the definition that is stressed, and that most agree with, is the "emulating" of human techniques.

While AI-based technology may never be able to replace genuine intelligence, it can provide users with many benefits. Developing human-centered automation and designing advanced technology that will capitalize on the relative strengths of humans and machines are key to the success and usefulness of AI. ***Expert systems***, for example, are computer-based systems designed to emulate the problem-solving behavior of a human who is an expert in a narrow domain. They can consistently provide expert advice in a timely manner, and are not influenced by factors, such as stress, that impair human decision making.

***Neural Networks***, another type of AI, are modeled on the brain, and solve problems by mapping input data to output data. The main application for these systems is pattern recognition. One such application is the recognition of pre-failure signatures in airborne machinery.




***Neural Network***

Traditionally, inexact concepts such as "big," "tall," or "warm," could not be expressed on a computer. ***Fuzzy logic***, a third type of AI, provides the opportunity to model conditions that inherently are imprecisely defined, and to deal with statements that are obscure or subject to different interpretations. The strength of a fuzzy logic system is its ability to manage imprecision. These systems are useful for applications that normally require human intuition, are difficult to control with conventional techniques, or are difficult to model.

## Some Current AI Applications

AI technology has existed for a number of years. During the early years, the promises made concerning this technology did not match the products delivered. With this in mind, Philippe O. Bouchard, in his October 1991 keynote address to the Advisory Group for Aerospace Research and Development, said *"the user community has been stung with high development costs and false expectations, although that is changing with respect to expert systems."*

Some of the early applications of AI-based technology have included image and speech recognition systems, natural language systems, and handwriting analysis. While research in these fields continues, AI-based technology is being used in a number of other applications. AI-based systems are now being used for control and monitoring systems, financial analysis, medical prognosis, manufacturing, training, sorting through a large quantity of databases, and scheduling.

AI-based systems currently are being used by the nuclear power industry. Some of the benefits of these systems include consistency of reasoning in stressful situations, reduction in time to perform certain tasks, and prevention of equipment failures using predictive diagnostics.

Much on-going research is being done in the field of AI, funded or performed by government laboratories and agencies, as well as private industry and universities. As research in the field of AI progresses, AI technology continues to mature and emphasize realistic expectations. For instance, the Institute of Electrical and Electronics Engineers sponsors the Artificial Intelligence for Applications Conference. This conference solicits papers describing the use of AI techniques to solve significant problems, as well as the application of these techniques to problems of increasing complexity.

**"The user community has been stung with high development costs and false expectations, although that is changing with respect to expert systems."**

## AI Applications for Aviation

For the aviation community, possible benefits of using AI-based systems would include:

- Optimizing the use of airspace
- Reducing the cost of flying
- Meeting Air Traffic Control requirements
- Aiding the decision-making process of the flightcrew
- Aiding maintenance activity
- Assisting data management

The amount of data that the flightcrew must absorb has increased, due to the expanding complexity and number of avionics systems in the cockpit. Reducing pilot and information overload can be achieved using AI technology. As with any technology, the final system interface (i.e., man-machine interface) needs to be an integral part of the design and development cycle. The FAA's National Plan for Aviation Human Factors addresses this issue.

The National Aeronautics and Space Administration (NASA) is performing and sponsoring a great amount of research on space applications. NASA also is involved with research on potential commercial and military flightdeck applications.

Within recent years, a number of AI-based applications have been proposed for use in civil transport aircraft. The proposed applications generally seek to enhance the safety or economics of flight. The large number of sensors on modern aircraft requires that data management be given careful consideration. Assimilation of the wealth of data available presents a difficult task for any crew. Information needs to be compressed and sorted so that the crew has meaningful and necessary results. This function will be computationally intensive, requiring reliable and high-throughput processing. AI-based systems currently under development are targeted to help reduce the amount of information requiring the pilot's attention.

Some of the applications that have been proposed and studied are:

- Systems designed to assist with flight management
- Systems to provide navigation support
- Systems to provide support for decisions
- Systems to provide diagnostic and monitoring support

## Flight Management Applications

As aircraft systems become increasingly complex, the pilot's mental and physical workload will increase beyond realistic limits. Expert systems can assist in the decision-making processes for the pilot. Acquiring, structuring, and applying the knowledge base needed by an expert system capable of operating in a dynamic domain presents challenges to researchers and developers.

***Emergency Procedures Expert System (EPES)*** is a decision aid system suited for flight management applications. EPES is intended to represent the knowledge of an experienced pilot in handling multiple emergencies; the system's goal is to provide pilot assistance during emergency situations while keeping the pilot "in the loop." During normal operations, EPES would remain unseen to the pilot, but would constantly monitor the state of the aircraft. If an emergency were to arise, EPES would initiate steps to correct the emergency, inform the pilot of the action, and allow the pilot to override the action, if desired.

## Navigation Systems Applications

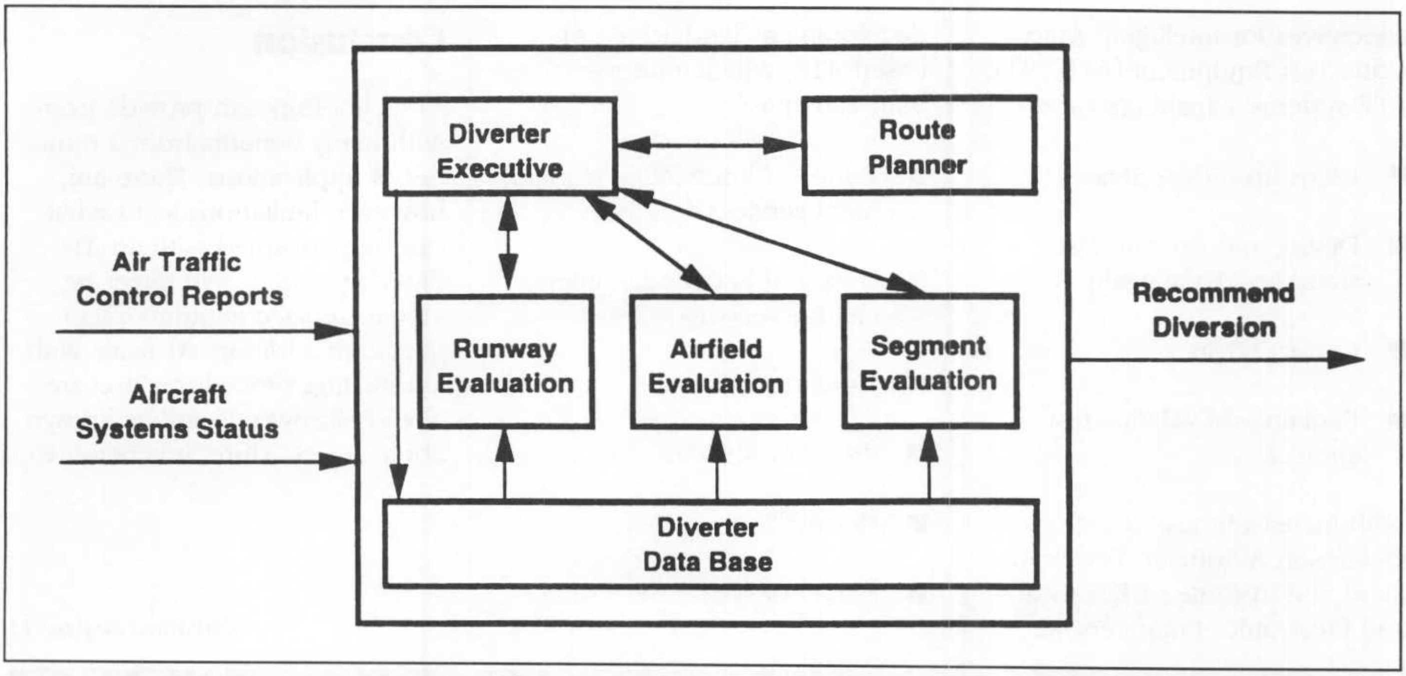
Another AI application is the ***Knowledge-Based AutoPilot (KBAP)***, a cooperative program between NASA and the Royal Aerospace Establishment (RAE) for developing and validating a real-time KBAP. KBAP investigates implementation and validation issues. It has been noted that KBAP "provides a simple, well-defined, yet real problem within which to explore, develop, and demonstrate real-time knowledge-based system concepts and verification and validation techniques for mission-critical systems."

A prototype autopilot was developed using CLIPS (a knowledge-based tool developed at NASA's Johnson Space Flight Center), but was found to be too slow for real-time flight control applications. RAE developed FLEX (a library of FORTRAN 77 subroutines that allow FORTRAN programs to interface with expert systems), and has applied it to this application with much improved response time. One of the immediate goals for improving the response time is to use the rules produced under CLIPS and implement them under FLEX. The long-term goal is to apply the conventional software verification and validation methodology used for flight critical control systems to KBAP.

## Decision Support Systems Applications

AI likely will be employed in the future to monitor and assist the pilot. Some of the current decision support systems under development are:

- **Cockpit Assistant System (CASSY)** is a knowledge-based computer aid for flight-planning tasks. This system supports the pilot in complex planning and decision operations during situation assessment and flight replanning operations. CASSY, developed to reduce the number of accidents attributed to human error, functions like an expert copilot in recommending flight plan revisions, providing warnings if the pilot deviates from Air Traffic Control clearances, and monitoring aircraft systems. It has been implemented in flight simulators for single pilot and dual pilot testing, and is undergoing flight testing, with the expectation that it will be operational as early as 1997. Research is being conducted by Dornier and the University of the German Armed Forces in Munich, Germany.
- **Diverter System** is an AI application that provides pilots with information for making in-flight diversion decisions. Planning a diversion is a labor-intensive and time consuming process. In addition to determining the plane's present position, fuel supply and maintenance status, the pilot also may need to consult aircraft handbooks, performance




***Diverter Software Architecture***

data, and many other resources. The goal of Diverter System is to use AI and algorithm-based decision aiding to replicate a pilot's information processing and application of logic principles during in-flight diversion planning. In August 1990, a report describing the prototype system was prepared for NASA; more development is underway.

- **Flight-Plan Interactive Negotiation and Decision - Aiding System for Enroute Rerouting (FINDER)** is an AI application that suggests a limited number of satisfactory solutions for crew members facing a diversion situation or, more generally, an enroute replanning situation. FINDER focuses on managing existing data and making decisions that aid the pilot. The system is being developed by Sextant Avionics and will be tested by Air France pilots.

- **Pilot's Associate Program** is being developed by teams from Lockheed and McDonnell Douglas, under a contract from the US Air Force and the Advanced Research Projects Agency. This program is to define, design, and demonstrate the application of machine intelligence to assistance of advanced fighter pilots. The Lockheed team is developing an expert system that tailors its response to the pilot's particular style of flying. A similar program for rotorcraft pilots, sponsored by the U.S. Army, also is under development

## Monitoring and Diagnostic Systems Applications

As aircraft systems have become more complex, difficulties have increased for system maintenance tasks. False alarms consume as much as 50% of maintenance resources, while troubleshooting actions take as much as 50% of total labor hours spent for repair. Accurate and efficient diagnostic systems are needed.

Expert systems are being developed for a number of aspects of avionics diagnostic testing. They monitor the results of Built-In Test (BIT) applications to provide better localization capability. Performance monitoring and fault locating software determine the cause of anomalies as they occur. In the future, software will be integrated into onboard maintenance systems to allow on-line diagnosis, reconfiguration, and repair.

Another application of expert systems is the production of Interactive Electronic Technical Manuals (IETMs) and Portable Maintenance Aids (PMAs). IETMs and PMAs combine on-line technical information with maintenance facilities.

Expert systems are beginning to be used in avionics testing as test executives for intelligent Automatic Test Equipment (ATE). The ATE systems' capabilities are:

- Learn from experience
- Devise and execute test strategies dynamically
- Correct errors
- Explain and validate test choices

With increasing use of expert systems in Automatic Test Equipment, the Institute of Electrical and Electronics Engineers is developing a standard for AI-based ATE, which addresses issues such as:

- Data and knowledge management services
- Data and knowledge interchange services
- Human services
- Program services
- Network services
- Model base specifications

## Conclusion

AI technology can provide users with many benefits from a number of applications. There are, however, limitations as to what can be performed with an AI-based system. It will never be able to replace genuine intelligence. In addition, AI deals with automating procedures that are already known. If little is known about a procedure, it is better to

*Continued on page 55*

***International News***

# Interagency Group for International Aviation to Negotiate Bilateral Aviation Safety Agreements

*This material was taken from the FAA Aircraft Certification Office's International Program Staff (AIR 4) Newsletter, July 1996.*

An Executive Decision Paper defining U.S. government policy toward procedures for developing and approving Bilateral Aviation Safety Agreement (BASA) was approved on January 30, 1996. This decision paper recommended that the U.S. State Department negotiate BASA, instead of Bilateral Airworthiness Agreements (BAA), with any of the countries in the following categories:

(1) Full member states of the Joint Airworthiness Authorities (JAA);

(2) All other states with which the United States currently has a BAA; and

(3) All states for which there is approval by the Interagency Group for International Aviation (IGIA) to pursue a BAA, including:

- those countries with which we are actively pursuing a BAA, and
- those countries where the technical assessment has not yet begun.

This decision allows the United States the flexibility to conclude the agreements quickly, which in turn improves regulatory efficiency, allows international air transport users to benefit from very high levels of safety, and reduces regulatory costs to industry.

This decision also revises past IGIA BAA approvals by allowing negotiation of a BASA instead of a BAA. This will save U.S. government resources, since it will prevent duplication of efforts by both the FAA and the State Department. It also will avoid the confusion created by multiple agreement formats. A BASA executive agreement with airworthiness Implementation Procedures fulfills the same role as a BAA , but it has the added benefit of allowing later expansion into other FAA regulatory disciplines, when appropriate. ❖

# International Airworthiness Programs Activity Update

*This material was taken from the FAA Aircraft Certification Office's International Program Staff (AIR 4) Newsletter, July 1996.*

The FAA's Aircraft Certification Service International Program Staff (AIR 4) is currently involved in various activities concerning the development, negotiation, and implementation of Bilateral Airworthiness Agreements (BAA) and Bilateral Aviation Safety Agreements (BASA) with several countries. This article provides an update of these on-going activities.

## Status of BASA Negotiations

As of July 1, 1996, the FAA has been involved in numerous activities related to negotiating and completing BASA agreements with the following countries:

| Country | Status of BASA | Remarks |
|---|---|---|
| **Austria** | *Under negotiation* | The Department of State and FAA received an Austrian counterproposal on April 12, 1996. The two offices currently are reviewing the proposal. |
| **Canada** | *Under negotiation* | The U.S. sent certain clarifications to Canada on November 11, 1995. |
| **France** | *Completed* | A BASA was signed on May 14, 1996. |
| **Germany** | *Completed* | A BASA was signed on May 23, 1996. |
| **Ireland** | *On-going* | A U.S. proposal was sent on March 3, 1996. |
| **Malaysia** | *Completed* | A BASA was signed on May 28, 1996. |
| **Netherlands** | *Completed* | A BASA was signed on September 13, 1995. |
| **Switzerland** | *On-going* | A U.S. proposal was sent on March 6, 1996. |
| **United Kingdom** | *Completed* | A BASA was signed on December 20, 1995. |

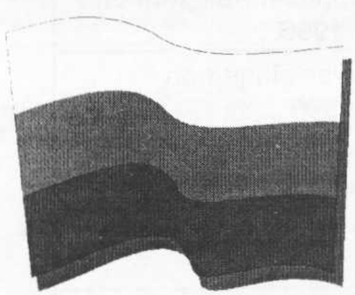
## Current BASA Assessment Programs Underway

### Malaysia

In February 1996, FAA recommended the conclusion of a BASA and Implementation Procedures (IP) for Airworthiness for the acceptance of tires designed and manufactured in Malaysia. The BASA was signed on May 28, 1996, by the U.S. Ambassador and Malaysia's Minister of Transport. This BASA became the first BASA between the United States and an Asian country. Its airworthiness IP is currently being co-developed and is expected to be completed sometime this summer.

An FAA final technical evaluation of the Model MD3-160 is scheduled for December 1996. At that time, FAA will determine whether the BASA airworthiness IP should be expanded to cover small, single engine, metal airplanes, based on the demonstrated competency of Malaysia's Department of Civil Aviation's engineering and flight test specialists.

### Russia



In April 1996, FAA completed its "shadow certification" of the Ilyushin-103 airplane — a five place, all metal, single engine airplane certified to FAR 23 requirements. The Russian Aviation Register of the Interstate Aviation Committee successfully applied FAR 23 requirements to this type design, making it eligible for future FAA type certification.

The FAA continues to work with the Russian authorities to improve their production oversight system so that it can be found comparable to the U.S. system. Other obstacles to a BASA include the lack of an Air Code in Russia and the lack of airworthiness regulations and procedural guidance.

Once all the certification system issues are resolved, FAA will recommend to the U.S. Department of State that a BASA be negotiated with Russia to accept Export Certificates of Airworthiness for Russian-designed and manufactured airplanes with up to nine places and equipped with Western engines, propellers, and avionics. Specifically, this would be limited to the Ilyushin-103's manufactured at the Lukhovitsy Machine Building Plant. Other airplane manufacturing facilities would have to be evaluated by FAA prior to product acceptance. This initial BASA could later be expanded to allow the U.S. acceptance of Russian cargo transport airplanes equipped with U.S. engines and U.S. avionics after the shadow certification of the Ilyushin-96T is completed.

Progress has been slow towards completing the Ilyushin-96T project, in part, because of financial problems of the Russian applicant (Ilyushin Design Bureau). The prototype airplane is expected to begin flight testing in late 1996.

### Indonesia

FAA's second interim assessment report was presented to the Directorate General of Air Communications (DGAC) in March 1996. In 1996, FAA's technical assessment activities shifted to a cost-reimbursable basis, funded by the Indonesian government. This is the first such reimbursable arrangement for FAA shadow certification work.

In March 1996, the FAA's Director of the Aircraft Certification Service (AIR-1) and the DGAC's Director of Airworthiness Certification signed a Memorandum of Understanding for the DGAC's production surveillance support of FAA's extension of the Bell 412 helicopter production certificate to the IPTN facility in Bandung, Indonesia.

## BAA Oversight Activities

### Czech Republic

The FAA's BAA Oversight team recently traveled to the Czech Republic. The FAA signed Operating Procedures for Design Approval, Airworthiness Certification, Continued Airworthiness, and Mutual Cooperation and Technical Assistance with the Civil Aviation Inspectorate of the Czech Republic in January 1996. These Operating Procedures, which supplement the U.S./ Czech Republic agreement regarding Certificates of Airworthiness for Imported Aircraft, are intended to facilitate the approval process for aircraft and other aeronautical products imported and exported between the U.S. and the Czech Republic.

## Poland

On June 24, 1994, the Government of Poland submitted a diplomatic note to request amendment of the Annex of the U.S./Poland BAA to include powered gliders; to increase the maximum weight of small airplanes from the present limit of 12,500 pounds to 19,000 pounds; and to increase the maximum horsepower of reciprocating engines from 1,000 hp to 1,500 hp. During an April 1996 meeting (mentioned below), the Polish General Inspectorate of Civil Aviation (GICA) requested that appliances also be included in the scope of the amended BAA.

The FAA concluded that the most efficient and effective method to act upon the Polish government's request was to commit to the mutual pursuit of a BASA, instead of amending the current BAA. In April 1996, the BASA team traveled to Warsaw and presented the Master Plan, which details the necessary activities to be taken by the FAA and GICA to complete a technical assessment and co-develop Implementation Procedures for Airworthiness under the BASA.

Of significant note is the fact that the Polish system is in transition at the present time. A new aviation law is being prepared by a Polish, Dutch, and Irish consortium under contract to the Ministry. This new law will most likely be adopted by the Polish parliament during the next two years. Also, new procedural documents (e.g., policies, practices and procedures) are being written by GICA for internal and external use. No such written procedures currently exist in the system. Finally, GICA is preparing to implement the Joint Airworthiness Authorities (JAA)/Joint Aviation Regulations (JAR) system over the next 2 to 4 years in order to become a full JAA member.

The FAA team concluded that completing the Master Plan would be more difficult due to the many changes occurring during the transitioning from the former Polish system to the new JAR system, but that the FAA should proceed with the technical assessment as outlined in the Master Plan. Since it will be important for the FAA to consider these changes in the evaluation of the Polish system, the completion of the technical assessment will be based on GICA's timeframe in implementing these changes. The most significant change that must take place before the U.S. can conclude a BASA with Poland is the development and implementation of GICA written policies, practices, and procedures to support the Polish regulatory certification system.

## Romania

In September 1993, the FAA and the Romanian Civil Aeronautic Authority (RCAA) met to discuss the possibility of expanding the current U.S./Romania BAA to include:

- airplanes for acrobatic flight certified to FAR 23;
- very light airplanes certified to the Joint Airworthiness Authorities' Joint Aviation Regulations -Very Light Airplane (VLA) regulations; and
- a medium-range passenger airplane with a design approval from the Civil Airworthiness Authority of the United Kingdom and manufactured in Romania under a licensing agreement.

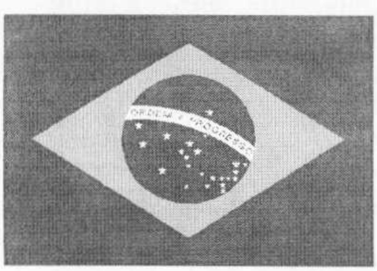
The FAA acknowledged that it was unable to begin an assessment program at that time due to previous commitments.

In late 1995, the FAA indicated to the RCAA that it could begin a limited technical assessment sometime in mid-1996. In April 1996, the BASA team traveled to Bucharest and presented the Master Plan, which details the necessary activities to be taken by the FAA and RCAA to complete a technical assessment and co-develop Implementation Procedures for Airworthiness under the BASA.

Of significant note is the fact that the Romanian system is in transition at the present time. A new aviation law is being prepared, and will most likely be adopted by the Romanian parliament during the next two years. Also, new procedural documents (e.g., policies, practices and procedures) are being developed and formalized by RCAA for internal and external use. Not all procedures are currently written for use in the system. Finally, RCAA is preparing to apply for membership in the Joint Aviation Authorities (JAA) in the near future. Since it will be important for the FAA to consider these changes in the evaluation of the Romanian system, the completion of the technical assessment will be based on RCAA's timeframe in implementing these changes.

The FAA team's initial impression of the current Romanian aircraft certification system is very favorable based on the written information presented and the resulting discussions on each topic. The FAA team concluded that it should proceed with the technical assessment as outlined in the Master Plan. Further in-depth discussions will be required for the FAA team to make a final determination of system comparability that yields equivalent safety results with that of the U.S. system.

### Brazil




The FAA is currently performing the validation of the EMBRAER Model 145 airplane under the provisions of the United States/Brazil agreement regarding Certificates of Airworthiness for Imported Aircraft Products and Components, with issuance of the U.S. type certificate scheduled for the fall of 1996. During this validation process, the FAA noted that, since the BAA was concluded in 1976, a number of changes had taken place in both the Centro Técnico Aeroespacial (CTA) - Instituto de Fomento e Coordenação Industrial (IFI)/Civilian Aircraft Certification Division (FDH) and the Department of Civil Aviation (DAC). As a result, the FAA requested a visit to CTA-IFI to review the aircraft certification system in an effort to gain a current understanding of CTA-IFI's and DAC's organizations, as well as how they carry out the terms of the U.S./Brazil BAA.

The BAA Oversight team traveled to Brazil in March 1996. The team concluded that the current Brazilian aircraft certification system is sufficiently similar in structure and meaning to produce results equivalent to those of the FAA aircraft certification system. There is clear national legislation empowering the civil airworthiness authority and a comprehensive system of well-documented regulations and procedures. This is based on the FAA discussions with CTA-IFI and DAC, as well as a review of some of the CTA-IFI system documentation. During this first meeting, time was not devoted to accompanying CTA-IFI or DAC personnel during the conduct of day-to-day activities and interfacing with the manufacturing industry. If the opportunity presents itself in the future, the FAA team expressed a wish to participate with CTA-IFI personnel in routine activities involving their manufacturing industry.

The meeting participants also concluded that it would be very beneficial to FAA, CTA-IFI, and DAC personnel to co-develop Operating Procedures under the BAA. The Brazilian Air Ministry's SEGVÔO matrix organization responsible for civil aviation activities is fairly complex, and all parties agreed that a set of Operating Procedures would ensure proper communication and enhance the authority-to-authority relationship under the Agreement. These Operating Procedures will be co-developed and are scheduled to be concluded later this year.

## New International Activities

### Chile

A Memorandum of Understanding between the FAA and the Directorate General of Civil Aeronautics (DGAC) of the Republic of Chile was signed on March 11, 1996, during the FIDAE Airshow. The objective of this Memorandum is to develop an understanding of both authorities' aircraft certification systems as we progress toward a U.S./Chile BASA.

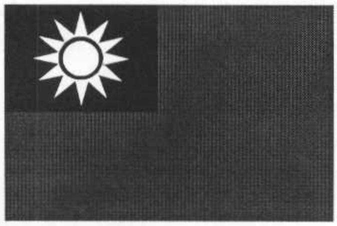
Representatives from the DGAC of Chile plan to travel to Washington, DC, during the third quarter of 1997 to discuss the current status of their organization and how best to proceed toward a U.S./Chile BASA.

### Taiwan

In 1990, the Taipei Economic and Cultural Representative's Office (TECRO) requested a BAA with the American Institute in Taiwan (AIT), citing the purpose of conformity certification of products manufactured in Taiwan in accordance with design data previously approved by the FAA. At that time, a possible joint venture with McDonnell Douglas Corporation drove that request. However, when the deal fell through, the need for an agreement disappeared.

In March 1996, Aerospace Industry Development Company, Ltd. (of Taipei, Taiwan) was selected as the supplier for the McDonnell Douglas Model MD-95 airplane empennage. Since then, FAA has met with AIT to discuss the BASA assessment process. Plans are for the AIT and TECRO to sign a Memorandum of Agreement providing the framework for the FAA to provide technical training and assistance to the Civil Airworthiness Authority of Taiwan as AIT and TECRO proceed toward an agreement with provisions for airworthiness approval for civil aeronautical products.

### South Korea



The Korean Foreign Ministry recently submitted a diplomatic note to the United States officially requesting a U.S./Republic of Korea BASA with Implementation Procedures (IP) for Airworthiness. FAA personnel met with the Korean aerospace delegation in late May 1996 to discuss that process, as well as FAA's expectations of the Korean Civil Aviation Bureau prior to the conclusion of a BASA and IP for Airworthiness in the future.

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*International News*

# Instant Availability: Plans for International Safety Information Sharing Network

In an unprecedented move to involve the international aviation community in DOT Secretary Federico Peña's and FAA Administrator David Hinson's "zero accident" challenge, the FAA's Office of System Safety recently unveiled its concept of a Global Analysis and Information Network (GAIN) that would make safety data available instantly, online, to aviation professionals worldwide.

That Office has solicited comments from the aviation community about the development of a GAIN prototype, including a proposal that the network be a privately owned and operated international consortium. The FAA believes that such a global safety network would help meet the zero accident challenge by collecting aviation safety data, analyzing that data for potential safety-related trends, and sharing that analysis with the aviation community worldwide to improve safety.

"I recently challenged the aviation industry to achieve zero accidents, but stated that regulation alone is insufficient to achieve this goal. The entire aviation community must become more proactive by sharing information about potential safety problems before they result in an accident," said Hinson. "I applaud the work of Assistant Administrator for System Safety Christopher Hart in developing this proposal and joining with the aviation community in debating its viability to help reach our goal.

Hart met with representatives from industry and labor to discuss the creation of a network that would best serve the needs of the aviation community. Such a system would involve different components of the global aviation system -- carriers, manufacturers, insurers, pilots, mechanics, flight attendants, air traffic controllers, and airport operators.

"Crucial information is already out there, which can be used to further enhance aviation safety. It is our responsibility, as members of the world aviation community, to make sure that this resource is not wasted -- that this information is turned into life-saving knowledge," said Hart.

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# FAA Changes for a "Dynamic Industry"

*Material for this article appeared originally in an article by Phyllis-Anne Duncan in the September 1996 edition of FAAviation News.*

On June 17, 1996, the FAA asked ValuJet to cease passenger-carrying operations in light of preliminary results from an intensive 30-day inspection after the airline's fatal crash in the Florida Everglades May 11. At midnight on June 17, ValuJet complied with an FAA "consent order" to cease operations until corrective action, as outlined in the consent order, could be taken.

## In-Depth Inspection

Some 60 FAA Aviation Safety Inspectors accomplished over 2,000 inspections on ValuJet from May 12 through June 10 -- the equivalent of four years' worth of inspections in a four-week period -- and focused on ValuJet's overall operations. The FAA was already in the midst of a 120-day special emphasis review of ValuJet as a result of several incidents and ValuJet's rapid growth. The post-accident 30-day inspection was an extension of this special emphasis review.

As a result of both the special emphasis review and the in-depth inspection after the accident, FAA found what Administrator David R. Hinson called "several serious deficiencies in ValuJet's operations." This included:

- failure to establish the airworthiness of some aircraft;
- system-wide maintenance deficiencies in ValuJet's maintenance program
- multiple shortcomings in the quality assurance of contractors
- lack of engineering capability in ValuJet's maintenance department, which would impede ValuJet's ability to assign and direct repairs.

The National Transportation Safety Board's (NTSB) investigation of the May 11 accident is on-going, and, as yet, no probable cause has been established or linked to the results of the FAA's in-depth inspection. There is some evidence that undepleted oxygen generating canisters (indicated as "empty" on a shipping form), which were received from a repair station under contract to ValuJet and placed on board ValuJet 592 as company material, ignited a fire in the forward cargo hold.

## Changes in FAA Inspection Policies

In light of the results of the ValuJet inspection and the unprecedented growth of airlines using contract maintenance and training, Administrator Hinson changed some of FAA's inspection policies:

1. The FAA will require airlines to demonstrate compliance of each of their major contract maintenance and training programs.

2. Airlines must demonstrate compliance of each of their major contract maintenance programs at each facility doing substantial heavy maintenance or repairs. The FAA will also review the repair station's procedures to ensure that they are part of the carrier's approved maintenance program, as well as review the carrier's quality assurance oversight of the work conducted by the contractor. (The contractor's work must conform with the carrier's approved maintenance program and must be carried out in accordance with the same regulatory requirements as the carrier.)

3. Airlines must also demonstrate compliance of their major contract training programs. The FAA will review training conducted at each facility employed by the carrier to perform contract training and will also review each contract facility's curriculum to assure consistence with the carrier's approved training program. The FAA will also review check airman involvement and the carrier's on-site oversight which is

supposed to ensure that the contractor's services comply with the FAR.

4. FAA's principal inspectors will now require that all contractors performing substantial maintenance and training be included in the airline's operations specifications. Use of any new contractor will require approval by the principal inspector before it is added to the operations specifications.

5. Before new contractors are approved by the principal inspector and included in the operations specifications, the carrier must audit the contractor. This audit must demonstrate to the principal inspector that the contractor is capable of performing the contracted work in accordance with the carrier's approved programs.

6. The FAA will also create new oversight requirements for inspectors who monitor repair stations and training centers. These new requirements will include special attention to airline maintenance activities being carried out at repair stations. For example, FAA inspectors now will be required not only to check the compliance of repair activities with the regulations governing the repair station, but also to check that the carrier assures that the maintenance and repairs done by the station are in compliance with the airline's maintenance program.

Said Administrator Hinson, "*It is important to note that the science of aviation is dynamic, and this agency is adapting its procedures to accommodating new trends in the industry. . . I will personally oversee additional efforts to make sure that we continue to adjust and adapt to the industry as it makes changes.*"

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*General News*

# Beta-Site Testing

*Material for this article was published previously in NAARP News (April-June 1996), which is published by the FAA's Airworthiness Assurance R&D Branch, AAR-430, at FAA's Hughes Technical Center.*

One critical aspect of the technology transfer process is pre-commercial test and evaluation by select end users, commonly referred to as *beta-site testing*.

The FAA's Airworthiness Assurance R&D Branch has several beta-site test activities recently completed or underway. Two tools developed by the Center for Aviation System Reliability (CASR) and Engine Titanium Consortium (ETC) are undergoing beta-site testing as described below:

**Computer Simulation of Inspection.** As in other engineering applications, simulation of the inspection processes offers both cost and time savings. Building on existing physical models developed in cooperation with other programs, FAA-CASR staff at Iowa State University (ISU) have developed an x-ray simulation code (XRSIM) with a Windows-based interface that allows the user to select equipment parameters, material properties, and experimental configurations in simulating an inspection. Applications include training, optimization of existing inspections, or design of new inspections in a more timely and cost-effective manner. The code has been used within the FAA-CASR program to assess several aviation inspection issues in cooperation with the Boeing Company and McDonnell Douglas Corporation.

The initial Boeing beta-site test took place from August-November 1995. Boeing users concluded that the greatest potential of XRSIM is in its use as a teaching tool, with additional utility as an engineering tool for experienced and knowledgeable radiographic inspection personnel. Boeing personnel suggested several improvements, which are currently being implemented. These improvements include changes in object manipulation, film characteristics, flaw simulation, and image display and analysis. Discussions are underway for a second beta-site test at

United Airlines, which would include Boeing participation.

One early application of XRSIM was on the rear pressure bulkhead of the McDonnell Douglas Model DC-9. Working together, FAA-CASR and McDonnell Douglas were able to assess the geometric limits of an existing x-ray inspection for this multi-layered, multi-material structure. These limits later were verified experimentally by both Douglas and ISU personnel, resulting in changes to the Douglas service bulletin.

After this success, an XRSIM beta site was established at Douglas aircraft in Long Beach, California, to evaluate a second application: the door frame inspection of the Model DC-10. XRSIM will be used to determine radiographic detectability thresholds for this inspection. A previous Douglas study done to develop a fatigue crack detectability curve for this inspection used conventional equipment and fatigue crack samples of various layers of materials stacked up. A major finding of that experiment was that the percentage of the material layers that were cracked must be approximately 30% of the total thickness for the flaw to be detected. Using XRSIM, Douglas engineers can model hundreds of simulations to verify the 30% finding, or determine if, under certain conditions (such as when a crack reaches an edge and opens more), the percentage varies.

Additional XRSIM beta-site test discussions are underway with United Airlines and Boeing for the evaluation of XRSIM for honeycomb structures with a beta-site test planned this year. Both American and Northwest Airlines have also expressed interest in participating in beta-site testing.

**ETC Portable Scanner.** The engine Titanium Consortium (ETC) also has beta-site test activities underway. The second generation portable scanner was transferred to the United Airlines Engine Maintenance Facility in San Francisco, California, in early April for use in module level inspections of Pratt & Whitney (P&W) and General Electric (GE) engine components. Current applications include the JT9D and CFM-6 engines. The beta-site test of the portable scanner is being coordinated by representatives from United and P&W. The initial delivery of the system included a two-day training session on both the hardware and software. Additional beta sites are being planned with Northwest Airlines and with overhaul facilities in use by the industry participants of the ETC.❖

***General News***

# Global Positioning System (GPS) Approval Terms

*Material taken from the "Design Approval Delegate Newsletter" published by Transport Canada.*

*Sole*, *Primary*, and *Supplemental* are terms associated with Satellite Navigation approvals that cause confusion, even among experts in the field. At the June International Civil Aviation Organization (ICAO) Global Navigational Satellite System (GNSS) working group meetings, a small group of "SatNav" experts from Europe and North America convinced each other that the following definitions captured the generally accepted distinctions among terms that have been used rather loosely until now:

**Sole-Means Navigation System.** A sole-means navigation system for a given phase of flight must allow the aircraft to meet, for that phase of flight, all four navigation system performance requirements: accuracy, integrity, availability, and continuity of service. This does not exclude the carriage of other navigation systems. Any sole-means navigation system could include one (stand-alone installation) or several sensors, possibly of different types (multi-sensor installation).

**Primary-Means Navigation System.** This is a navigation system approved for a given operation or phase of flight that must meet accuracy and integrity requirements, but need not meet full availability and continuity of service requirements. Safety is achieved by limiting flights to specific time periods, and through appropriate procedural restrictions. There is no requirement to have a sole-means navigation system on board to support a primary-means system.

**Supplemental-Means Navigation System**. This is a navigation system that must be used in conjunction with a sole-means navigation system. Approval for supplemental-means for a given phase of flight requires that a sole-means navigation system for that phase of flight must be on board. Among the navigation system performance requirements for a given phase of flight, a supplemental-means navigation system must meet the same accuracy and integrity requirements as a sole-means system; there is no requirement to meet availability and continuity requirements. Operationally, while accuracy and integrity requirements are being met, a supplemental-means system can be used without any cross-check with the sole-means system. Any navigation system approved for supplemental-means could involve one (stand-alone installation) or several sensors, possibly of different types (multi-sensor installation).

These definitions were put together by a committee under time pressure, so they may not contain the precise words that will please everyone. They do, however, capture the differences among the three approval stages.

Each definition addresses "a given phase of flight," avoiding the pitfall of expecting a sole-means system to meet all requirements for every phase of flight. The definitions also make it clear that a sole-means system does not have to be the only piece of navigation equipment on the aircraft.

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*General News*

# Time Rollover in the Global Positioning System

*Material for this article came from a report by the same name, prepared by Jacob K. Struck, Chief, Measurement Systems Branch, AMSTA-AR-AEC-M, U.S. Army, Armament Research, Development and Engineering Center.*

Great concern has been expressed and much thought has been given lately to the impending millennium and its effect on computers. There is speculation that billions of dollars will be spent on identifying and solving the anticipated myriad problems in dealing with software, firmware, and hardware that utilizes two-digit rather than four-digit year representation. This concern has given rise to a number of questions and concerns regarding the Defense Department's Global Positioning System (GPS); specifically whether time data derived from the GPS signal will be affected by the advent of the Second Millennium or by some other similar "rollover" effect.

## Will There Be A GPS Rollover?

There will indeed be a rollover effect on GPS time, but it will occur *before* the advent of the Second Millennium. The first GPS rollover event will occur exactly at midnight on the night of August 21-22, 1999.

An investigation of the *Global Positioning System Standard Positioning Service Signal Specification* [1] reveals the reason for — and the exact time and date of — this rollover phenomenon.

GPS time data are established by the GPS Control Segment, whose responsibility it is to regulate, command, control, and administer the GPS satellite constellation. GPS time is used as the primary time reference for all GPS operations. Each GPS Space Vehicle (SV) carries an atomic time standard synchronized to GPS time, which is either a cesium or rubidium clock. Each SV's time clock is periodically monitored for accuracy and, if necessary, corrected by the Control Segment via an RF uplink control message.

On board each SV, GPS time is stored as a 29-bit binary number called the *"Z-Count."* The Z-Count contains two parts and is encoded as follows:

1. The least significant 19 bits of the Z-Count represents the number of 1.5 second epochs since the transition from the previous week. There are 604,800 seconds per week and 403,199 1.5-second epochs per week. The 1.5

second epoch is internally generated in each satellite and serves as a convenient unit for precisely counting and communicating time, given the design constraints and considerations of the overall system. The count is called the Time of Week (TOW) and is reset to zero at the end of each week.

2. The 10 most significant bits of the Z-Count are the modulo-1024 binary week count of GPS time, which began at midnight on the night of 05-06 January 1980 (the start of GPS time). The week count can range from 0 to 1023, at which time, it resets to zero. This reset will occur each time the 1023 count is encountered and is the "rollover" event. Rollovers will occur at 19.7 year intervals, starting from the GPS time start date.

As can be seen from the Z-Count time representation, the number of weeks and the number of 1.5 second epochs can be converted to years, months, days, hours, minutes, and seconds, and added to the GPS start date to calculate the actual calendar date and time.

The dates of the next 5 GPS rollover events are listed in *Table 1.*

Since the Z-Count does not contain any year data, once a rollover occurs, there is no way of determining the specific rollover interval, and thus, the actual year from this binary data, from the time code, or from any other navigation data contained in the GPS signal. As a matter of fact, the signal specification clearly states:

> *"Users must account for the previous 1024 weeks in conversions from GPS time to a calendar date."* [1]

Thus, it is clearly the burden of the user community to account for, in whatever way is appropriate, these periodic rollovers as they occur. In the case of any particular GPS receiver, the firmware can keep track of this rollover, it can require user input to resolve the apparent negative 1024 week time change at each rollover event, or it can be totally oblivious to all rollover events and, thus not produce usable date information after the first rollover.

Recent literature on this subject [2] indicates that several manufacturers of GPS equipment were not even aware of this rollover phenomenon and were "dumbfounded" when informed of its existence. It is logical to assume that no provisions had been made in their current equipment to compensate for the rollover event.

Of late, there has been a rapidly increasing awareness of the rollover phenomenon by both the GPS user community and manufacturers of GPS equipment. It is likely that any newly-designed GPS equipment will incorporate a means of accounting for the modulo-1024 week counter limitation, thus eliminating any noticeable rollover effect. New shipments of existing designs will undoubtedly have firmware fixes incorporated, wherever possible. If existing equipment has flash memory or removable (P)ROMs, it is possible that a retrofit firmware version could be downloaded or installed, extending the useful lifetime of the equipment beyond the rollover event.

## GPS Time *vs.* UTC

GPS time is not the same as UTC, or Coordinated Universal Time (previously called Greenwich Mean Time, GMT, or Zulu Time). UTC is derived from atomic standards maintained at several sites around the world such as the National Institute of Standards and Technology (NIST, formerly National Bureau of Standards, or NBS).

While atomic time is fundamentally constant, celestial time is measured by precisely observing the motions of celestial and planetary objects, most notably the Sun. The position of the Sun relative to the earth defines our day and night, and also the passage of years. Celestial motion, and in particular, the earth's orbit around the sun, is gradu-

| Rollover Number | Rollover Date |
|---|---|
| 1 | August 22, 1999 |
| 2 | April 7, 2019 |
| 3 | November 21, 2038 |
| 4 | July 7, 2058 |
| 5 | February 20, 2078 |

***Table 1***

ally, yet perceptibly, slowing down with respect to atomic time. Celestial time is determined by other sites around the world, such as the US Naval Observatory in Washington, DC and the Greenwich Royal Observatory in England.

In order to resolve the discrepancy between atomic and celestial times, periodic corrections are imposed on UTC, realigning atomic time with celestial time, with the intention of compensating for this gradual slowing of the celestial time scale. If these corrections were not made, day would eventually become night, albeit in the far, far future. In the interests of ultimate celestial precision, corrections to UTC are generally made in "leap seconds" which are added on New Year's eve at 0000 hours, as necessary. To date, there have been 11 leap seconds added since the beginning of GPS time. GPS time is not corrected for celestial time slowing. GPS time and UTC were precisely aligned at the beginning of GPS time, which began at midnight on January 5-6, 1980. No leap seconds have been added to GPS time, so it leads UTC by some 11 seconds as of the date of this writing. The complete GPS signal does, however contain the encoded number of leap seconds to be added to GPS time, which allows UTC seconds to be accurately calculated from GPS data and GPS time, without the need for any outside information or intervention.

Some GPS equipment can, at the operator's command, display or output either GPS- or UTC-referenced time. It is vital to be aware of which time reference is being utilized for each data element, when precise comparisons must be made with other time-correlated data elements. It is also vital to ensure that all similar GPS equipment be set to display and report time data utilizing the same time reference when precise time correlation of data is necessary.

## Current Equipment Capabilities

Certain GPS equipment that is available currently may be capable of dealing with the time rollover. Some of these (such as the Magnavox MX 4818, a black-box, fixed-site, reference station

*Continued on page 55*

*General News*

# First International Conference on Alternative Aviation Fuels

On Nov. 2, 1995, members of the aviation community from around the world gathered at Baylor University in Waco, Texas, for the "First International Conference on Alternative Aviation Fuels." Over 100 people from 7 countries and 3 continents were present to listen to researchers, representatives of industry, pilot organizations, and the U.S. government as they discussed the need to find a replacement for 100-octane leaded aviation gasoline and the promise held by alternative aviation fuels.

The conference represented all points of view: from pioneers in the use of alcohol fuels in aircraft, such as Mercury Astronaut Gordon Cooper and Baylor Professor Max Shauck; to people such as Cessna's Cesar Gonzalez, who are convinced that the future of general aviation is inextricably tied to the petroleum industry. There was someone representing every possible viewpoint at the conference.

While on some points people agreed to a disagree, there were a number of areas of wide agreement. Foremost among these was the consensus that the days of leaded Avgas are limited. Everyone agreed that, either as a result of government regulation or as a result of unfavorable economics, in the near future fuel producers are not going to be able or willing to continue to supply leaded Avgas.

There was much discussion of the different advantages and disadvantages associated with the fuels offered as alternatives to leaded Avgas. The renewable fuels advocates pointed out that renewable aviation fuels, such as ethanol and ethyl tertiary butyl ether, have very good anti-knock characteristics, are much less prone to vapor lock, and have broad ranging economic and environmental benefits for society. Proponents of other fuels pointed out that these fuels have problems with airplane range and the lack of existing infrastructure.

Representatives of the Experimental Aircraft Association, Aircraft Owners and Pilots Association, and Cessna pointed out that the size of the aviation fuels market is very small and concluded that the future of aviation fuels should be tied to existing larger fuel markets. They argued in favor of using Autogas in aircraft or developing a fuel, such as 82UL, that has characteristics very close to existing unleaded motor gasolines.

Opponents of this viewpoint noted the technical and economic difficulties of developing a high octane aviation fuel derived from petroleum and the fact that the majority of Avgas is used by aircraft that are unable to use a low octane fuel. They also pointed out that, if the aviation community does not take advantage of the opportunities offered by the need to find an alternative to leaded Avgas, then it will be passing up a unique chance to make flying more economically and environmentally beneficial to the nation.

The conclusion of the conference was a visit to Texas State Technical College where Baylor's Renewable Aviation Fuels Development Center conducts engine tests, aircraft modification, maintenance, and flight testing. Conference attendees were able to inspect Baylor's collection of four ethanol-powered aircraft.

The goals of the conference were to exchange information, encourage open debate between opposing viewpoints, and stimulate new research and development of alternative aviation fuels. All of these goals were achieved.

The Proceedings of the First International Conference on Alternative Aviation Fuels (dated May 1996) are available through the National Technical Information Service, Springfield, Virginia 22161. ❖

*General News*

# Boeing Shares Collier Trophy with FAA

A replica of the Robert J. Collier Trophy, considered to be the aviation industry's most prestigious award, was presented to the staff of the FAA's Seattle Airplane Certification Office (ACO) by FAA Administrator David R. Hinson and Boeing Commercial Airplane Group Vice President Tom Schick in ceremonies on September 9, 1996. Earlier this year, The Boeing Company received the trophy for its Model 777 twinjet, and Boeing shared this award with the FAA. The insignia on the trophy reads, "For the greatest achievement in aeronautics or astronautics in America, the value of which has been thoroughly demonstrated by actual use in the preceding year."

***Accepting the Collier Trophy, from left to right are: FAA Administrator David Hinson, Seattle Aircraft Certification Office Manager Don Riggin, and Transport Airplane Directorate Manager Ron Wojnar.***

In bestowing the Collier Trophy, the National Aeronautic Association annually recognizes the greatest achievement in aeronautics and astronautics in America. In nominating Boeing for this award, the Aerospace Industries Association of America, Inc. called the 777 "a landmark in commercial aircraft development by virtue of its significantly advanced performance, efficiency, safety and environmental acceptability."

"*The Boeing Company very much appreciates the dedication of the men and women of the FAA*," said Schick, "*your commitment to technical excellence and the safety of the traveling public is evident in all that you do.*" He noted that "*it is no accident of* *fate that the only airplanes to receive such awards were built at Boeing with the involvement of the world's finest regulatory authority and the application of your rigorous standards."*

Certification of the 777 design was a five-year process. In that time, FAA engineering, flight test and operations staff spent over 96,000 hours to ensure that federal safety requirements were met. The initial type certification for the 777 was presented to Boeing in April 1995.

Congratulating the Seattle ACO employees for their *"extraordinary achievement,"* Hinson pointed out that the certification process for the 777 *"set standards for the way airplanes will be certificated in the future."* *"The list of Collier winners is an honor roll of aviation greats,"* he said, *"and we are delighted to be included among them."*

The Collier Trophy was founded in 1911. The first recipient was Orville Wright. Other winners include Howard Hughes, General Hap Arnold, Captain Chuck Yeager, the X-15 test pilots, and several astronauts. Boeing previously received the Collier Trophy for its B-52, 747, 757 and 767 airplanes. ❖

*General News*

# Aircraft Postcrash Fire Burnthrough Resistance

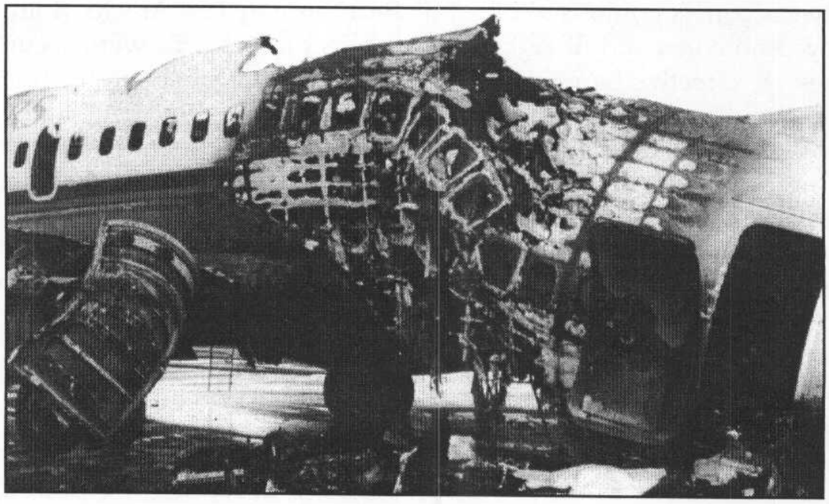
The Federal Aviation Administration is conducting research and full-scale fire tests for the purpose of hardening an aircraft fuselage against burnthrough by a postcrash, external fuel fire.

The rapidity of postcrash fuel fire penetration into an aircraft cabin will impact the survivability of passengers and crewmembers. Investigators of the impact-survivable accident, shown in the photograph below, concluded that fuel fire flames can penetrate the cabin within 60 seconds, contributing to a loss in life.

## Fuselage Burnthough Resistance

In a majority of survivable accidents accompanied by fire, ignition of the interior of the aircraft is caused by burning jet fuel external to the aircraft. Therefore, the integrity of the aircraft and its ability to provide a barrier against fuel fire penetration is an important factor related to the survival of aircraft occupants. Fuselage burnthrough resistance becomes particularly important when the fuselage remains intact following a crash, which occurs frequently in survivable accidents.

Fuselage burnthrough resistance may be simplistically viewed as the time interval for a fuel fire to penetrate three fuselage shell members: aluminum skins, thermal acoustical insulation and sidewall panel/cabin flooring. Flame penetration may occur in other areas as well, such as windows, air return grilles and seams/joints. The burnthrough resistance of the aluminum skin in well known. It takes only about 20 to 60 seconds for the skin to melt, depending on its thickness. The thermal acoustical insulation becomes the next impediment to burnthrough

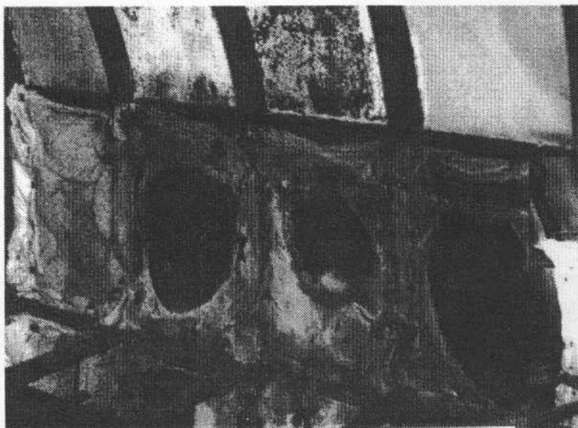


***Impact-survivable accident***

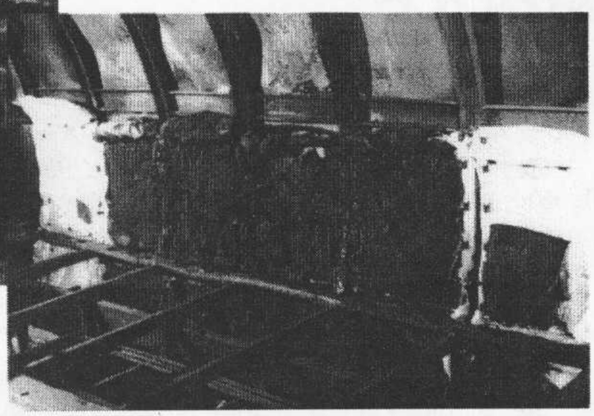
following the melting of the aluminum skins. In recent years, the FAA conducted seven outdoor fuel fire burn tests on surplus fuselages to determine the mechanism and time frame for burnthrough. It was determined that the fiberglass insulation provided an additional 1 to 2 minutes of protection, if it completely covered the fire area and remained in place. Thus, the method of securing the insulation to the fuselage structural members is important. Finally, the sidewall panels/flooring offer the final barrier to fire penetration. Sandwich panels comprised of honeycomb cores and fiberglass facings are effective barriers; however, full-scale fire tests also show that the fire can penetrate into the cabin through air return grilles, seams/joints or window reveals. Moreover, some airplanes utilize aluminum sidewall panels which offer minimal burnthrough resistance. FAA researchers are focusing on the thermal acoustical insulation as the most potentially effective and practical means of achieving a burnthrough barrier.

## Test Results

FAA tests have demonstrated the potential significant effectiveness of a new insulation material as a fuselage burnthrough barrier. The new material, a heat stabilized oxidized polyacrylonitrile fiber (OPF) was compared to the current fiberglass insulation under identical fire conditions in the FAA's Full-Scale Fuselage Burnthrough Test Article. Both insulation materials were securely attached to the framing members. It takes about 1.5 to 2 minutes for the fuel fire flames to penetrate the aluminum skin and fiberglass batting (above left). The OPF insulation did not burn when subjected to a fuel fire for over 5 minutes (above right).



***Current fiberglass insulation after about 2 minutes exposure to jet fuel fire***



***New heat stabilized polyacrylonitrile insulation after about 5 minutes and 30 seconds exposure to jet fuel fire***

## Research Program

The research being conducted by the FAA on fuselage burnthrough resistance is a cooperative activity with the Civil Aviation Authority in the United Kingdom. The CAA tasked Darchem Engineering to develop a medium-scale test apparatus, calibrated against FAA full-scale fire test data, which employs a 1.2 meter square sample to screen improved materials/concepts. The FAA and the CAA are interested in testing materials/concepts that may be effective burnthrough barriers. As was done with the OPF insulation, it is requested that promising materials/concepts be initially screened in the CAA/Darchem medium-scale test apparatus. This will help determine the potential effectiveness and whether full-scale fire tests by the FAA are warranted. For additional information contact Tim Marker or Gus Sarkos, Fire Safety Section, AAR-422, FAA Technical Center, at (609) 485-6469/5620; or Nick Povey, CAA Safety Regulation Group, at 44-1-293-573-347.

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# Use of Original Manufacturer's Approved Structural Design Data by Modifiers

FAA Order 8110.4A, "*Type Certification Process*," allows modifiers the use of the original manufacturer's approved type certification data in certain circumstances when this data is supplied by the modifier. Recently, however, there have been cases of modifiers using the original manufacturer's structural certification data that could result in unsafe conditions. Transport category airplane structures, and the supporting data to substantiate these structures, are exceptionally complex to the extent that great caution must be exercised and additional concerns must be taken into account.

This article provides clarification and technical guidance for FAA Designated Engineering Representatives (DER) in the use of "applicant provided data" that is purported to be the original manufacturer's FAA-approved substantiating data. The general policies regarding the legal use of such data are provided in FAA Order 8110.4A and will not be repeated here. The emphasis here is on the technical use of FAA-approved structural substantiation data (loads reports, stress reports, etc.) by applicants other than the original manufacturer.

For an original type certificate, the manufacturer is required to submit the substantiating reports and computations necessary to show that the product to be certificated meets all the applicable airworthiness, engine emissions, and noise requirements [Section 21.21(b) of the Federal Aviation Regulations (FAR)]. All type certification data necessary for showing compliance must be submitted to the FAA for review and approval; however, there is no rule dictating the manner or form in which the data should be presented and the data may, at the discretion of the certification office, be presented to an FAA engineering designee acting on the behalf of the FAA. Since, there is no consistent manner in which FAA-approved data are formally documented and retained by the FAA, caution must be exercised in the use of these data by other applicants who obtain it by whatever means and provide it to FAA for use in showing compliance for a modification.

The FAA DER must determine that the modifier has shown (by calculation, comparison, tests or other means) that the airplane, as modified, meets the minimum airworthiness requirements specified by the certification basis for the airplane and that the modified airplane is safe.

The applicant is not necessarily required to duplicate the original manufacturer's loads and use the same analytical methods, nor show compliance to other special company design conditions that are not considered a part of the certification basis. However, it is important that the modifier be held to the same level of certitude and standards of compliance expected of the original manufacturer, which includes validation of load intensities and distributions as required by Section 25.301(b) of the FAR. When the original manufacturer's data are used to justify the reliability of the applicant's own loads calculation, the inference must be appropriate, producing near equivalent results at the same location with the same load condition. If the applicant cannot duplicate the manufacturer's design loads within the level of accuracy required for the subsequent stress analyses, then validation studies and tests (e.g., flight loads survey) would be needed to establish the reliability or conservatism of the modifier's loads calculations.

The FAA does not prohibit the reasonable use of the original manufacturer's data that are obtained by the modifier and submitted in support of a modification; however, this data must be used with caution, and assessed for acceptability in view of the particular modification program. The acceptability of previously approved data submitted in support of a modification project for a transport category airplane should be subject to the following considerations:

a. **Approval Status:** Many reports and other design information are produced by the manufacturer and the manufacturer's vendors during the course of an airplane design program. However, not all such data are FAA-approved. The applicant who submits the original manufacturer's design data in support of a modification program must provide sufficient evidence to FAA that the specific data are FAA-approved. The evidence supplied by the applicant must be sufficient to the extent that the FAA can verify the approval status of the data without conducting an extensive and burdensome search of the FAA records and type certification data files.

b. **Applicability:** The FAA-approved data may be applicable to a specific model and even to a specific line number. Airplanes are continuously modified both on the production line and in service to add additional options and configurations. Furthermore, weight saving programs after the airplane is in production may reduce previously published safety margins. These changes are often substantiated with supplementary analyses that may not be reflected in the particular FAA-approved data submitted by the modifier. The applicant must provide evidence that the FAA-approved data are applicable to all the versions and configurations of the type design that is to be covered by the modification.

c. **Completeness:** Data are often FAA-approved for a specific purpose (e.g., for use in showing compliance with a specific paragraph for a specific component or part of the airplane). It is important to recognize that the prior FAA approval may have been only one of several submittals that contributed to the showing of compliance since test reports and other data may have also been submitted to further support the finding of compliance. In addition, portions of the structural substantiation data are sometimes included in summary reports, which may not contain analyses of every part or component, or all structural load cases, needed to show compliance. The modifier must provide sufficient evidence that the data are complete to an extent commensurate with the way the data will be used to support the modification. Submittal of individual pages or parts of pages taken out of context would not be sufficient to show compliance. Generally the complete document must be submitted to the extent necessary for the FAA to verify the approval status and evaluate the full context of the conclusions contained therein.

d. **Use of the data:** Perhaps the most important factor is the way the FAA-approved data is employed by the applicant to support a modification project. The original manufacturer's data can be correctly used in a variety of ways, such as validating assumptions, confirming methodology, and verifying critical load cases. It is not usually possible to rely directly on the margins of safety and load conditions identified in the manufacturer's summary reports, since they may not necessarily be the minimum margins or the most critical load cases. However, when the safety margins are described by the original manufacturer as the minimum for a component, and the load cases are identified and described as the critical load case for the component, then it may be possible for the applicant to use this information in order to support the applicant's own loads/stress analyses or tests, and draw logical conclusions concerning compliance with a specific requirement for the modified airplane.

e. **Reduced static strength margins:** Many components of the primary structure are critical for requirements other than static strength. When the applicant shows positive yet reduced static strength margins for any component, he must further ascertain that all the other requirements are adequate including fatigue, damage tolerance, and aeroelastic stability. It is especially important to determine the influence of reduced strength margins for those items identified as principal structural elements and any other items that are the subject of inspection requirements. Furthermore, the engineering designee should review the available service difficulty history for the component with the reduced static margin to confirm that a reduced margin would not have an adverse effect on safety.

Experience, engineering judgment, and knowledge of the engineering practices of the original

*Continued on page 55*

# FAA Reviews NTSB HAZMAT Recommendations

*Material for this article appeared originally in an article by Bob Hawk in the September 1996 edition of FAAviation News.*

The FAA has begun a review of safety recommendations issued on May 31, 1996, by the National Transportation Safety Board (NTSB) as a result of preliminary findings from the investigation of the crash of ValuJet 592 in Florida on May 11.

FAA Administrator David Hinson said, "The FAA will thoroughly review the Board's recommendations as quickly as possible. We agree with the thrust of the recommendations, and we will now assess them in the context of the various actions the FAA instituted both before the accident and in the days immediately following it. Safety is the FAA's highest priority."

The NTSB's recommendations and FAA's preliminary responses are as follows:

## NTSB Recommendation:

*Permanently prohibit the transport of oxygen generators on any passenger or cargo aircraft when the oxygen generators have passed their expiration dates and the chemical core has not been depleted.*

## FAA Preliminary Response:

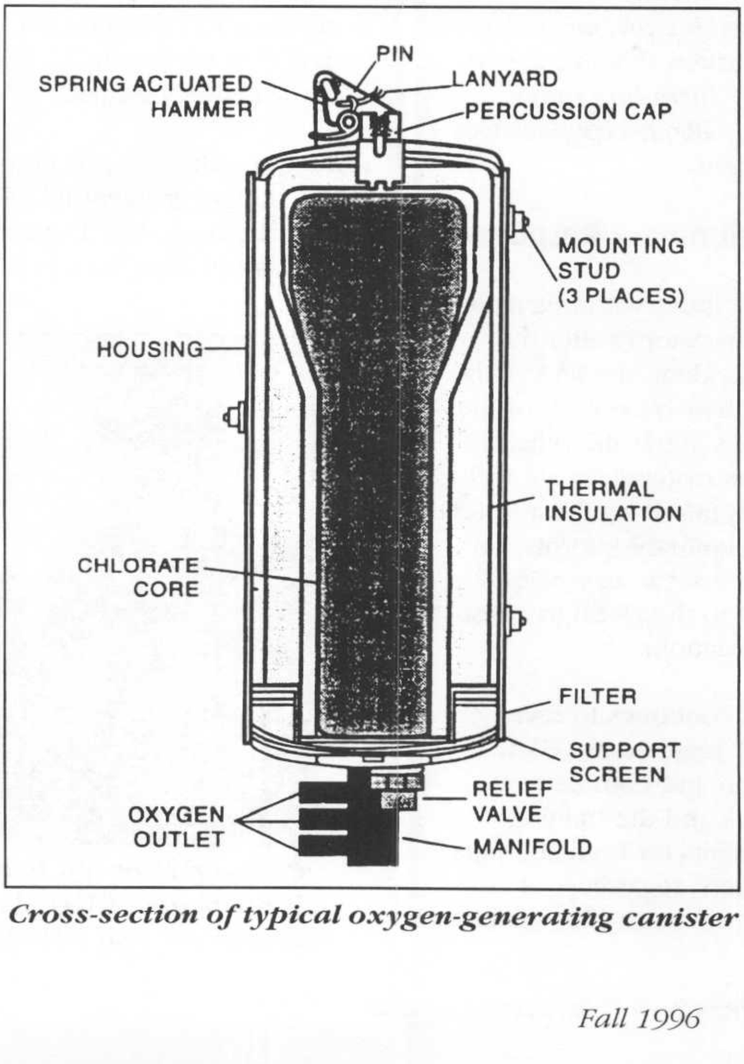
The FAA concurs with the intent of the recommendation and, effective May 24, 1996, the U.S. Department of Transportation banned the transportation of all oxygen generators as cargo on passenger-carrying aircraft, irrespective of the generators' expiration dates or the state of the chemical core. The ban is an interim rule effective until January 1, 1997. The FAA has been accepting public comments on the interim rule and will subsequently determine whether to modify, expand, terminate, or make the prohibition permanent. Within a week of the FAA's ban, the United Kingdom and Canada followed suit.

## NTSB Recommendation:

*Prohibit the transportation of oxidizing materials that pose fire hazards in cargo compartments that do not have smoke or fire detection systems.*

## FAA Preliminary Response:

The FAA has already begun a




***Cross-section of typical oxygen-generating canister***

review into the air transportation of oxidizers and has, with other another DOT agency — the Research and Special Programs Administration (RSPA) — begun research into the categories of hazardous materials (HAZMAT) allowed to be transported on passenger aircraft. Appropriate restrictions on HAZMAT that pose fire hazards to cargo compartments will also be studied. FAA also began reviewing its regulations on fire detection and suppression in Class D cargo compartments.

### NTSB Recommendation:

*Immediately evaluate the practices and training of all air carriers for the acceptance of passenger baggage and freight, including company materials, and for the identification of undeclared hazardous materials. The evaluation should cover all personnel, including ramp personnel, who accept packages for shipment.*

### FAA Preliminary Response:

The FAA agrees with this recommendation. Shortly after the ValuJet accident, the FAA initiated a comprehensive review of the regulations allow shipping of hazardous material by air, including issues raised by the accident itself. Preliminary information form that review was swiftly provided to the NTSB to assist in its investigation.

The FAA continues to review HAZMAT regulations (HMR 175), inspection and enforcement programs, and the training requirements for both shippers and carriers, regardless of whether the hazardous materials are being transported as baggage, cargo, or company materials. Among other things, this review will focus on training requirements for all personnel who offer and accept hazardous materials for transportation by air.

### NTSB Recommendation:

*Require air carriers as necessary to revise their hazardous material training based on the evaluation required by the previous recommendation.*

### FAA Preliminary Response:

The FAA agrees with this recommendation, and changes to training requirements and procedures for air carriers will be developed as appropriate, based on findings from the review underway and recommended by NTSB. ❖

***Inside FAA***

# Anthony Broderick Retires: Distinguished Aviation Professional Leaves FAA

Anthony J. ("Tony") Broderick, FAA's Associate Administrator for Regulation and Certification, has retired after more than 25 years of dedicated government service.

Broderick, who is a private pilot, joined the government in 1971 as a physicist at the U.S. Department of Transportation's Transportation Systems Center in Cambridge, Massachusetts, where he was an internationally recognized expert on the complex problems of upper atmospheric ozone reduction. He moved to Washington in 1976 as chief of the High Altitude Pollution Program Staff in the FAA's Office of Environment and Energy.

***Pictured from left to right are: Transport Airplane Directorate (TAD) Manager Ron Wojnar, Tony Broderick, and TAD Asst. Mgr. Darrell Pederson***

Before his appointment as the agency's Association Administrator for Regulation and Certification, Broderick held the position of Associate Administrator for Aviation Standards, an organization where he previously served as deputy.

*"The men and women of the FAA constitute the finest aviation safety organization in the world,"* said Broderick. *"It has been a real honor to serve on the same team with them over the past 20 years."*

Throughout his FAA career, Broderick has been the recipient of several prestigious awards. In 1979 he was presented the Arthur S. Flemming award as one of the 10 outstanding young men and women in the Federal Service. He was awarded by the President of the United States the Senior Executive Service ranks of both Meritorious Executive and Distinguished Service. In 1992, he was presented with an ***Aviation Week & Space Technology*** Aerospace Laurel for government leadership in assuring strong FAA safety oversight of foreign airlines operating in the United States. In 1995, Flight International named him Aerospace Personality of the Year.

"Mr. Broderick has a long and distinguished career in aviation safety," said FAA Administrator David Hinson. *"The entire aviation industry owes him a debt of gratitude."*

In a note addressed to the *"men and women of Regulation and Certification,"* Broderick said, *"The support I have received from all of you throughout my career in FAA has been extraordinary. I ask that you continue* those good *efforts and I hope that, in some small way, my presence here has made a positive difference."* He closed by saying, *"Our working together on a wide variety of exciting and stimulating challenges has been, for me, a wonderful opportunity that can never be equaled or forgotten."*

Among Broderick's most recent accomplishments was bringing all commuter airlines under the same Federal regulations that govern large carriers, essentially creating "one level of safety" for the flying public.

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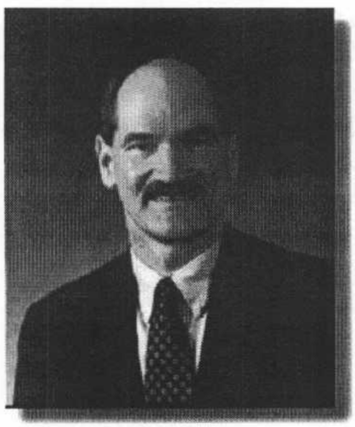
***Inside the FAA***

# Guy S. Gardner Named New Associate Administrator for Regulation and Certification



***Guy S. Gardner***

On September 27, 1996, FAA Administrator Hinson announced the selection of Guy S. Gardner as Associate Administrator for Regulation and Certification. Mr. Gardner replaces Anthony Broderick in that position. Since September 1995, Garner has been serving as the Director of the FAA's William J. Hughes Technical Center.

Gardner received a Bachelor of Science degree with majors in astronautics, mathematics, and engineering science from the United States Air Force Academy in 1969; and received a Master of Science degree in aeronautics and astronautics from Purdue University in 1970.

He completed U.S. Air Force pilot training at Craig Air Force Base, Alabama, and F-4 upgrade training a MacDill Air Force Base, Florida in 1971. In 1972, he flew 177 combat missions in Southeast Asia while stationed in Udorn, Thailand. In 1973-74, he was an F-4 instructor and operational pilot at Seymour Johnson Air Force Base, North Carolina. He attended the USAF Test Pilot School at Edwards Air Force Base, California, in 1975, and then served as a test pilot with the 6512th Test Squadron located at Edwards in 1976. In 1977-78, he was an instructor test pilot at the USAF Test Pilot School. In 1979-80, he was operations officer of the 1st Test Squadron at Clark Air Base, Philipppines.

Gardner was selected as a pilot astronaut by NASA in May 1980. During his 11 years as an astronaut, he worked in many areas of Space Shuttle and Space Station development and support. Gardner first flew in space as pilot on the crew of STS-27, aboard the Orbiter Atlantis, on December 2-6, 1988. The mission carried a Department of Defense payload. Gardner next flew as pilot on the crew of STS-35, aboard the Orbiter Columbia, on December 2-10, 1990. The mission carred the ASTRO-1 astronomy laboratory consisting of three ultraviolet telescopes and one x-ray telescope.

Gardner left NASA in June of 1991, returning to the Air Force as Commandant of the USAF Test Pilot School at Edwards Air Force Base, California. In August 1992, Gardner retired from the Air Force to go to NASA Headquarters as Program Director of the joint U.S. and Russian Shuttle-Mir Program. He attended the Defense Systems' Management College in 1994, and then became the Director of the Quality Assurance Division, Office of Safety and Mission Assurance at NASA Headquarters.

In September 1995, Gardner joined the FAA as Director of the William J. Hughes Technical Center, at the Atlantic City International Airport, in New Jersey.

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*Inside FAA*

# New National Resource Specialists

In meeting the challenges posed by advancing aviation technology, and in order to function effectively in the future aviation environment, the FAA has taken steps to upgrade its workforce capabilities. Over the past several months, the FAA has hired seven new National Resource Specialists (NRS), each of whom is a recognized expert in a specific field of aviation technology.

The NRS program was established in the FAA more than 15 years ago, based on the recognition of the need for technical specialists in the FAA who have highly specialized, state-of-the-art knowledge and skills in specific technical areas. The program was established to ensure continued FAA technical competence in its aircraft certification programs.

The NRS's comprise a professional community of engineers and scientists who serve as special technical advisors both within and outside of the FAA. They are responsible for maintaining close and continuous contact with representatives of the aviation community, professional societies, academic and research institutions, specialists in other Federal agencies (including the military), and foreign airworthiness authorities to maintain and develop their specialized knowledge and skills.

They also represent the FAA in national and international activities that need use of their technical expertise, and participate as technical advisors in the development of FAA type certification regulations and standards, national policy, and national directives or advisory circulars to provide procedures and practices in their specialized technical area.

The NRS's often have been closely involved in the initial research and development of new systems, such as the Global Positioning System (GPS), Microwave Landing System (MLS), Traffic Alert and Collision Avoidance System (TCAS), and fly-by-wire flight control systems. Their expertise also has been tapped in several studies in such things as the development of new composites, flutter suppression, cockpit human factors considerations, among others. Many times they are called upon to participate in or lead such activities as seminars or symposiums, and develop training courses designed to enhance the state-of-the-art knowledge of FAA certification engineers, pilots, and inspectors.

The role of the NRS provides the FAA with a unique opportunity and working relationship to achieve uniformity between the Directorates in procedures, application of the Federal Aviation Regulations, and better understanding of the FAA's technical positions.

The NRS's who are currently on board are listed on the following pages.

| NAME | SPECIALTY | LOCATION | TELEPHONE |
|---|---|---|---|
| Abbott, Kathy* | Cockpit Human Factors | Washington, DC and Seattle, WA | (202) 267-7192 or (206) 227-1024 |
| Barnes, Terence | Flight Loads/ Aeroelasticity: Fixed Wing | Seattle, WA | (206) 227-2761 |
| Broz, Alfred | Non Destructive Evaluation | Boston, MA | (617) 238-7105 |
| Buckman, Martin* | Propellers | Boston, MA | (627) 238-7112 |
| DeWalt, Michael | Aircraft Computer Software (Engineering) | Seattle, WA | (206) 227-2762 |
| Hill, Gene* | Aircraft Icing | Settle, WA | (206) 227-2180 |
| Larsen, Hals* | Propulsion Systems | Seattle, WA | (206) 227-2182 |
| Lyddane, George | Flight Management | Long Beach, CA | (310) 627-5206 |
| Pourbabai, Ben* | Manufacturing and Quality Assurance Technology | Washington, DC | (202) 267-9580 |
| Singh, Raghubansh* | Software Quality Assurance | Washington, DC | (202) 267-9580 |
| Soderquist, Joseph | Advanced Composite Materials | Washington, DC | (202) 267-9585 |
| Soltis, Steve | Crash Dynamics | Long Beach, CA | (310) 627-9585 |
| Swift, Tom | Fracture Mechanics | Long Beach, CA | (310) 627-5205 |
| Treacy, James J. | Advanced Avionics/Electrical | Seattle, WA | (206) 227-2760 |
| Walen, David* | Electromagnetic Interference | Seattle, WA | (206) 227-2180 |

** Recently appointed*

*Inside FAA*

# FAA Technical Center Name Change

The FAA Tech Center is no more. On May 6, 1996, the Center was officially re-dedicated the William J. Hughes Technical Center to honor former New Jersey Congressman William J. Hughes, who was instrumental in keeping the Technical Center open in New Jersey. The name change was originally proposed in legislation sponsored by Senator Frank Lautenberg (D-NJ) last fall.

William J. Hughes, currently the U.S. Ambassador to Panama, has been a long-time supporter of the Technical Center. A New Jersey native who served in Congress from 1974 until 1995, Hughes has been instrumental in the Center's growth. He played a key role in obtaining the support necessary to expand and modernize the Center with a new headquarters building, a technical support facility, the advanced automation system laboratory, and the aviation security research and development laboratory.

Located just outside Atlantic City, the Technical Center covers 5,059 acres and consists of laboratories, test facilities, support facilities, an airplane hangar, and the Atlantic City International Airport. The facility serves as the scientific test base for FAA research, development, and acquisition programs. Current activities involve test and evaluation in air traffic control, communications, navigation, airports, aircraft safety, and security. Research work includes long-range development of innovative systems and concepts, development of new equipment and software, and in-service modification of existing systems and procedures. ❖

# New Publications Available

To obtain a copy (at no charge) of any of the following reports, please contact:

C. A. Bigelow at
telephone (609) 485-6662;
fax (609) 485-4569; or
e-mail cathy_bigelow_at_ct27@admin.tc.faa.gov

*Spin Synchronous X-ray Sinography (SXS) for Nondestructive Imaging of Turbine Engines Under Load.* Report DOT/FAA/AR-95/90. This report describes a high resolution imaging inspection for the interior of a rotting engine, particularly for turbine disks and associated components that can be done without engine teardown.

*Investigation of Fuselage Structure Subject to Widespread Fatigue Damage.* Report DOT/FAA/AR-95/47. This report describes an experimental test program, conducted by Boeing Commercial Airplane Group, to obtain test data on airplane fuselage structures subject to multiple site damage in an environment that reflects typical commercial jetliner manufacturing and operating conditions.

*Corrosion and Corrosion Fatigue of Airframe Materials.* Report DOT/FAA/AR-95/78. This report describes the characterization of the chemical, microstructural, and statistical aspects of pitting corrosion, and studies on corrosion fatigue crack growth.

*Fracture Testing of Large-Scale Thin-Sheet Aluminum Alloy.* Report DOT/FAA/AR-95/11. This report describes a test program on a series of large-scale, pre-cracked aluminum alloy panels with multi-site cracking.

*Stochastic Modeling of Antisymmetric Buffet Loads on Horizontal Stabilizers in Massively Separated Flows.* Report DOT/FAA/AR-95/7. This report describes a modern method developed to model antisymmetric buffet design loads on horizontal stabilizers with a known probability, using a rigid wind tunnel model.

*Tire Test Correlation: Radial Versus Bias-Ply Tires.* Report DOT/FAA/AR-TN95/97. This report describes the correlation of the temperature performance of a radial tire with a bias-ply tire of identical size under controlled laboratory dynamometer conditions.

*Light Shaping Diffusers for Improved Visual Inspection of Aircraft.* Report DOT/FAA/AR-95/32. This report describes a significant, but relatively inexpensive, improvement to flashlights that dramatically improves the uniformity of flashlight illumination.

*Characterization of Early Stages of Corrosion Fatigue in Aircraft Skin.* Report DOT/FAA/AR-95/108. This report describes a research program aimed at gaining an improved deterministic understanding of the transition from corrosion pit to short crack to long crack.

*Flight Loads Data for a Boeing 737-400 in Commercial Operation.* Report DOT/FAA/AR-95/21. This report presents flight data collected from one Boeing Model 737-400 airplane during routine commercial operation.

*Proceedings of the FAA-NASA Sixth International Conference on the Continued Airworthiness of Aircraft Structures.* Report DOT/FAA/AR-95/86. These proceedings of the conference that was held June 27-28, 1995, in Atlantic City, New Jersey, are now available.

*A Simplified Approach to Damage Tolerance Analysis of Riveted Repairs.* ICAF Document 2055-Melbourne, 1995, by C.A. Bigelow, J. G. Bakuckas, Jr., and P. W. Tan (edited by J. M. Grandage and G. S. Jost). This paper describes a simplified approach to the damage tolerance analysis of riveted repairs and compares the simplified approach to a more rigorous solution calculated using the finite element method.

*Proceedings of Application of Probabilistic Design Methodologies to Gas Turbine Rotating Components Workshop.* This document contains the presentations made by the FAA and Air Force at this workshop, which was held November 8-9, 1995, in Atlantic City, New Jersey. ❖

# Procedure Changes for Ordering Copies of Certain Government Publications

The supply point for obtaining copies of FAA Advisory Circulars and other publications has recently changed. The "Subsequent Distribution Office," which provides copies, has been relocated to the Department of Transportation's warehouse facilities in Landover, Maryland. The new address for publication requests is:

U.S. Dept. of Transportation
Subsequent Distribution Office, SVC-121.23
Ardmore East Business Center
3341 Q 75th Avenue
Landover, MD 20785

The new telephone numbers are:

DOT publications help line:
(301) 322-4961

FAX number for requesting publications:
(301) 386-5394

(**Note**: Only *written* requests for publications are accepted.)

If you would like an overall guide, the "Guide to Federal Aviation Administration Publications" is excellent and is being converted from hardcopy distribution to Internet and Intranet listing.

The Internet and Intranet address is:

http://www.faa.gov/apa/publicat/GUIDETOC.htm

Questions about specific FAA publications also may be directed to:

FAA Public Inquiry Center at (202) 267-3484.

Most Federal publications can be obtained through Government Printing Office Bookstores, which are located in most major cities. Some documents are free; others require a fee. ❖

*Publications and Media*

# AD's Available on CD-ROM

The FAA's Summary of Airworthiness Directives (AD) is now available for sale on CD-ROM.

What is on the CD-ROM?: All AD's (Small and Large Aircraft) from the 1940's through December 1995. The files are in Adobe Acrobat format and include all drawings and figures. An Adobe Acrobat Reader package is included on the CD-ROM; however, no indexing or linking is provided. The files are in easy-to-follow directories similar in format to the paper Summary of AD's. The March 1996 index (numeric and alphabetical) is included. Updates to the Summary are available free on FedWorld (see below for more information).

You can order the CD-ROM by contacting:

National Technical Information Service (NTIS)
5285 Port Royal Road
Springfield, Virginia 22161
telephone: (703) 487-4650
fax: (703) 321-8547

Ask for:
Stock number PB96501846

The price is $125 for U.S., Canada, and Mexico orders; and $250 for other international purchases. The purchase price is for one CD-ROM.

All new AD's also are available free on FedWorld. FedWorld is an electronic bulletin board available via modem or through the Internet. Follow the following steps to access FedWorld:

Via Internet:

- Telnet to fedworld.gov
- FTP - ftp://ftp.fedworld.gov/pub/faa
- World Wide Web: www.fedworld.gov

Via Modem:

- Dial (703) 321-3339
- 28.8 baud; parity none;
- 8 databits, 1 stopbit;
- Duplex to Full
- Terminal Emulation ANSI

Other FAA safety data information that is available free on FedWorld include:

- new AD's
- Service Difficulty information
- General Aviation Airworthiness Alerts
- airman testing information
- regulations
- other aviation information

The FedWorld help desk can be reached at: (703) 487-4223.

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*Rulemaking*

# FAA Issues Nine Proposed Airworthiness Directives Based on Boeing 737 Critical Design Review

On August 21, 1996, FAA issued nine proposed airworthiness directives (AD), each addressing a change or improvement in the design of components in the flight control system of Boeing Model 737 series airplanes. These proposed rules are based on recommendations coming from a team that was formed by the FAA in October 1994 to conduct a "Critical Design Review (CDR)" of the flight control systems installed on Boeing Model 737 series airplanes.

That nine-member "CDR Team" was composed of engineers and airworthiness inspectors from the FAA, the U.S. Air Force, Transport Canada, and the National Transportation Safety Board (NTSB). The formation of the CDR Team was prompted by questions that arose following:

- a 1993 accident near Colorado Springs, Colorado, involving a Model 737-200; and
- a 1994 accident near Pittsburgh, Pennsylvania, involving a Model 737-300.

(The CDR Team's review was performed independent of the official NTSB investigation of these accidents. The cause of the both accidents have not been determined.)

As part of its work, the CDR Team:

- analyzed conclusions from previous reviews and analyses of the design of the flight control systems on Model 737 series airplanes;
- experimented with new and used flight control system components;
- studied Boeing flight simulator scenarios and conducted extensive simulator exercises;
- interviewed component manufacturers and flight control experts, such as Parker, Honeywell, Douglas Aircraft, and Transport Airplane Directorate; and
- visited and conducted informal inspections of component repair stations.

After five months, the Team completed its review in May 1995. The Team concluded that the aircraft met all certification requirements. The team identified no specific control system scenario that could explain either accident.

The Team did come up with 26 recommendations or action points aimed at addressing design, maintenance, operations, and crew training issues for the 737 fleet. Of the 26 recommendations, at least nine address various changes to the design of the flight control systems of these airplanes, as well as correction of any design deficiencies. The 9 proposed AD's issued by the FAA address these recommendations of the CDR Team.

The table below provides more detailed information concerning each of the proposed AD's. The proposals were published in the **Federal Register** on August 29, 1996. The FAA will accept public comments on the proposals through October 24, 1996.

The following tables contain the proposed AD's based on the Boeing Model 737 Critical Design Review:

| Docket Number | CDR Team Recommendation | Cause / Unsafe Condition | Corrective Action | Models and Number affected |
|---|---|---|---|---|
| 96-NM-145-AD | ***RECOMMENDATION #25***: The Seattle Aircraft Certification Office (ACO) to determine the degree of incorporation of [Boeing Service Bulletin 27,1033, dated February 13, 1970] in the B737 fleet; reassess its safety impact; and, as appropriate, require its incorporation on applicable models of the B737. | ***Cause***: Mechanical interference can occur within the aileron (lateral) transfer mechanism, and can result in one of the two control wheels jamming. When one control wheel jams, the movement of the other one may be limited. Also, the flight crew may need to use above-normal force on the control wheel to override the jam.<br>***Unsafe Condition***: This condition could result in an unexpected, control upset if the flightcrew does not respond rapidly enough to override the jam, and if the airplane is already banked or at a low altitude. | ***Within 18 months***: Replace or rework the aileron control transfer mechanism. | 737-100<br>737-200<br>Worldwide: 236<br>U.S. Fleet: 157 |
| 96-NM-146-AD | ***RECOMMENDATION #26***: The Seattle ACO, in conjunction with Flight Standards, to determine the degree of incorporation of [Boeing Service Letter 737-SL-27-71-A, dated June 19, 1992] in the B737 fleet; reassess its safety impact; and, as appropriate, require its incorporation on applicable models of the B737. | ***Cause***: The filter screen of flow restrictor filter screen can deteriorate and fragments from it can partially jam the aileron/ elevator power control unit (PCU).<br>***Unsafe Condition***: This jamming can cause reduced pitch or roll capability of the airplane. | ***Within 18 months***: Replace flow restrictors of the aileron and power control unit (PCU) with improved units that have improved screens. | 737's equipped with specific aileron or elevator PCU<br>Worldwide: 244<br>U.S. Fleet: 146 |
| 96-NM-147-AD | ***RECOMMENDATION #15***: The Seattle ACO to require appropriate action be taken to correct the galling condition of the standby rudder on the B737. | ***Cause***: Corrosion has been found on the outside and on the inside passages of both the servo valve and bypass valve sleeves of the stand-by PCU. Also, galling has occurred between the stand-by PCU input shaft and the associated bearing.<br>***Unsafe Condition***: These conditions can cause an uncommanded rudder movement or lock the rudder in a commanded position. | ***Each 3,000 flight hrs.***: Conduct operational tests of the stand-by rudder PCU, and correct any discrepancy. Conduct inspections for galling on the shaft and bearing of the standby PCU; and replace the PCU actuator if galling is found. | 737-100<br>737-200<br>737-300<br>737-400<br>737-500<br>Worldwide: 2,830<br>U.S. Fleet: 1,037 |
| 96-NM-148-AD | ***RECOMMENDATION #25***: The Seattle ACO to determine the degree of incorporation of [Boeing Service Bulletin 737-27-1154, dated August 25, 1988] in the B737 fleet; reassess its safety impact; and, as appropriate, require its incorporation on applicable models of the B737. | ***Cause***: Incorrectly installed aileron control cable pulley brackets have experienced fatigue. This could lead to cracking or fracture of the pulley brackets.<br>***Unsafe Condition***: Failure of the pulley brackets can result in slack in the cables and reduced ability of the flight crew to control the airplane laterally. | ***Within 18 months***: Conduct an inspection for fatigue cracks in base trim and upper flange over-trim of pulley brackets of aileron control cables. Replace any cracked or over-trim item. | 737-300<br>Worldwide: 262<br>U.S. Fleet: 169 |

| Docket Number | CDR Team Recommendation | Cause / Unsafe Condition | Corrective Action | Models and Number affected |
|---|---|---|---|---|
| 96-NM-149-AD | ***RECOMMENDATION #10***: The Seattle ACO to determine the requirement for and the feasibility of incorporating additional means to protect the components in the main wheel well of the B737 from the effects of environmental debris. | ***Cause***: High pressure washing in the wheel well can lead to corrosion in systems and components in the in the hydraulic system located in the main wheel well.<br><br>***Unsafe Condition***: Corrosion of these components or equipment can result in reduced controllability of the airplane. | ***Within 90 days***: Revise the maintenance program to prohibit high pressure washing of wheel well and main landing gear. | 737-100<br>737-200<br>737-300<br>737-400<br>737-500<br><br>Worldwide: 2,643<br>U.S. Fleet: 1,040 |
| 96-NM-150-AD | ***RECOMMENDATION #26***: The Seattle ACO, in conjunction with Flight Standards, to determine the degree of incorporation of [Boeing Service Letter 737-SL-27-30, dated April 1, 1985] in the B737 fleet; reassess its safety impact; and, as appropriate, require its incorporation on applicable models of the B737. | ***Cause***: Separation of the chrome plating from the side of the manifold cylinder bore located in the PCU has been reported. The separated plating fragments can partially jam the valves in the rudder PCU.<br><br>***Unsafe Condition***: This jamming could result in reduced movement of the aileron, elevator, and/or rudder, and lead to reduced controllability of the airplane. | ***Within 18 months***: Inspect the aileron/ elevator PCU and rudder PCU for manifold cylinder bores containing chrome plating. Replace those cylinder bores with reworked bores. | 737-100<br>737-200<br>737-300<br>737-400<br>737-500<br><br>Worldwide: 2,675<br>U.S. Fleet: 1,091 |
| 96-NM-151-AD | ***RECOMMENDATION #12***: The Seattle ACO to require failure analysis of the B737 yaw damper . . . and any relevant tests be conducted to identify all failure modes, malfunctions, and potential jam conditions of these elements. *AND*<br><br>***RECOMMENDATION #13***: To require corrective action(s) for those failure modes or malfunctions not shown to be extremely improbable. | ***Cause***: Reports of uncom-manded yawing have been attributed to (1) failure of the yaw damper coupler due to wear of its rotor bearing; and (2) corrosion in the electrical coils of the "engage" (solenoid) valve of the yaw damper.<br><br>***Unsafe Condition***: A sudden uncommanded yawing movement of the airplane can cause injury to passengers and crewmembers. | ***Within 3,000 flight hours***: Initiate repetitive tests to verify the integrity of the yaw damper; and correct any discrepancy.<br><br>***Within 18 months***: Replace certain engage solenoids with improved solenoids that are not susceptible to corrosion. | 737-100<br>737-200<br>737-300<br>737-400<br>737-500<br><br>Worldwide: 2,675<br>U.S. Fleet: 1,091 |
| 96-NM-152-AD | ***RECOMMENDATION #11:*** The Seattle ACO to ensure the incorporation of wheels based on TSO-C26 Rev C or later revision. | ***Cause***: Failure of the wheel flange can result in metallic debris hitting critical flight control elements in proximity to the wheel.<br><br>***Unsafe Condition***: This could result in hydraulic failure, flight control jamming, and/or electrical power loss on the airplane. | ***Within 180 days***: Replace certain outboard and inboard wheel halves with improved halves. | 737-100<br>737-200<br><br>Worldwide: 634<br>U.S. Fleet: 241 |
| 96-NM-153-AD | ***RECOMMENDATION #25***: The Seattle ACO to determine the degree of incorporation of [Boeing Service Bulletin 737-27-1155, dated October 26, 1989] in the B737 fleet; reassess its safety impact; and, as appropriate, require its incorporation on applicable models of the B737. | ***Cause***: Springs in certain aileron centering units have fractured due to fatigue. Broken spring parts can become lodged in the centering cam weight reduction hole when the aileron control wheel is turned.<br><br>***Unsafe Condition***: This can result in jamming of the aileron control wheel and consequent reduced lateral control of the airplane. | ***Within 18 months***: Modify the aileron center spring and trim mechanism by installing improved springs and other components. | Any 737 equipped with certain spring/trim mechanism<br><br>Worldwide: 1,631<br>U.S. Fleet: 830 |

# Current Advisory Circular Projects

The Transport Airplane Directorate currently is developing several Advisory Circulars (AC) that will be available to the public at a later date. The following projects are underway:

### *Airplane Flight Manual*

Description: This document defines the information required to be included in an airplane flight manual by the applicable airworthiness regulations, and provides current guidance as to both the form and content of the approved and unapproved portions of an AFM.

Status: This AC was published in the **Federal Register** for public comment on April 15, 1992. The project has been subsequently revised to more fully harmonize with Joint Airworthiness Authorities (JAA). This project is temporarily on hold until other related issues are resolved.

Related Rule: Section 25.1581 of the Federal Aviation Regulations (FAR)

### *Revision of AC 25-7, Flight Test Guide for Certification of Transport Category Airplanes*

Description: The objective of this project is to update the guidance in FAA Order 8110.8, "Engineering Flight Test Guide," and incorporate that guidance into an advisory circular. The first portion of this project was completed when Subpart B (Flight) was updated and issued as Advisory Circular 25-7 on April 9, 1986. The current portion of this project includes a review of AC 25-7 to address harmonization of the FAR/JAR. Ultimately, all remaining Part 25 guidance from Order 8110.8 will be updated and incorporated into AC 25-7, at which time Order 8110.8 will be canceled.

Status: Draft revision of the AC was published in the **Federal Register** on April 3, 1996; the period for public comment closed September 30, 1996.

Related Rule: Various sections of Part 25 of the FAR.

### *Operations Without Normal Electrical Power*

Description: This AC sets forth three specific methods of compliance with the requirements pertaining to electrical power sources and distribution systems required to power instrument displays, systems, equipment, or parts of the airplane which are required for safety of flight during IMC operations.

Status: The draft AC is being reworked as a result of comments received from coordination within the FAA. A redraft is expected by late 1996, and will be followed by re-coordination within the FAA.

Related Rules: Sections 25.1309, 25.1333, and 25.1351 of the FAR.

### *Revision of AC 25.571-1A, Damage-Tolerance and Fatigue Evaluation of Structure.*

Description: This revised AC provides clarification of the damage tolerance assessment for the operational life of an airplane type that exceeds the original design life.

Status: The AC was published for public comment on November 19, 1993; the comment period closed January 14, 1994. The revised AC currently is in final coordination within the FAA, along with related rule project, and is expected to be published in the **Federal Register** by December 1996.

Related Rule: Section 25.571 of the FAR.

### *High Altitude Takeoff Approval for Turbojet Powered Transport Airplanes*

Description: This AC provides guidance for the certification of takeoff power at high altitudes for turbojet and turbofan powered airplanes. It consolidates FAA guidance concerning this subject and serves as a ready reference for those involved with transport category airplane type certification and operation. Guidance is included concerning the evaluation of power management techniques, thrust lapse rates, engine limits compliance, and altitude extrapolation limits.

Status: A draft AC is in coordination within the FAA. It is expected to be published in the **Federal Register** by December 1996, at which time public comments will be accepted.

Related Rules: Section 21.101 and 25.105, 25.111, 25.939, and 25.1521 of the FAR

### *Flammable Fluid Drainage*

Description: This AC provides guidance for demonstrating compliance with FAR section 25.1187, "Flammable Fluid Drainage."

Status: A notice requesting public comments on the draft AC was published in the **Federal Register** on July 25, 1995. The period for public comment closed on November 22, 1995. The team developing this project is reviewing the comments received.

Related Rules: Section 25.1187 of the FAR.

### *Transport Category Airplane Electronic Display Systems*

Description: A project has been initiated to revise AC 25-11, "Transport Category Airplane Electronic Display Systems," to address known deficiencies and correct errors.

Status: A draft AC is in its initial drafting stage.

Related Rules: Pertinent sections of Part 25 of the FAR.

### *Airworthiness Criteria for the Approval of Airborne Windshear Detection and Avoidance Systems in Transport Category Airplanes*

Description: A project is underway to develop an AC that provides guidance for the airworthiness approval of airborne windshear short and long-range detection and avoidance systems in transport category airplanes.

Status: The draft AC is in its initial drafting stage.

Related Rules: Pertinent sections of Part 25 of the FAR

The FAA also is in the process of considering various projects to initiate. Some of these are:

### *Revision of AC 20-57A, Automatic Landing Systems*

Description: This project would update existing AC 20-57A, "Automatic Landing Systems." The existing AC was written for and based on airplanes using ILS guidance for final approach and landing; however, this information is no longer appropriate for new systems. This revision to AC 20-57A would include additional guidance concerning localizer/glideslope characteristics, windshear modeling, irregular terrain, and threshold crossing height.

Related Rules: Various sections of the FAR.

### *Contaminated Runway Accountability*

Description: This project would update AC 91-6B "Water, Slush, Snow and Ice on the Runway," which was issued on May 24, 1978. The updated version would include guidance on takeoff, landing, and reduced braking friction, as well as water/slush drag forces.

Related Rules: Sections 25.107, 25.109, 25.125, 25.1581, 91.37, 121.189, 121.195, 121.197, 135.379, 135.385, and 135.387 of the FAR.

### *Engine Restart Demonstration*

Description: This project would develop an AC that would provide guidance for demonstrating compliance with a proposed rule to require improved engine inflight restarting capability within the airplane operating envelope.

Related Rules: Section 25.903 of the FAR.

### *Design Guidance for Turbojet and Turbine Engine Rotor Unbalance*

Description: This project would develop an AC that provides guidance on installation and operation of turbojet and turbofan airborne vibration monitors (AVM) for transport category airplanes.

Related Rules: Section 25.901, 25.903, 25.1301, 25.1305, 25.1309, and 33.29 of the FAR.

### *Revision of AC 25.1329-1A, Automatic Pilot Systems Approval*

Description: This project would revise AC 25.1329 to include guidance pertaining to autopilot features that can result in attitude changes at rates imperceptible to the flightcrew and thus remain undetected until the airplane reaches significant attitude deviations.

### *Certification of Transport Category Airplane Propulsion Systems.*

Description: This project would develop an AC that would provide a consolidated source of advisory material associated with Part 25 of the FAR, Subpart E, Propulsion. Some of the topics to be included would be:

- Engine Nacelle Anti-icing Provisions
- Certification Methods for Full Authority Digital Electronic Engine Control Systems (FADEC)
- Automated Fuel Management Systems
- Engine Fire Extinguishing Concentration Testing

Related Rules: Part 25 of the FAR, Subpart E, Propulsion.

### *Airframe Handbook*

Description: This project would develop a consolidated source of advisory/policy material pertaining to the structural and flight control requirements of Subpart C, and portions of Subparts D and E of the FAR.

Related Rules: Part 25 of the FAR, Subparts C, D, and E.

### *Revision to AC 25-17, Transport Airplane Cabin Interiors Crashworthiness Handbook*

Description: This project would revise AC 25-17 to bring it up to date with the current regulatory amendments. This AC currently provides an acceptable certification method for demonstrating compliance with the crashworthiness requirements of part 25 of the FAR.

Related Rules: Pertinent sections of Part 25 of the FAR.

### *Mechanical Systems*

Description: This project would develop a consolidated source of advisory material associated with Subpart D (Design & Construction) and Subpart F (Equipment) of part 25 of the FAR, for those areas related to mechanical systems.

### *Electrical Systems*

Description: This project would develop a consolidated source of advisory material associated with Subpart F (Equipment) of part 25 of the FAR, for the area related to electrical systems.

❖

*Rulemaking*

# Recently Issued FAA Rulemaking

## Amendment 25-87, " Standards for Approval for High Altitude Operation of Subsonic Transport Airplanes"

- Issued May 29, 1996; published in the **Federal Register** on June 5, 1996.
- This amendment to the FAR specifies airplane and equipment airworthiness standards for subsonic transport airplanes to be operated up to an altitude of 51,000 feet. This action is prompted by an increase in the number of applications received to raise the maximum certificated operating altitude for transport category airplanes, and is intended to ensure an acceptable level of safety for airplanes operated at high altitudes.

The following list represents proposed rulemaking that has been published for public comment:

## Notice 95-17, "1-g Stall Speed as the Basis for Compliance with Part 25 of the Federal Aviation Regulations,"

- Issued November 19, 1995; published in the **Federal Register** on January 18, 1996.
- Period for public comment closed May 17, 1996.

- This notice proposes to amend the FAR to redefine the airplane referenced stalling speed as the 1-g stalling speed in lieu of the minimum stalling speed. The proposed changes would: (2) provide for a consistent, repeatable reference stalling speed; (2) ensure consistency and dependable maneuvering margins; (3) clarify the requirement for the use of 1-g stalling speeds in determining structural design speeds; (4) increase the head-on gust structural design requirement, and (5) provide for adjusted multiplying factors to maintain essentially equivalent requirements in areas where the use of minimum stalling speed has proven adequate. These changes are needed since the stalling characteristics of modern jet transports as determined by current methods can result in inconsistent reference stalling speeds. These changes would result in a higher level of safety where current methods have resulted in artificially low operating speeds.

- FAR Sections Affected: Sections 1.1, 1.2, 25.103, 25.107, 25.111, 25.119, 25.121, 25.125, 25.143, 25.145, 25.147, 25.149, 25.161, 25.175, 25.181, 25.201, 25.231, 25.233, 25.237, 25.331, 25.333, 25.335, 25.345, 25.349, 25.479, 25.481, 25.527, 25.531, 25.533, 25.535, 25.729, 25.735, 25.773, 25.1001, 25.1323, 25.1325, 25.1507, 25.1583, 25.1587, and App. C, Sec. 36.9, of Part 36.

## Notice 96-6, "Revision of Hydraulic Systems Airworthiness Standards to Harmonize with European Standards for Transport Category Airplanes"

- Issued June 26, 1996; published in the **Federal Register** on July 3, 1996.

- The period for public comment closed October 1, 1996.

- This notice proposes to amend the airworthiness standards for transport category airplanes to harmonize hydraulic systems design proposed for the European Joint Aviation Requirements (JAR). These proposals were developed in cooperation with the Joint Aviation Authorities (JAA) of Europe and the US and European aviation industry through the Aviation Rulemaking Advisory Committee (ARAC). These changes are intended to benefit the public interest by standardizing certain requirements, concepts, and procedures contained in the airworthiness standards without reducing but potentially enhancing the current level of safety.

## Notice 96-6, "Miscellaneous Cabin Safety Changes"

- Issued on July 16, 1996; published in the **Federal Register** on July 24, 1996.

- The period for public comment closes November 21, 1996.

- This notice proposes to revise the airworthiness standards for transport category airplanes relating to flight attendant assist space, flight attendant assist handles, door hold open features, outside viewing means, interior compartment doors and portable oxygen equipment. With one exception, these proposals are not the result of any specific incident or recommendation, but are part of the agency's continuing effort to upgrade the regulations to improve the overall level of safety in areas where the state-of-the-art and good design practice have indicated that such upgrades are warranted. These proposals would result in both new type design regulations as well as retroactive requirements implemented in the operative rules.

## Notice No. 96-10, "Braked Roll Conditions"

- Issued July 25, 1996; published in the **Federal Register** on August 5, 1996;

- The period for public comment closes on November 4, 1996.

- This notice proposes to amend the requirements for landing gear braking on transport category airplanes to require that the airplane be designed to withstand main landing gear maximum braking forces during ground operations. This action would ensure that the landing gear and fuselage are capable of withstanding the dynamic loads associated with the maximum dynamic braking condition, and would also relieve a burden on industry by eliminating differences between the FAR and the JAR.

The Transport Airplane Directorate currently has the following rulemaking projects underway:

## Fuel System Crash Resistance

Purpose: This project involves developing a notice that proposes new requirements for improved fuel system crash resistance. The current standards would be amended to require: (1) a means to isolate fuel tanks within the fuselage; (2) a means to shut off the fuel supply to the engine during normal and emergency shutdown procedures; (3) improved fuel line impact resistance; and (4) location of fuselage mounted fuel tanks in protected locations.

Status: An initial draft of the notice is in the early stages of coordination within the FAA. It is expected to be published in the Federal Register around December 1996.

FAR Sections Affected: Section 25.963, 25.993, and 25.1189

## Protective Breathing Equipment

Purpose: This project involves developing a notice that proposes to revise the standards for protective breathing equipment (PBE) to be used for crewmembers in transport category airplanes. Protective breathing equipment would be required to be installed at each flight crewmember work station, and portable PBE would be required for each crewmember that might be required to fight an in-flight fire. This action is prompted by reports of crewmembers being unable to see to operate the airplane, or to have adequate protection to fight fires effectively, and is intended to ensure the adequacy of PBE in all environments that may be encountered.

Status: This FAA project has been canceled, and the Aviation Rulemaking Advisory Committee (ARAC) has been asked to take it on.

FAR Section Affected: Section 25.733.

## Improved Standards for Determining Rejected Takeoff and Landing Performance

Purpose: This project involves developing amendments to the FAR, applicable to transport category airplanes, that provide revised standards for determining the runway length that must be available for takeoff and landing. The current standards will be revised to: (1) revise the method of accounting for pilot reaction time in determining the runway length that must be available for the pilot to reject a takeoff; (2) account for the effect of wet runways on takeoff performance; and (3) account for the reduced capability of worn brakes on takeoff and landing performance.

Status: A draft document is in its early stages of final coordination within the FAA. It is expected to be published as a final rule by December 1996.

FAR Sections Affected: Section 1.1, 1.2, 25.101, 25.105, 25.109, 25.113, 25.115, 25.735, 25.1587, 121.189, and 135.379.

## Low Fuel Quantity Indicators

Purpose: This project involves developing an amendment to require new transport category airplane designs to incorporate an alert to the flightcrew of potentially unsafe low fuel quantities. This action is the result of a review of fuel depletion incidents involving loss of power or thrust on all engines that could have resulted in forced landings and injury or loss of life. Most of these incidents resulted from improper fuel management. This amendment is intended to increase airplane safety by providing an alert to the flightcrew that would allow either correction of certain fuel management errors or the opportunity to make a safe landing prior to engine fuel starvation.

Status: This project was previously issued as a notice, and public comments have been received. The final rule is expected to be published by March 1997.

FAR Section Affected: Section 25.1305

## Loss of Engine Cowling

Purpose: This project involves developing an amendment to the airworthiness standards for transport category airplanes that adds improved design standards for the retention of engine cowling and nacelle skin. This amendment is the result of a review of a number of incidents of in-flight loss of engine cowling or nacelle skin and is intended to enhance airplane safety by ensuring retention of engine cowling and nacelle skin.

Status: A document is in its initial drafting stage.

FAR Section Affected: Section25.1193.

## Type and Number of Passenger Emergency Exits

Purpose: This project involves developing a notice that proposes to revise the current requirements for the passenger emergency exits of transport category airplanes and to adopt two new exit types into the regulations. These proposals are intended to provide more consistent standards with respect to the passenger seating allowed for each exit type and the type and number of exits required for passenger seating configurations. This notice also proposes to reduce the maximum inflation time of an escape slide to reflect the current state-of-the-art.

Status: The notice is awaiting approval by the Office of the Secretary of Transportation.

FAR Sections Affected: Sections 25.783, 25.785, 25.803, 25.807, 25.809, 25.811, 25.812, and 25.813.

## Fatigue Evaluation of Structure

Purpose: This project involves developing an amendment to the fatigue requirements for damage-tolerant structure on transport category airplanes to require: (1) full-scale fatigue testing, and (2) inspection thresholds based on crack growth from likely initial manufacturing defects in the structure. These changes are needed to ensure continued airworthiness of structures designed to the current damage tolerance requirements. They are intended to ensure that should serious fatigue damage occur within the operational life of the airplane, the remaining structure can withstand loads that are likely to occur, without failure, until the damage is detected.

Status: The rule is in its final stages of coordination within the FAA. It is expected to be published in the Federal Register by December 1996.

FAR Section Affected: FAR 25.571.

## Revised Seat Safety Standards

Purpose: This project involves developing a notice that proposes to amend the seat dynamic test requirements for transport category airplanes to relieve the requirement to test crew seats in the cockpit with floor warpage, and to require that seat leg reaction loads be recorded during the dynamic tests. This proposed change is needed to accommodate the unique design features of crew seats when testing to the new dynamic emergency landing conditions. The seat leg reaction loads developed during the dynamic tests are needed to ensure adequate floor strength to support the seat loads.

Status: The notice is in its initial drafting stage.

FAR Section Affected: Section 25.562.

## Revised Access to Type III Exits

Purpose: This project involves developing amendments to the FAR to adjust the requirements for access to Type III emergency exits (typically smaller over-wing exits) in transport category airplanes with 60 or more passenger seats. These adjustments reflect additional data derived from a series of tests conducted at the FAA's Civil Aeromedical Institute (CAMI) subsequent to the adoption of these requirements and are intended to relieve an unnecessary economic burden. The amendments would affect air carriers and commercial operators of transport category airplanes, as well as the manufacturers of such airplanes.

Status: This project was previously issued as a notice, and public comments have been received. The final rule currently is under review within the FAA. It is expected to be published in the **Federal Register** by December 1996.

FAR Sections Affected: 25.813(c)(2)(i), and 121.310(f)(3)(iii)

## Cabin Safety Changes

Purpose: This project involves developing a notice proposing to amend Part 25 of the FAR to require an assist handle at all designated flight attendant assist spaces to enable attendants to steady themselves while helping passengers out the exit; to require a means to hold door-type emergency exits open when opening in an emergency; to require a viewing window or equivalent, to enable outside conditions to be viewed prior to opening an emergency exit, at each emergency exit; to specify that 12" X 20" area on the floor for flight attendant assist space; and to prohibit the installation of an interior door between a passenger and an emergency exit.

Status: The notice currently is in coordination within the FAA.

FAR Sections Affected: Section 25.809, 25.813, 25.1447, 121.310, and 121.333.

### Fuel System Vent Fire Protection

Purpose: This project involves developing an amendment to the airworthiness standards for transport category airplanes that will require fuel vent system protection during post-crash ground fires. This action is the result of information obtained from public hearings on aircraft fire safety and recommendations by the Special Aviation Fire and Explosion Reduction (SAFER) Advisory Committee, and is intended to provide protection against a fuel tank explosion following a post-crash ground fire. This amendment would apply to air carriers, air taxi operators, and commercial operators of transport category airplanes, as well as the manufacturers of such airplanes.

Status: This project was previously issued as a notice, and public comments have been received. The final rule for this project is currently being drafted.

FAR Sections Affected: 25.975, 121.316, 125.214, 135.187

Review of FAA Standard for Maximum Allowable Carbon Dioxide Concentration in the Crew and Passenger Compartments.

Purpose: This project involves developing an amendment to revise the standards for maximum allowable carbon dioxide ($CO_2$) concentration by reducing the allowable maximum concentration from 3 percent to 0.5 percent in occupied areas of transport category airplanes. This action is in response to a recommendation from the National Academy of Sciences to review the $CO_2$ limit in

*Continued on page 55*

*Rulemaking*

# Aviation Rulemaking Advisory Committees (ARAC): Update of Activities

airplane cabins, and would provide a cabin $CO_2$

The Aviation Rulemaking Advisory Committees (ARAC) are formal standing committees, comprised of representatives from aviation associations and industry. Established by the FAA Administrator in 1991, ARAC provides industry input in the form of information, advice, and recommendations to be considered in the full range of FAA rulemaking activities. (This is a regular feature of the ***Update***.)

## *Flight Test Working Group*

*Working Group Chair:* **Jerry Zanatta**, Boeing

**Task 1** - *AIA/AECMA Petition for Rulemaking:* Make a recommendation to the ARAC Transport Airplane and Engine Interest Group concerning the disposition of the joint Aerospace Industries Association of America, Inc. (AIA), and Association Europenne des Constructeurs de Material Aerospatial (AECMA) petition for rulemaking dated May 22, 1990. More specifically, these issues relate to harmonization of the strength of pilots table of maximum control forces and associated advisory material; harmonization of FAR/Joint Airworthiness Regulations (JAR) maneuverability requirements and associated material; and harmonization of the minimum control speed requirements of the FAR/JAR. [FAR sections 25.143(c), 25.143(f), 25.149, 25.201]

**Status:** *Amendment 25-84 to FAR part 25 was adopted June 2, 1995, and published in the **Federal Register** on June 9, 1995 (60 FR 30744). This task is considered to be completed.*

**Task 2** - *Gate Requirements for High Lift Devices:* Recommend to the ARAC simplified and clarified requirements related to gate positions on the control used by the pilot to select the position of an airplane's high lift devices.

**Status:** *A notice of proposed rulemaking and related advisory material are currently in the final stages of coordination within FAA headquarters; expect to publish in the Federal Register by December 1996.*

**Task 3** - *Flight Characteristics in Icing Conditions*: Recommend to the ARAC new or revised requirements and compliance methods related to airplane performance and handling characteristics in icing conditions.

**Status:** *The fifth meeting on this subject was held in July 1996. Further discussions were held relative to the intended application of the Subpart B and F rule changes proposed by the airworthiness authorities at the previous meeting. In particular, industry expressed concerns with the potential for broad interpretation of the proposed rules that could lead to significant increases in the expenditure of flight test resources. Current efforts are focusing on developing guidance material to define the intended application of the proposed regulations. The working group has targeted February 1997 for achieving technical consensus.*

## *Loads and Dynamics Harmonization Working Group*

*Working Group Chair:* **Vic Card**, Civil Aviation Authority (CAA), United Kingdom

**Task 1** - *General Design Loads*: Develop new or revised requirements and associated advisory and guidance material for the general design loads for transport category airplanes (FAR sections 25.331, 25.335, 25.341, 25.345, 25.351, 25.427, 25.483, 25.511, 25.561, 25.963, and other conforming changes).

**Status:** *A Notice of Proposed Rulemaking (NPRM) was issued on August 29, 1996, along with a notice of a related draft Advisory Circular (AC). The period for public comment on the notice closed November 27, 1995. The final amendment and AC currently are in coordination within the FAA.*

**Task 2** - *Engine Torque:* Develop new or revised requirements and associated advisory and guidance material for determining the design loads for engine seizure conditions (FAR section 25.361 and other conforming changes).

**Status**: *The Working Group is in the initial drafting stages of this recommendation.*

**Task 3** - *Flutter, Deformation, and Fail-Safe Criteria:* Develop new or revised advisory and guidance material for flutter, deformation, and fail-safe criteria (FAR section 25.629).

**Status:** *Initial coordination within the FAA has taken place. The Working Group has come to agreement on the changes to the Advisory Circular (AC). Upon incorporation of these changes, the AC will be forwarded for final FAA (legal) concurrence, then will be returned to the Working Group to forward to ARAC.*

**Task 4** - *Interaction of Systems/Structure:* Review existing special conditions for fly-by-wire airplanes and existing requirements for control systems, including automatic and/or power-operated systems, and recommend any new or revised general requirements needed for flight control systems and structures affected by those systems (FAR sections 25.302, 25.671, 25.1329, Part 25 Appendix K).

**Status:** *The Working Group is working to resolve an issue that has arisen concerning the desire of the industry and Joint Airworthiness Authorities (JAA) to include a relieving clause in the document that was not previously contained in the FAA Special Conditions on this subject.*

**Task 5** - *Continuous Turbulence Loads:* Review the requirement for the continuous turbulence standard in light of the ARAC proposal for a tuned discrete gust requirement in order to determine whether the continuous turbulence requirement should be revised or removed from the FAR/JAR for better consistency with the new proposed tuned discrete gust criteria [FAR section 25.305(d)].

**Status**: *The Working Group is in the initial drafting stages of this recommendation.*

**Task 6** - *Strength and Deformation:* Review the recent requirements adopted in the FAR by Amendment 25-77 (for the design of transport airplanes against buffet and forced structural vibrations) and consider appropriate changes for the JAR and FAR to harmonize these rules [FAR sections 25.305(e) and (f)].

**Status:** *No changes to the FAR are proposed. The JAR is to be amended.*

**Task 7** - *Design Flap Speeds:* Review the current flap design loads requirements to resolve differences in interpretation between the FAA and the JAA concerning the structural design stall speeds on which the flap design speeds are based. Review all aspects of the flap design load requirements, including the design airspeeds, vertical and head-on design gust criteria, and the effects of automatic retraction and load relief systems [FAR section 25.335(e)].

**Status**: *The Working Group has completed its review of the relevant issues, and no changes are proposed to the current FAR requirements. The 1g Structural Design Stall Speed will be referred for all new designs for both the FAR and JAR.*

**Task 8** - *Residual Strength Loads for Damage Tolerance:* Review the differences in residual strength design load requirements between the FAR and JAR and resolve differences to harmonize this rule. Prepare a Notice of Proposed Rulemaking (NPRM) or make recommendations to other ARAC efforts concerning FAR section 25.571, so that they can be included in rulemaking that may be forthcoming from those efforts [FAR section 25.571(b)].

**Status**: *The Loads and Dynamics Working Group has completed its review of relevant issues and forwarded its recommendations to the General Structure Working Group, which is considering the whole rule.*

**Task 9** - *Shock Absorption Tests:* Review the changes recently introduced into the JAR that have resulted in differences between the FAR and JAR in regard to the requirement for shock absorption tests. Review those changes in view of harmonizing the FAR and JAR {FAR section 25.723(a)].

**Status:** *The Working Group has submitted a draft NPRM and AC to ARAC.*

**Task 10** - *Rough Air Speed:* The ARAC has proposed a new section 25.1517 concerning rough air speed design standards in its proposal for a tuned discrete gust requirement. This action is harmonized with the current JAR 25.1517; however, further changes in the rough air speed requirement may be needed in both the FAR and JAR. Review JAR 25.1517 and the new proposed FAR 25.1517 to determine if further changes are needed [FAR section 25.1517)].

**Status**: *This project is in the early planning stage, and will progress along with the Continuous Turbulence Loads project (Task 5).*

**Task 11** - *Taxi, Takeoff, and Landing Roll:* Prepare an AC that establishes criteria that may be used to calculate rough runway and taxiway loads, as required by FAR sections 25.491, 25.235, and 25.305.

**Status**: *This project is in the early planning stage.*

**Task 12** - *Braked Roll Condition:* Review the provisions of section 25.493 of the FAR and JAR concerning the braked roll condition and finalize a harmonized NPRM.

**Status**: *Notice 96-10 was published in the Federal Register on August 5, 1996. The period for public comment closes on November 4, 1996.*

**Task 13** - *Engine Windmilling Imbalance Loads*: Define criteria for establishing the maximum level of engine imbalance that should be considered, taking into account fan blade failures and other likely causes of engine imbalance. Develop an acceptable methodology for determining the dynamic airframe loads and accelerations resulting from an imbalanced windmilling engine. Validate the proposed methodology with a demonstrative ground or flight test program (as deemed appropriate by ARAC) that has the objective of establishing confidence in the proposed methodology. [See **Federal Register** notice (61 FR 34922, July 3, 1996) for validation process.]

**Status**: *This project is in the early planning stage.*

## *Installation Harmonization Working Group*

*Working Group Chair:* **Bruce Honsberger,** Boeing

**Task 1** - *Installations (Engines)*: Develop recommendations concerning new or revised requirements for the installation of engines on transport category airplanes and determine the relationship, if any, of the requirements of FAR 25.1309 to these engine installations (FAR 25.901).

**Status**: *The Working Group's final recommendation of a proposed change to FAR 25.901(c) is pending completion of both the associated Advisory Circular (AC) (that is currently under development within this Working Group) and the related work on FAR 25.1309 tasked to the Systems Design and Analysis Harmonization Working Group.*

**Task 2** - *Windmilling Without Oil:* Determine the need for requirements for turbine engine windmilling without oil (FAR 25.903).

**Status**: *The Working Group is waiting completion of work by the Engine Harmonization Working Group. It is anticipated that no change will be needed in FAR part 25, and that the Joint Airworthiness Authorities (JAA) will delete JAR 25.901(e).*

**Task 3** - *Non-contained Failures:* Revise advisory material on non-contained engine failure requirements (FAR 25.903 and related provisions of FAR Parts 23, 27, 29, 33, and 35, as appropriate; AC 20-128). The Working Group should draw members for this task from the interests represented by the General Aviation and Business Airplane and Rotorcraft Interest Groups.

**Status**: *The Working Group has approved and forwarded to the FAA a revised AC for general aviation and transport category airplanes, and a separate AC for rotorcraft. The Part 23 and 25 guidance will be available in the last quarter of 1996. The Task Group is currently evaluating data for the purpose of generating a new AC that will include a revised engine debris model and provide additional guidance on subjects such as multiple fragment damage, fuel tank explosion, shielding of critical components, etc.*

**Task 4** - *Thrust Reversing Systems:* Develop recommendations concerning new or revised requirements and guidance material for turbojet engine thrust reversing systems (FAR 25.933).

**Status**: *The Task Group has developed a preliminary draft Notice of Proposed Rulemaking (NPRM) and JAA equivalent (NPA), and an AC and JAA equivalent (ACJ) proposal, which were presented to the Working Group for review.*

**Task 5** - *APU Installation Requirements*: Identify and harmonize Auxiliary Power Unit (APU) installation requirements {FAR 25.901(d)].

**Status**: *The Task Group has developed a preliminary draft of harmonized APU installation rules for transport category airplanes. It is planned that these proposed APU installation rules will eventually appear as a new Appendix K within FAR 25 and as a revised Subpart "J" within the JAR 25. The Task Group is currently drafting a NPRM and a JAA equivalent (NPA) proposal which will be presented to the Working Group for review.*

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## Seat Testing Harmonization Working Group

*Working Group Chair:* **Dean Klippert**, McDonnell Douglas Corporation

**Task**: Make recommendations to the ARAC Transport Airplane & Engine Interest Group concerning the requirements and guidance material for the certification of flightcrew seats and the associated test conditions (FAR 25.562; AC 25.562A).

**Status**: *Advisory Circular 25.562-1A was issued by the Transport Airplane Directorate on January 19, 1996. This Working Group action is considered closed.*

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## General Structures Harmonization Working Group

*Working Group Chair:* **Herb Lancaster**, Boeing

**Task 1** - *Bird Strike Damage:* Develop new or revised requirements for the evaluation of transport category airplane structure for in-flight collision with a bird, including the size of the bird and the location of the impact on the airplane (FAR sections 25.571, 25.631, and 25.775).

**Status:** *The Working Group has prepared a draft Notice of Proposed Rulemaking (NPRM). Initial FAA legal and inter-Directorate coordination has taken place. Alternatives are to be discussed at the next meeting of this Group.*

**Task 2** - *Safe Life Scatter Factor*: Develop recommendations for new or revised advisory and guidance material concerning the safe life scatter factors (FAR section 25.571).

**Status**: *The Working Group has developed a change to Advisory Circular (AC) 25.571-1A, "Damage-Tolerance and Fatigue Evaluation of Structure." This change addresses the evaluation of scatter factors for the determination of life for parts categorized as safe-life. The Working Group has completed this task, which is expected to be transmitted to the FAA soon for issuance and publication.*

**Task 3** - *Proof of Structure:* Review FAR section 25.307, corresponding paragraph 25.307 of the JAR, and supporting policy and guidance material, and recommend to the FAA appropriate revisions relative to the issue concerning limit load tests, ultimate load tests, and structural testing for harmonization, including advisory material (FAR section 25.307).

**Status**: *The Working Group is reviewing issues.*

**Task 4** - *Material Strength Properties and Design Values*: Review FAR section 25.613, corresponding paragraph 25.613 of the European JAR, and supporting policy and guidance material, and recommend to the FAA appropriate revisions for harmonization, including advisory material (FAR section 25.613).

**Status**: *The Working Group is reviewing issues.*

**Task 5** - *Damage Tolerance and Fatigue*: Review FAR section 25.571, and corresponding paragraph 571 of the JAR and supporting policy and guidance material and recommend to the FAA appropriate revisions for harmonization including advisory material (FAR section 25.571).

**Status**: *The Working Group is reviewing issues.*

**Task 6** - *Fuselage Doors*: Review the current standards of Section 25.783 and corresponding JAR 25.783 concerning doors and any related advisory material. Also review any relevant service experience, National Transportation Safety Board Recommendations A-89-092, A89-093, A89-094, and A92-21, and recommendations made by the Air Transport Association door review team. In light of this review, recommend changes to harmonize Section 25.783 and JAR 25.783; recommend harmonized standards; and develop related advisory material, as necessary.

**Status**: *The Working Group is reviewing issues.*

## Cargo Standards Harmonization Working Group

*Working Group Chair*: **Dean Klippert**, Douglas Aircraft

**Task** - Make recommendations to the ARAC Transport Airplane and Engine Interest Group concerning new or revised requirements for main deck Class B cargo compartments, a subject which has recently been coordinated between the FAA and JAA.

**Status**: *A Notice of Proposed Rulemaking has been drafted and has been coordinated within the FAA Directorates. The FAA representative on the Working Group is reviewing the internal comments received.*

## Direct View Harmonization Working Group

*Working Group Chair*: **Dean Klippert**, Douglas Aircraft

**Task** - Review the proposed guidance material contained in FAA draft Adivsory Circular 25.785 for finding compliance with the cabin attendant's direct view requirements of FAR section 25.785, and make recommendations to the ARAC Transport Airplane and Engine Interest Group for new or revised guidance (FAR section 25.785; AC 25.785).

**Status**: *ARAC has forwarded its recommendations to the FAA for action.*

## Hydraulic Test Harmonization Working Group

*Working Group Chair*: **Jim Draxler**, Boeing

**Task** - Make recommendations concerning new or revised requirements for hydraulic systems and the associated test conditions for hydraulic systems installed in transport category airplanes (FAR section 25.1435).

**Status**: *A Notice of Proposed Rulemaking and an Advisory Circular (AC) Notice of Availability were published in the* ***Federal Register*** *on July 3, 1996. The period for public comment closed on October 1, 1996.*

## *Systems Design and Analysis Harmonization Working Group*

*Working Group Chair*: **Ed Schroeder/Jean-Claude Boquet**

**Task 1** - Develop guidance material concerning the evaluation and control of certification maintenance requirements created to satisfy the requirements of FAR section 25.1309 for newly certificated transport category airplanes.

**Status**: *ARAC recommendation was forwarded to the FAA July 14, 1994; Advisory Circular (AC) 25-19 was issued by the FAA on November 28, 1994. This Working Group action is considered completed.*

**Task 2** (new) - *System Design & Analysis Harmonization and Technology Update.* Review Section 25.1309, JAR paragraph 25.1309, and associated AC 25.1309-1A, and Advisory Circulars Joint (ACJ) Numbers 1 through 8. In light of this review, recent experience in applying Section/paragraph 25.1309 of the FAR and JAR, and the implications of new technology, harmonize Section/paragraph 25.1309 and revise the associated guidance material in AC 25.1309-1A and ACJ's 1 through 8 as necessary. In addition to the general task of harmonizing the wording and application of Section/paragraph 25.1309, attention should be given to the airplane level of safety assessment, instructions for continued airworthiness of fault tolerant systems, use of operational factors in the safety assessment process, and acceptable methods for showing compliance with Section/paragraph 25.1309. Review wording and application of 25.1309 and revise if necessary such that non-safety related equipment, such as passenger entertainment devices, etc., are not required to meet their specifications for intended function.

**Status**: *The Working Group is reviewing issues.*

## *Airworthiness Assurance Working Group*

*Working Group Chair*: **Ron Wickens**, Federal Express

**Task 1** - *Structural Modifications*: Conduct periodic reviews of manufacturer service bulletins to determine whether new or revised structural modifications or inspections should be instituted and made mandatory as the airplane ages beyond its original design life goal. This review should cover the following airplanes: Airbus A-300, British Aerospace BAe 1-11, Boeing B-707, B-727, B-737, B-747, Douglas DC-8, DC-9/MD-80, DC-10, Fokker F-28, and Lockheed L-1011.

**Status**: *This action is considered completed.*

**Task 2** - *Corrosion:* Develop recommendations concerning whether new or revised requirements and compliance methods for corrosion prevention and control programs should be instituted and made mandatory for the Airbus Model A300, British Aerospace Model BAC 1-11, Boeing Models 707, 727, 737, and 747; McDonnell Douglas Models DC-8, DC-9, DC-9-80 series, and DC-10; Fokker Model F-28; and Lockheed Model L-1011.

**Status**: *Airworthiness Directive (AD) actions have been completed for all models. Action on this task is now considered completed by the Working Group.*

**Task 3** - *Repairs*: Develop recommendations concerning whether new or revised requirements and compliance methods for structural repair assessments of existing repairs should be instituted and made mandatory for the Airbus Model A300, British Aerospace Model BAC 1-11, Boeing Models 707, 727, 737, and 747; McDonnell Douglas Models DC-8, DC-9, DC-9-80 series, and DC-10; Fokker Model F-28; and Lockheed Model L-1011.

**Status**: *The FAA internal team recently completed its review of the draft Notice of Proposed Rulemaking that was prepared by the Working Group. An associated advisory circular is currently under review by the FAA internal team.*

**Task 4** - *Structural Fatigue Audit:* Develop recommendations on whether new or revised requirements for structural fatigue evaluation and corrective action should be instituted and made mandatory as the airplane ages past its original design life goal.

**Status**: *The Working Group's recommendation, in the form of a draft revision to Advisory Circular 91-56, "Structural Fatigue Evaluation for Aging Airplanes," was forwarded to the FAA on July 14, 1994. This document is currently under review within the FAA.*

**Task 5** - *Supplemental Structural Inspection Document*: Conduct a review of existing supplemental structural inspection programs to determine whether any new or revised requirements should be instituted and made mandatory as the airplane ages past its original design life goal. This review should cover the following airplanes: Airbus Model A300, British Aerospace Model BAC 1-11, Boeing Models 707, 727, 737, and 747; McDonnell Douglas Models DC-8, DC-9, DC-9-80 series, and DC-10; Fokker Model F-28; and Lockheed Model L-1011.

**Status**: *ARAC review of this issue is considered completed. Manufacturers are completing final documents.*

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## *Braking Systems Harmonization Working Group*

*Working Group Chair*: **Bob Amberg**, Boeing

**Task** - Recommend to the ARAC new or revised requirements for approval of brakes installed on transport category airplanes. The product of this exercise is intended to be a harmonized standard, acceptable to both the FAA and the JAA.

**Status**: *Preliminary drafts of a Technical Standard Order, Notice of Proposed Rulemaking, and Advisory Circular are under review by the Working Group.*

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## *Performance Standards Working Group*

*Working Group Chair*: **Jay Anema**, Boeing

**Task 1** - The Performance Standards Working Group is charged with making a recommendation to the ARAC Emergency Evacuation Interest Group concerning whether new or revised standards for emergency evacuation can and should be stated in terms of safety performance rather than as specific design requirements. Specifically, the working group should address the following issues as a minimum:

- Can standards stated in terms of safety performance replace, supplement, or be an alternative to any or all of the current combination of design and performance standards that now address emergency evacuation found in Parts 25 and 121 of the FAR.
- If a performance standard is recommended, how can the FAA evaluate a minor change to an approved configuration, or a new configuration that differs in either a minor or a major way from an approved configuration.

**Task 2** - The Performance Standards Working Group is charged with making a recommendation to the ARAC Emergency Evacuation Interest Group concerning new or revised emergency evacuation requirements and compliance methods that would eliminate or minimize the potential for injury to full scale demonstration participants.

**Status**: *The Working Group developed a Recommendation in response to Task 2. A Notice of Proposed Rulemaking, Notice No. 95-9, was published in the* ***Federal Register*** *on July 18, 1995. The period for public comment on the notice closed on October 16, 1995. The FAA representative on the Working Group is reviewing public comments that were submitted.*

*Additional information concerning ARAC activities can now be obtained through the Internet at (800) 322-2722 or (202) 267-5948. The information available features current ARAC information, including a full listing of all working groups, their leaders, their members, and their tasks. Also included is a calendar of ARAC meetings, and contact points for those who wish to become involved in the process. More information on the system is available by calling FAA's Washington D.C. headquarters at (202) 267-3345.*

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*From the Archives . . .*

# Mystery Photograph Exposed!

Many thanks to John Coles of Boeing Customer Services for uncovering the story behind the mystery photo (right) in the Spring 1996 edition of ***The Update***. John talked with Terry Samphire from Boeing's Customer Training organization, who helped provide the information we were seeking:

*"The scene took place in the early 1980's at the Maintenance Training Center in our previous South Park site. The three men in the picture are John Aldridge (on the floor), Bill Ahl, and Tom Burkholder (left and right, respectively, on the stand). The apparatus they are working on is the 767 Maintenance Training Simulator. The area where they are working is the fuel access panel just aft of the leading edge on the left wing; the box on which the larger pane is open represents the number 1 engine nacelle."*

(We also received a "mystery letter" whose anonymous author identified the person standing on the floor as "W. R. Savery, retired." Will the real person please stand up?)

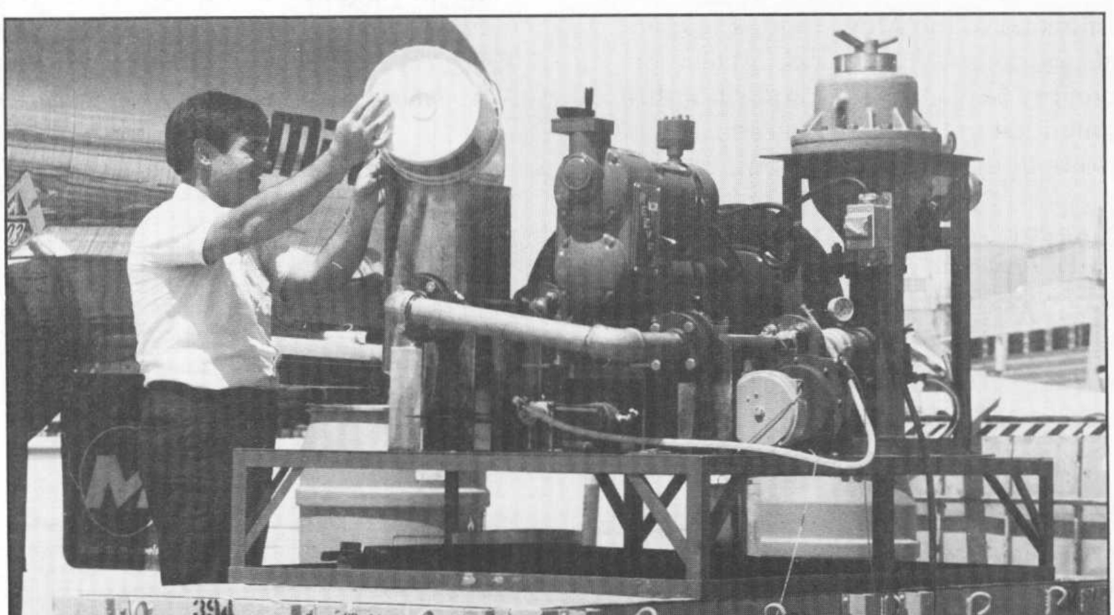
Well, if that was easy, here's another photo (below)` that we dug out of the archives. Again, we need your help in identifying:

- When and where the photo was taken;
- What that odd machine is called;
- Who the individual is; and
- What it is he is doing.

If you have any such information, we would appreciate if you would forward it to:

R. Jill DeMarco, Editor-in-Chief
Transport Airplane Directorate
1601 Lind Avenue SW., ANM-103
Renton, Washington 98055-4056

❖



***DOT fuel tests using leftovers from the FAA's cafeteria***

*Quality Technology*

# The Four Most Common Causes of ISO 9001 Audit Failure

Based on data from ISO Headquarters in Geneva, Switzerland, and reported data from ISO Registrars in Europe and North America, the following is a list of the four most common causes for failing an ISO 9001 Audit (in order of declining occurrence):

1. **DOCUMENT CONTROL.** This is the source for 20% of audit failures. It has three major causes:

- Documentation for a specific decisionmaking/implementation process is nonexistent.
- Documentation is outdated and not available at the relevant employee locations.
- Procedures and manuals not actually followed at all times.

2. **DESIGN CONTROL.** This is the source for 12% of audit failures. Three common causes are:

- Little or no documentation for the engineering calculations and design assumptions ("back of the envelope engineering" or "it's all in my head" syndromes)
- Outdated versions of engineering drawings are not reliably eliminated from circulation.
- No adequate proof as to when certain product modifications and improvements took place.

3. **PURCHASING.** This is the source for 10% of the audit failures. Three significant reasons are:

- Insufficient documentation regarding the criteria to be used in the purchasing process and adherence to them.
- Insufficient validation that the criteria used actually correlates to the technical and quality requirements and specifications.
- Insufficient data regarding the ability (and track record) of vendors and subcontractors to meet contractual requirements. In other words lack of a vendor qualification program.

4. **INSPECTION AND TESTING.** This is the source for 10% of the audit failures. Causes include:

- Insufficient documentation that no incoming product was released before it was inspected or verified as to conformity.
- Insufficient documentation as to the inspection criteria to be utilized.

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*Meetings*

## Standardization Workshop: Transport Airplane Passenger to Cargo Conversions

The FAA is sponsoring a technical workshop to discuss issues concerning converting transport airplanes form passenger to cargo configurations. The workshop is intended mainly for Designated Engineering Representatives (DER) and Designated Alteration Station (DAS) engineers.

**LOCATION**: FAA Southern Regional Headquarters Auditorium, Atlanta, Georgia

**DATES**: Tuesday, Nov. 19, through Friday, Nov. 22, 1996

Various FAA technical experts will be speaking at the workshop on topics such as:

- DER/DAS Engineer Standardization
- Regulations and Procedures Covering Changes to Type Design
- Cargo Conversion Design
- Airframe Compliance (Methodology, Analysis, Testing, Validation)
- FAR 25.1309: System Safety Assessment (Reliability Studies plus Safety Analysis)
- Crashworthiness
- Noise
- Project Description
- Continued Airworthiness
- Job Aid Application

For more information on this workshop contact:

**Gerry Lakin, FAA Focal Point**
**Standardization Branch, ANM-113**
**Transport Airplane Directorate**
**1601 Lind Avenue SW**
**Renton, Washington 98055-4056**
*Telephone: (206) 227-1187*
*Fax: (206) 227-1149*
*E-mail: Gerald.Lakin@faa.dot.gov*

❖

*Meetings*

# Public Meeting: Jammed Flight Control Systems, FAR 25.671(c)(3)

The FAA is sponsoring a meeting to solicit and review information from the public on the criteria used in showing compliance with Section 25.671(c)(3) of the Federal Aviation Regulations (FAR), relative to jammed flight control systems. Interested parties are invited to make presentations or submit material for the record.

The public meeting is scheduled for:

**Tuesday, December 3, 1996**
**Holiday Inn Sea-Tac International Airport**
**17338 International Boulevard**
**Seattle, Washington 98199**

**Purpose of Meeting**: This meeting is intended as a forum to hear comments from the general public regarding criteria to be used in showing compliance with the requirements of Section 25.671(c)(3) relative to the flight control jams in the "normally encountered" position. The FAA is inviting the interested public to participate in developing standardized methods to be used in showing compliance with this requirement. The FAA will consider information presented at the public meeting in the course of developing future advisory material on this subject.

In addition, the public is invited to discuss the National Transportation Safety Board (NTSB) Recommendation A-96-108, which recommends that FAR 25.671 be revised to account for failure or jamming of any flight control surface at its design-limited deflection. The FAA will consider any public comments on this recommendation in developing its response to the NTSB.

**To attend**: Persons planning to attend the public meeting may pre-register by contacting:

**Iven Connally, Transport Standards Staff**
**FAA, Transport Airplane Directorate**
**1601 Lind Avenue SW**
**Renton, Washington 98055-4056**
**telephone (206) 227-2120; fax (206) 227-1100**

On-site registration will begin at 7:30 a.m. on December 3, 1996; the public meeting will begin at 8:30 a.m. Hotel reservations should be made in advance by calling the Holiday Inn at (206) 248-1000, or fax (206) 242-7089. A block of rooms has been reserved at the hotel; the room rate is $74 plus tax. Persons wishing to attend the public meeting are encouraged to make reservations by November 15, 1996. (To receive the special room rate, when making reservations, identify yourself as an attendee of the "FAA public meeting on jammed flight controls.")

Additional details concerning the meeting and the proposed policy/criteria can be found the **Federal Register** of October 28, 1996 (61 FR 55682). ❖

*For Your Information*

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The New Boeing Model 777

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## Artificial Intelligence

*Continued from page 12*

research the procedure than to attempt development based on vague specifications.

With currently available technology, expert systems perform better as assistants or advisors than as primary decision makers. Humans will always have the advantage over expert systems because they have the power of human sensory pattern recognition and flexibility. AI systems will not be capable of replacing humans in most applications, and will be used mainly to augment the capabilities of the user.

AI technology is not efficient at solving all types of problems, but it can assist in managing problem complexity for a number of applications. Although there are still issues that must be addressed before AI systems are fielded in critical applications of airborne avionics, AI-based systems for commercial aircraft ultimately can offer economic advantages and contribute to flight safety.

### For More Information

Technical Report DOT/FAA/CT-94/41 provides detailed guidance in design considerations for aircraft AI applications in avionics, flight management, navigation, decision support, and monitoring and diagnostic systems. It also provides guidelines pertinent to certification of AI applications in:

- AI standards,
- Conventional software verification and validation
- Expert system software verification and validation.

This report is available to the public through the National Technical Information Service, Springfield, Virginia 22161.❖

## Global Positioning

*Continued from page 21*

Primary-means is differentiated from sole-means by the planning aspect; a primary-means system meets requirements most of the time, but flight must be planned around periods of unavailability.

Supplemental-means is differentiated from primary-means by the need to have a sole-means system on board for back-up. This recognizes the fact that supplemental systems have lower availability than primary means, a shortcoming that cannot be addressed by planning alone. ❖

## Time Rollover

*Continued from page 23*

Global Positioning System receiver) will be usable for many years to come, as long as they are re-initialized just after each rollover to reset their internal time reference to the correct date. The position accuracy of this type of equipment will not be affected by these rollover events and can remain at full accuracy without the need for any re-initializations whatsoever.

### References

[1] *Global Positioning System Standard Positioning Service Signal Specification* 2nd Edition, US Defense Department Publication available on the US Coast Guard GPS Internet site, http://www.navcen.uscg.mil/gps/reports/ sigspec/sigspec.htm , June 2, 1995

[2] *GPS World Showcase*, Vol. 7, Number 8, Page 6, Advanstar Communications, Cleveland

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## Structural Design Data

*Continued from page 27*

manfacturer are essential in correctly assessing the acceptability of previously approved data for a modification project. Therefore, the DER should consult with the aircraft certification office having certificate responsibility over the original manufacturer in the assessment of the acceptability of previously approved data. In addition, the certification offices should make a sincere effort to assist each other in the assessment of the validity and acceptability of the previously approved data. ❖

## FAA Rulemaking

*Continued from page 45*

concentration equivalent to that recommended for buildings.

Status: This project was previously issued as a notice, and public comments have been received. The final rule is currently under review within the FAA; it is expected to be published by December 1996.

FAR Section Affected: Section 25.831

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Certification Information for
the Aviation Industry and Designees

Transport Certification

# Update

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*The purpose of the Transport Certification Update is to provide the aviation community-at-large and designees with the latest information concerning regulations, guidance material, policy and procedure changes, and personnel activites involving the certification work accomplished within the FAA Transport Airplane Directorate's jurisdictional area. Although the information contained herein is the latest available at press time, it should not be considered "authority approved," unless specifically stated; neither does it replace any previously approved manuals, special conditions, alternative methods, or other materials or documents. If you are in doubt about the status of any of the information addressed, please contact your cognizant Aircraft Certification Office (ACO), Manufacturing Inspection District Office (MIDO), or other appropriate FAA office.*

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