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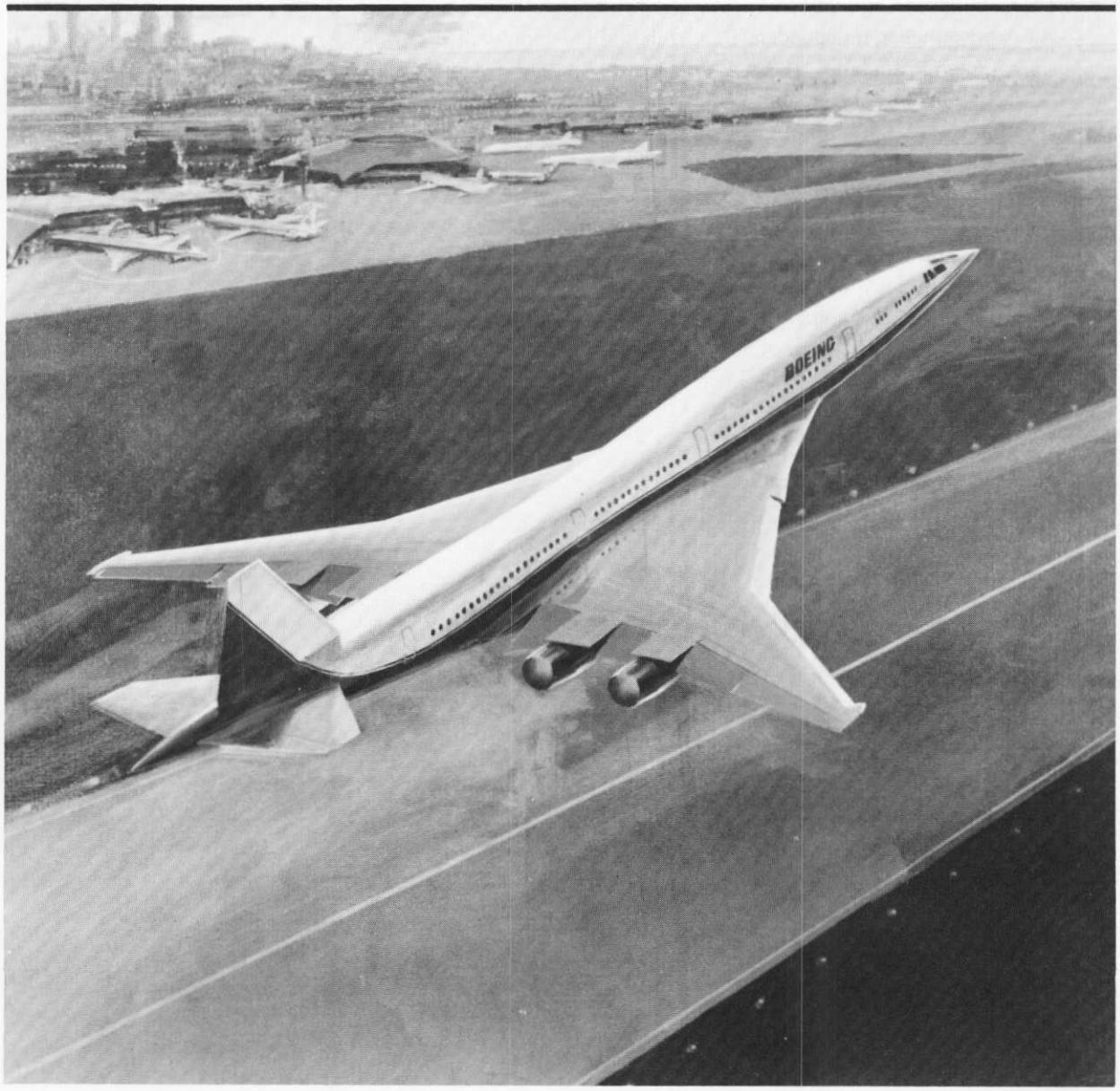

Possible Design for a Future High Speed Civil Transport

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The purpose of the Designee Newsletter is to provide designees with the latest information concerning regulations, guidance material, policy and procedure changes, and personnel activities involving the certification work accomplished within the 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.

Lead Topic

Commercial High Speed Transport Aircraft: Status of Current Research

Overview

The U.S. abandoned work on supersonic transport (SST) aircraft 20 years ago, largely because of insurmountable environmental issues such as airport noise and nitric oxide emissions that are a threat to the atmosphere's protective ozone layer.

However, the development of high speed civil transport (HSCT) technology by the National Aeronautics and Space Administration (NASA) and the United States aerospace industry has now been called for by many as part of a major program in aeronautics research and development to help the United States keep its world lead in the commercial aircraft market well into the next century.

NASA has funded HSCT research with $260 billion since 1990, and plans to outlay $187 million for fiscal year 1994 alone. Over the next eight years, the agency plans to invest over $650 million in "seed money" for the aircraft.

The current plans are for an HSCT that will allow airlines to provide profitable Mach 2.2-or-better service to more than 300 passengers at a time with a ticket premium only 20% higher than today's full-fare prices. The HSCT will use standard fuel, and be able to take off from standard runways using standard air traffic control procedures.

For it to enter the market, however, it will need to meet strict limits on airport noise and sonic boom levels, add no significant damage to the atmospheric ozone layer, and be competitive with a new generation of efficient long-haul subsonic aircraft.

Developing an acceptable HSCT will present a difficult and potentially very costly technical challenge to NASA and the U.S. aerospace industry over the next 10 to 20 years. To meet these challenges, NASA has developed a cooperative government-industry, multi-year technology development and validation plan at the request of Congress. The objective of the NASA plan is to advance key technologies in hopes that the operating cost of a commercial HSCT would be well below that which could be achieved using today's technology.

Nearly all of the U.S. aerospace companies -- Boeing, Douglas, Lockheed, Northrop, General Electric, and Pratt & Whitney -- are participating in various HSCT efforts. A number of smaller companies, national labs, and universities are contributing as well. NASA's High Speed Research (HSR) funding, divided between engine and airframe development efforts over more than eight years, is intended to take U.S. firms well beyond the technical level of British Aerospace and Aerospatiale of France, joint builders of the Concorde.

Foreign participation in HSCT production is inevitable, especially by the Pacific Rim countries that will account for much of the market.

Technology Considerations

The technology now exists -- primarily as design, materials, and engine knowledge and systems -- to build a high speed civil transport aircraft that would have a greater range, capacity, and speed than the present-day Concorde. Such an HSCT would use technology developed by the U.S. supersonic transport (SST) program of the 1960s and the NASA supersonic cruise research program of the 1970s. However, technology research is on-going, which is focusing on new materials critical for the propulsion systems, aerodynamics, structures and materials, and control systems of the HSCT.

NASA contractors General Electric and Pratt & Whitney, as well as the University of California at Irvine, are working to develop and evaluate ceramic matrix composite (CMC) materials for HSCT engine combustor components. CMC's consist of inorganic materials such as silicon nitride or silicon carbide, reinforced with high-strength ceramic fibers that are likewise imperious to heat.

The research is focusing on the ability of the materials to withstand the hot, harsh environment of the combustor. A further challenge is the development of CMC materials with "backside cooling" characteristics -- to prevent the combuster from developing hot spots that lead to nitrogen oxide (NO_X) emissions of more than 5 grams per kilogram (g/kg) of fuel burned.

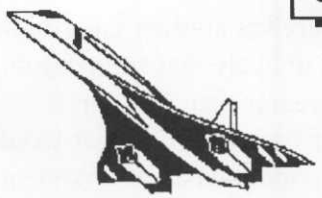
Development is underway to come up with advanced materials that will allow for significant weight reduction while maintaining structural integrity and operation in high temperature environments.

NASA and its contractors hope to develop a new generation of intermetallic-matrix composites -- fiber-reinforced compounds of chemically bonded metals, various titanium or nickel aluminites, or molybdenum disilicide -- that would save weight, both by their high specific strengths and by being heat-resistant enough not to require an active cooling system. Ceramic fibers are potential reinforcing elements, as are fibers made with tungsten, molybdenum, and sapphire.

Several projects are aimed at the HSCT's airframe and structures. Like the engines, the main driver is materials. HSCT designers are calling for materials that can withstand Mach 2.2 or 2.4 operating temperatures of 350°F and yet are light enough to allow an aircraft range of some 5,000 nautical miles. Polymeric composite materials (polyimide, cyanate ester, or other advanced plastics reinforced by premium carbon fiber) are available today, with many variants already in use in the manufacture of supersonic fighter jets and such large military aircraft as the B-2. The HSCT challenge is to find organic matrix materials that can endure projected aircraft lifetimes of 60,000 hours, involving thousands of thermal cycles.

A significant portion of the HSCT effort is devoted to the development of accelerated durability testing methods. Temperatures, mechanical loads, and environmental influences will be increased as mathematical models are developed to gauge long-term performance.

COMPARATIVE PERSPECTIVE



Concorde		HSCT Goals
North Atlantic	Market	Atlantic & Pacific
1976	Entry into Service year	2005
2.0	Speed (Mach No.)	2.4
3000	Range (nautical mi.)	5000-6500
100	Payload (passengers)	250-300
400,000	Takeoff Gross Weight (lb.)	700,000
87	Required Revenue (¢/RPM)	10
Premium	Fare Levels	Standard
Exempt	Community Noise Standard	FAR 36 - Stage 3
75	Noise footprint (sq. mi.)	5
20	Emissions Index (gm/Kg fuel)	5

High-Speed Civil Transport Comparative Perspective

Environmental Considerations

Protection of the ozone layer may be one of the most limiting considerations of HSCT development at this time. Analyses indicate that current damage to the ozone layer resulting from deposition of chlorofluorocarbons (CFC) and other gases will take a century or more to be repaired. Any significant emissions that could further deplete the ozone layer, such as NO_X from aircraft engines, will likely not be acceptable because of the potentially harmful environmental and health effects of further ozone depletion. Therefore, a prime objective of a propulsion system development plan for an HSCT will be to reduce emissions so as to do no more harm to the ozone layer.

Working with atmospheric models, NASA has determined that NO_X emissions of 15 g/kg of fuel burned by an aircraft that flies at Mach 1.6 to 2.4 would result in a 1% steady-state ozone depletion -- a level of damage considered by most scientists to present little or no danger to the Earth's population. Because of uncertainties of the models, however, NASA has set an HSCT emissions goal of just 5 g/kg of fuel burned. In comparison, today's typical subsonic jetliner emits 40 g of NO_X/kg of fuel consumed, and the Concorde's emissions are higher than 20g.

One aspect being considered is that, to achieve ultra-low levels of NO_X emissions, there must be uniform burning. Therefore, NASA has settled on two advanced engine combustor concepts:

- **rich-burn, quick quench, lean-burn (RQL), and**
- **lean-premixed-prevaorized (LPP).**

Both concepts call for temperatures higher than those possible in today's metallic engines.

The problem of noise is an environmental challenge that will be faced by HSCT developers. The current technology for HSCT engines -- the variable cycle engine -- is unable to meet Stage 3 airport noise requirements (currently the most stringent).

However, current analysis indicates that these or even tighter standards could be met with developing technology.

Researchers are investigating advanced nozzle concepts as a route to an acceptably quiet HSCT engine. They are focusing on how to balance aerodynamic performance with noise reduction. Weight is also a problem, since an effective noise-attenuating HSCT engine nozzle will be extremely large and could weigh approximately the same as the engine core.

In addressing some of the noise concerns, NASA will be drawing on the materials advances of the Integrated High Performance Turbine Engine Technology (IHPTET) program. This joint NASA/Department of Defense program has set a fundamental goal of doubling the current thrust-to-weight ratio of today's state-of-the-art engines. Seven U.S. aircraft engine companies are participating in the IHPTET.

Sonic booms are yet another environmental concern. It is unlikely that sonic booms significantly greater than 1 lb./sq. ft. overpressure from an HSCT fleet would be acceptable in populated areas. While in principle it is possible to design a Mach 2-3 HSCT that produces a sonic boom below 1 lb./sq. ft. at ground level, such designs are impractical with current technology.

One approach is to design the aircraft so that its cross-sectional area widens in a continuous fashion from front to back. This gradual change in area would produce numerous shocks, but none would be as large as the single shock that comes from the front of a conventionally shaped aircraft. A similar effect could be obtained by tailoring the distribution of lift. (Whenever air rushing past an aircraft experiences a sudden increase in lift, as when it encounters the wing, a shock wave results.) Boom could be reduced by spreading the lift-generating regions more evenly around the aircraft.

Both of these approaches have their drawbacks, however, since low-boom configurations appear to incur significant performance penalties. One initial solution would be to restrict the HSCT to flying subsonic over land, but permit it to go supersonic over water. (This is the restriction under which the Concorde currently must fly.)

Although this sounds like a simple solution, fuel and other operational economy concerns dictate a "double-barreled" design approach: a viable HSCT will have to be efficient at both supersonic and subsonic cruising speeds.

Research is planned, however, to determine if sonic boom reduction is achievable with less than 2% loss in aircraft aerodynamic performance (relative to a supersonic over-water, subsonic over-land baseline configuration) through wind-tunnel model testing.

Market Considerations

Worldwide air travel demand has tripled in the past 20 years to a current level of approximately 390 billion revenue-passenger-miles per year. That number is forecast to double by the year 2005, and then to double again by 2025, with long-range international travel, particularly travel in the rapidly expanding Pacific Rim commerce and trade centers, as the fastest growing sector of the projected market.

To meet future economic demands, an industry market analysis indicates that the HSCT "will have to carry three times the Concorde passenger load over twice the distance and be cost competitive with the subsonic fleet."

Therefore, the HSCT program has two market goals that it intends to achieve:

- **reducing the costs of air transportation services and**
- **reducing the travel time for both passengers and freight over long (over 5,000 km) routes.**

Projections are that an HSCT could cut North Atlantic travel times in half, and that a Los Angeles-Tokyo flight typically requiring 10 hours and 20 minutes today (in current subsonic transports cruising at about Mach 0.85) could be completed in just 4 hours and 20 minutes with an HSCT (cruising at Mach 2 2).

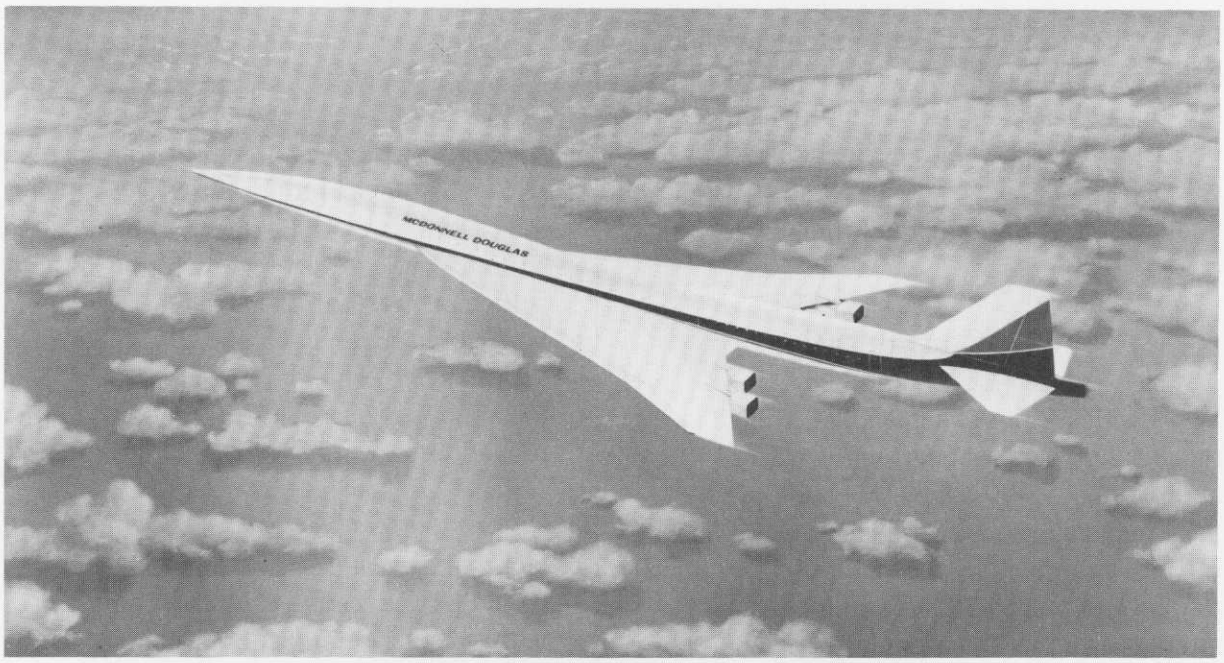
All concerned have agreed that the regular fares must be held to (at most) 20% over today's full fares. The image of being an aircraft that is available only to those sufficiently well off financially to pay high fares could severely hamper the public's acceptance of an HSCT research and technology program. (A target of no fare premiums appears to be highly desirable.)

Lower operating costs could result from the fact that a greater number of seat-miles would be deliverable each day compared with subsonic aircraft of the same capacity. This could occur even if the capital costs per seat and fuel consumption per seat-mile were higher for an HSCT than competing subsonic aircraft, assuming that maintenance and turn around times can be held acceptably low.

Air Transport System Considerations

HSCT developments are likely to have some effects on the air transport system. It would be important to the airlines operating HSCT aircraft that the international air traffic control system function more efficiently than it does now. Greater air traffic system efficiency is a major concern for the entire airline industry, however, and such steps may be taken even in the absence of an HSCT fleet.

The HSCT offers the hope of leveling departure and arrival peaks and allowing for improved destination weather prediction accuracy because of its much shorter flight times. Also, flying at a greatly expanded range of altitudes could reduce international air traffic control pressures, compared to a



Artist's depiction of a possible HSCT design

situation where only subsonic aircraft operated.

The economics of an HSCT fleet would require that ground turn-around time be kept to a minimum. To minimize time loss due to unscheduled maintenance and repair, airlines would have to establish specialized repair facilities at several HSCT terminals.

One initial concern was the availability of fuel, if the HSCT was not to use Jet A fuel. Flight at higher than Mach 2.2 levels may require that other fuels -- JP-7 fuel, for instance -- be used; thus, new fuel storage and handling facilities would be needed at all airports served by an HSCT fleet. Such facilities would be considerably more costly if liquid hydrogen or methane were used (Mach 4 and above). For reasons such as these and many more, the current research is aimed at the HSCT using standard fuel.

Review of U.S. Supersonic Transport Development

The history of SST research in this country up to now has been an interesting, albeit short-lived, one.

Interest in supersonic flight increased markedly after World War II. In 1947, a U.S. Air Force Bell X-1 experimental aircraft became the first manned aircraft to exceed the speed of sound (Mach 1). Soon after, single engine military and test aircraft were routinely flying in the Mach 2 range, and in 1956, the B-58 bomber, which could reach speeds of Mach 2, was built.

That event marked the start of serious interest in building a large aircraft that could cruise (extended flight) in the Mach 2 to 3 range, and in 1957, the U.S. Air Force began development of the B-70 bomber, designed to cruise at Mach 3. Because of changing

priorities in the U.S. strategic military policy, however, the B-70 never went into production.

During the same time, a supersonic cruise reconnaissance plane, the "Blackbird" (A-11, YF-12, and SR-71), was being developed for the Central Intelligence Agency by the U.S. Air Force.

The technology developed during the B-70 program spurred interest in developing a supersonic cruise transport (SST) for civilian applications.

In 1963, the United States announced a major SST research and development program. In addition to the supersonic flight technology exemplified by the B-70 developments, the proposed U.S. SST program was stimulated by the great commercial success of subsonic jets and the beginning of SST development programs in the Soviet Union (the TU-144) and Europe (the French and British Concorde). Information obtained during development of the SR-71 was also made available to help support the civilian effort through agreements with the Air Force.

Although there was much enthusiasm at the start of the SST program, serious problems appeared almost at once. These included:

- **the absence of significant information from military sources (the B-70 program had been canceled and security constraints slowed technology transfer form the SR-71 program);**
- **a lack of interest by the airlines because of the heavy investment in subsonic jet aircraft;**
- **the need for major Federal funding because the cost of development was beyond the capabilities of any one airframe manufacturer; and**
- **major technical challenges to meet severe cost and environmental goals.**

Nevertheless, a program was started in 1963 under the direction of the FAA. The program was designed to be a two or, if necessary, three phase effort. The first phase was a design competition that either would result in a winning design for a prototype or would require a further competition (phase II) between two finalists if a clear winner could not be determined. The last phase was to be the development of a prototype aircraft. Eventually, the design by Boeing (for the airframe) and General Electric (for the engines) was selected as the winner, and the two companies were contracted to develop a prototype.

The design aircraft, the Boeing 2707-300, was considerably more complicated than the TU-144 and the Concorde because the U.S. chose to develop a larger (187 passenger) and faster (Mach 2.7) aircraft. In addition, management of the program was made more difficult because of multiple agency involvement. As a result, delays in the prototype development program ensued. In addition, opposition to development intensified during the late 1960s on cost and environmental grounds. After much debate and an expenditure of about $1 billion (actual year dollars), the program was terminated by the Congress in 1971.

Although the SST program was ended, interest continued in both the Congress and the Administration for further development

of supersonic cruise transport technology. This interest was motivated primarily by a desire to keep the U.S. abreast of SST technology developments in the event of major new initiatives by the Soviets or the Europeans. At the time, it was reasonably clear that neither the TU-144 nor the Concorde would be an economic success.

In 1972, NASA proposed a research program aimed at addressing the important cost, performance, and environmental problems. The program, called the Supersonic Cruise Research (SCR) program, lasted from 1973 to 1981. In 1974, the administration requested $46 million for the SCR program, which was cut by the Congress to $10.1 million. Annual expenditures ranged from $8 to $11 million for the remainder of the program.

In 1979, at the request of the House Committee on Science and Technology, NASA developed a supersonic transport technology validation plan focused on propulsion, airframe, and aircraft systems technology. This validation program was designed to expand the SCR program so that technology development would reach a point that would allow the airframe and engine manufacturers to decide on future development of an advanced supersonic transport. The validation program was to cost $662 million (1981 dollars) over an eight-year period. No initiatives emerged from this NASA effort, however, and in 1981, the SCR program itself was canceled because of budget constraints and lack of interest by the airline industry.

Results of NASA and industry research conducted since the cancellation of the SCR program, however, provided evidence that the technologies could be developed for future environmentally acceptable HSCT aircraft. From 1987 through 1989, NASA and the industry conducted a series of HSCT studies, the results of which indicated that a substantial market for such an airplane would exist early in the next century if:

(1) acceptable standards of airport noise and sonic boom levels could be met,

(2) the projected fleet would have not harmful effects on the atmosphere, and

(3) the fare premium did not exceed 20% of the new-generation long-haul subsonic transport fares.

As a result of these studies, we find the HSCT program where it is today.

Today

Although the HSCT will not fly in commercial service probably until the year 2006, it is seen as significantly boosting the U.S. aerospace industry's competitiveness.

Analyses done for NASA show that if an HSCT can be developed that meets the economic and environmental goals described above, a substantial market for it will exist in the first decades of the next century. Development of this technology today could lead to an HSCT fleet early in the next century that could substantially improve long haul air transport productivity.

[Portions of the foregoing article were taken from information provided in various NASA reports and news articles. The Transport Airplane Directorate thanks Ms. Kathy Abbott of NASA Langley Research Center for her valuable input for this article.]

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General News

The Clinton Administration's Aviation Initiative Provisions

Below is the text of the Clinton administration's aviation initiative provisions intended to make the air transportation system safer and more efficient.

In response to recommendations of both the National Performance Review and the National Airline Commission, a committee of Administration experts is developing a detailed plan to restructure FAA's Air Traffic Control (ATC) services as a government corporation. Our goal is to make ATC more business-like and to overcome certain chronic impediments to good management, such as inflexible personnel rules and burdensome procurement regulations, that have frustrated efficient and effective delivery of ATC services.

The committee is seeking a corporate structure that will streamline procurement, simplify the personnel process, provide funding stability, ensure continuity of leadership, and reduce the incidence of unnecessarily detailed management oversight. It is also evaluating the implications of the corporate model for aviation safety, productivity, responsiveness to customer needs, national defense requirements, and other key issues.

The committee will present its restructuring proposals, together with the draft legislation needed to implement the changes, to the Secretary of Transportation in April 1994. The Secretary will work with Congress to enact any required legislation.

The committee is comprised of senior officials from the Departments of Transportation and Defense, the Office of Management and Budget, the Council of Economic Advisers, the National Economic Council, the National Performance Review, and other agencies.

Suggestions and concerns regarding the delivery of FAA services are being solicited from the aviation community, Congressional representatives, industry leaders, and other aviation experts.

The FAA Administrator has been charged with the task of accelerating the use of the Global Positioning System (GPS), a satellite-based navigation system. GPS offers enormous opportunities for enhancing civil aviation safety and efficiency. It enables us to integrate high-precision navigation with air traffic control. This will increase the capacity of our airspace system and reduce delays and the costs they impose on airlines, passengers, and shippers. Our accelerated schedule for the next 3 years calls for GPS to be available for navigation after take-off and for landing beginning in 1994, and to be available for navigation over the oceans in 1995. Augmentation systems allowing broader and more robust GPS applications, such as the use of GPS for certain types of precision approaches, are to be put on-line by 1996.

We are also working to ensure successful implementation for the long term. Because

GPS was conceived, developed, and fielded as a military system, its application to civil aviation presents significant technical and operational challenges. Recognizing the need for coordinated action, the Secretaries of Transportation and Defense jointly established a DOT/DOD task force to undertake a thorough analysis of the policy and security questions regarding civil use of GPS, to define civil requirements for GPS and any barriers to their fulfillment, and to make recommendations for sustaining GPS on a long-term basis.

"A solid working partnership between industry and government will spur the development of technologies having the highest payoffs for our national aviation system. . ."

The task force's recommendations on management jurisdiction between the Departments, GPS funding, international acceptance of GPS, and various technical matters concerning civil GPS applications were reported to the Secretaries in December 1993. In support of these actions to promote civil use of GPS, we will be modernizing the national airspace system to accommodate both civil and military needs by installing new equipment for automating ATC operations, accelerating standards on the operation and certification of GPS components, and working with industry to develop standards for future GPS and ATC enhancements.

Furthermore, our plan for restructuring ATC services will include options for creating public-private consortia as a vehicle for expediting the development and implementation of ATC technologies. A solid working partnership between industry and government will spur the development of technologies having the highest payoffs for our national aviation system and help to sustain America's preeminence in civil aviation research and development. Working with industry, we are committed to building a strong, advanced technology base for civil aviation that will guarantee continued expansion of benefits both domestically and internationally, while ensuring that U.S. industry maintains a strong competitive posture in the manufacture of aircraft and delivery of air services.

In support of these objectives we have increased NASA's aeronautics budget by 18 percent for fiscal year 1994, focusing on increased investment in civil aviation. Working with industry and FAA, NASA has developed research programs to enhance aviation competitiveness, system capacity, environmental compatibility, and safety. The principal components are the Advanced Subsonic Technology (AST) program and the High Speed Research (HSR) program:

- **AST provides basic research for the next-generation subsonic transport, and includes capacity and efficiency improvements together with NASA's contribution to GPS implementation.**

- **HSR is aimed at providing the research foundation for an industry-developed High Speed Civil Transport that is economically viable and environmentally compatible for the long-haul, over-water market.**

This fast-growing market is likely to make the High Speed Civil Transport the key to global competitiveness in aircraft manufacturing in the future.

Upgraded and new aeronautical facilities also are receiving increased attention in response to the aging of our national facilities and the needs of industry and government. For example, new wind tunnels that do a better job of simulating flight conditions should improve the aircraft design process, enabling production of high-quality aircraft at lower cost with faster delivery to market.

In addition to these programs, we will take full advantage of the Defense Department's investment in "dual-use" aeronautical research, *i.e.*, research on systems and equipment intended for military use that may be applicable to civil aviation. For example, under the President's $470 million Technology Reinvestment Project, federal grants have been awarded to private firms and institutions to support commercial development of products such as a new airport radar system, based on technology originally developed by the Navy, that can detect hazardous weather conditions while simultaneously monitoring air traffic.

Furthermore, the FAA, in addition to its ongoing support of GPS and ATC modernization, will work with industry in a cooperative research and development effort for new aircraft designs and manufacturing processes.

To guide our partnership with industry, the Administration's Interagency Aeronautics Working Group, co-sponsored by the Office of Science and Technology Policy and the National Economic Council, will

(1) establish aeronautics research and development goals by February 1, 1994, and

(2) complete an R&D action plan by February 1995.

". . .we will take full advantage of the Defense Department's investment in 'dual-use' aeronautical research. . ."

The Department of Transportation has begun a comprehensive examination of the High Density Rule to assess its viability as an efficient air traffic and delay management tool and to determine whether certain operating limitations imposed by the rule can be eliminated or modified to better utilize airport capacity. Put in place nearly 25 years ago as a "temporary" measure to deal with airport congestion, the High Density Rule today limits the number of airline operations at four major U.S. airports: Chicago's O'Hare, New York's LaGuardia and JFK International, and Washington National.

The Department's study is assessing capacity at these airports and the impact of the rule on airline competition, fares, and service patterns. It also is evaluating the rule's economic, financial, and environmental implications, including the process for allocating domestic and international slots and alternative traffic management techniques such as peak-period pricing. The study will be completed by November 1994.

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General News

FAA Launches Independent Research and Development Program

The FAA's Independent Research and Development (IR&D) Program could not begin at a more opportune time, according to Dr. Fred Snyder, acting program manager. Snyder believes that it fits right in with the renewed national emphasis on two key areas:

- American competitiveness in the world of high-tech marketing, and
- Rebuilding the infrastructure here at home.

Built-In Strength, Flexibility

Patterned after a long-standing successful Department of Defense model, the FAA's IR&D covers the part of research not required in the performance of a contract or grant. Its effectiveness will come from having the contractor choose the topic and methods of research, thereby capitalizing on the company's strong points. Contractors define problems to be resolved in stimulating their industry and developing innovative technologies.

With its built-in flexibility, the IR&D has become the industrial counterpart of FAA's successful Aviation Research Grants Program.*

For the Future

Experts say that the shift from a defense-based to a civilian-based economy is picking up steam, and the IR&D program, already familiar to some defense contractors, is a way to attract new research and development to civilian projects. An expected result of such government-industry partnerships is the formation of a large pool of technically qualified contractors prepared to build the air transportation system for the 21st century.

"Freedom of choice within the context of FAA needs is what will make this program successful," says Snyder. "The companies can use their best technical, professional, and business judgment to decide research topics." The FAA will have access to this information and will be able to deliver it to its principal investigators and program offices," Snyder continues.

Goals of Research

IR&D is intended to stimulate the nation's economy and industrial competitiveness in the technical arena by:

- **Strengthening the nation's industrial and technology base in relation to aviation;**

- **Developing technologies critical to the FAA's future;**
- **Developing and promoting the effective application of technology; and**
- **Obtaining databases to transfer technology gained in research and development among the FAA, other federal laboratories, private contractors, and academia.**

Data Collection Key

Annually, companies participating in the program submit information to a database maintained by the Defense Technical Information Center (DTIC). Because member agencies have access to the technical data, they can keep up with industry's capabilities in their areas of interest. The FAA and other participants can identify and communicate with companies at work on advancements in the transfer of technology. They can also zero in on funds spent and plans for spending in specific technical areas.

The FAA is still in the initial stage of obtaining databases for its IR&D program. "We are working with the Navy to obtain a copy of their database," says Al Adkins, information resource manager for the FAA's Office of Research and Technology Applications. "Once we have the information, we can learn about private-sector activities in specific areas of technology key to FAA programs."

Meshing Research Activity

The placement of the IR&D program within the FAA's Office of Research and Technology Applications makes it possible to mesh related activities. This office also manages other programs with similar goals:

- **Small Business Innovation Research Program**
- **Aviation Research Grants and Centers of Excellence Program, and**
- **Technology Transfer Program**

If you would like more information on the IR&D Program, please contact:

Dr. Fred Snyder
Office of Research and Technology Applications, ACL-1
FAA Technical Center
Atlantic City International Airport, New Jersey 08405

Telephone: (609) 484-5769
Fax: (609) 484-6509

[*For more information on the FAA's Aviation Research Grants Program see the Transport Airplane Directorate's Designee Newsletter, Edition 15, February 1993. Or contact your local Government Printing Office and request a copy of FAA Order 9550.7, "*Research Grants Handbook*," dated April 8, 1992.]

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General News

People and Machines: FAA Emphasizes Human Factors Research in Aviation Safety

Stressing that the human factor is critical to aviation safety and effectiveness, FAA Administrator David Hinson recently established a new policy for incorporating human factors considerations into all agency programs and activities.

The policy is designed to increase aviation safety, efficiency, and productivity by systematically integrating human factors into the planning and execution of all agency system acquisitions and operations functions. It also reestablishes the FAA Human Factors Coordinating Committee, sponsored and chaired by the FAA Chief Scientific and Technical Advisor for Human Factors, Office of the Executive Director for System Development.

"The human factor has been widely recognized as critical to aviation safety and effectiveness," said Hinson. "FAA efforts will emphasize human factors considerations to increase system performance and capitalize on the relative strengths of people and machines."

The policy fulfills one element of the National Plan for Aviation Human Factors that was jointly developed by the government and the aviation community. The partnership included the FAA, the National Aeronautics and Space Administration (NASA), the Department of Defense, academia, and several professional groups, such as the Air Transport Association's Human Factors Task Force, whose members include representatives of pilot and contractor unions, airframe and parts manufacturers, and major airlines.

The new policy stresses a systems approach to human factors and institutionalizing basic human factors principles within the FAA. This will emphasize human factors research on existing systems and operations to define human-machine performance problems and identify cost-sensitive solutions. The new approach will also be applied to FAA system acquisitions and regulatory activities in the promotion of civil aviation.

Human Factors Research Underway

The FAA's new policy and a surge of interest in human factors issues as they relate to aviation safety have intensified current research inquiring into this leading cause of aviation accidents. It has also propelled the FAA's Civil Aeromedical Institute (CAMI), with its 30 years of experience in various areas of human performance measurement and aeromedical safety, into the international spotlight in the advancement of human factors research.

"Age 60"

Among the high-visibility current human factors projects assigned to CAMI is the "age 60" project. An agency regulation bars

pilots who passed their 60th birthday from flying larger airline aircraft having more than 30 passenger seats.

Controversy surrounding the interpretation of an older "age 60" study led to the request for CAMI to initiate research concerning the relationship between pilot experience, age, and accident rates. Using a contract with the Hilton Systems, Inc., the CAMI team found that there was little evidence concerning an increase in accident rates for Class III pilots prior to age 63. The finding has resulted in a notice by the FAA of a public hearing to request comment on the "age 60" rule.

World Leadership via International Studies

Another significant performance-based project at CAMI focuses on pilots with subtle neuropsychological problems, who may be unable to perform properly in an emergency. COGSCREEN, a name derived from cognitive screening, is an automated test battery used to improve the medical assessment of pilots recovering from brain injury or disease.

The purpose of this research is to find an automated, low-cost, and sensitive screening tool that can be used to detect potentially debilitating neuro-psychological problems in pilots.

Obvious cases of brain damage are not difficult to detect, but subtle ones are. They are often missed without difficult and expensive testing. COGSCREEN, however, has proved to be sensitive to the detection of low-grade cognitive deficits, while providing the efficiency of computer-automated testing. This test is also easy to administer and inexpensive.

The international phase of this project was begun in 1990 under an agreement to enter into a cooperative study between the United States and Russia. Some 800 airline pilots in both countries were tested to establish statistical data from which international norms could be drawn for evaluating pilots recovering from brain disease or injury. Further cooperative work on COGSCREEN is in progress.

Benefits of the FAA's new approach to human factors research include increased personnel efficiency and effectiveness, improved system performance, reduced operations and maintenance costs, increased availability of objective data for use in FAA regulatory activities, and increased aviation safety.

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Note from the Editor

If you are a Designee and would like to have your name added to our mailing list to receive future copies of the Transport Airplane Directorate **Designee Newsletter**, please submit your request to:

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General News

Concurrent Cooperative Certification ("C-Cubed")

A new harmonization initiative known as Concurrent Cooperative Certification, or *"C-Cubed,"* was introduced by the FAA, in conjunction with Joint Aviation Authorities (JAA) management, in early 1992. C-Cubed is an evolutionary process that is being developed and implemented on a pilot program basis as the FAA and JAA work together to develop an improved understanding of each other's certification process and to gain confidence in each other's technical competence and regulatory authority for performing airworthiness certification functions.

Simply stated, C-Cubed is harmonization of the certification process involving multiple airworthiness authorities. The C-Cubed process is intended to fully optimize the Bilateral Airworthiness Agreement (BAA) between the United States and JAA member countries by relying on the exporting airworthiness authority's findings of compliance with the importing authority's rules. Currently, importing and exporting airworthiness authorities conduct separate type certification projects on new airplane models. The C-Cubed process will reduce or eliminate the redundancy in certification efforts between exporting and importing airworthiness authorities.

The C-Cubed Process

The task of developing procedures for implementation of the C-Cubed process has been assigned to an FAA/JAA Working Group. This process is still in the development stage. Currently, the Working Group is focusing on integrating certain key elements of a well-coordinated certification process. Those key elements include:

- Simultaneous application for FAA and JAA certification;
- Establishment of a commonly agreed upon type certification basis;
- Joint witnessing of bench, ground, and flight tests;
- Increased delegation of compliance findings to the exporting airworthiness authority; and
- Concurrent (same day) type certificate issuance.

C-Cubed Activities

Since its initiation, airworthiness authorities and transport category airplane manufacturers have implemented the C-Cubed process using the Boeing Model 777 as the pilot program. Although a number of steps in the certification process of the Model 777 had been accomplished at the time the C-Cubed pilot program was initiated, there was ample evidence of a cooperative spirit and open communication between the FAA and JAA. From the FAA's point of view, the FAA and JAA teams have made good progress in implementing C-Cubed for certification of the B-777. Pilot program results thus far have also enabled the FAA to further improve the C-Cubed process.

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General News

Australia and U.S. Aviation Authorities Work Together

On July 30, 1993, two addenda were signed to the Memorandum of Cooperation between Australia's Civil Aviation Authority (CAA) and the FAA.

Annex 4 deals with the development of a new system of detecting structural cracks in aircraft. With the aging of the world's aircraft, this new system is seen as an important enhancement of overall flight safety.

Over the next five years, the FAA will invest about $1.3 million in the Australian research being done by Professor John Baird and Bob Clark of the University of New South Wales' Department of Aerospace and Mechanical Engineering at the Australian Defence Force Academy in Canberra.

The goal is to develop a holographic technique for detecting faults in aircraft structures, and is expected to result in a product that can be made available to an Australian-U.S. consortium for co-production.

Annex 5 establishes a work plan to pool collective Australian-U.S. expertise in the use of the satellite-based navigation systems. The CAA has formed a special team to work with the FAA to validate the Global Navigation Surveillance System (GNSS) as an aid when enroute, and the Global Positioning System (GPS) when in the vicinity of airport terminals.

Also being considered are:

- **the effects of ionospheric disturbances on the GPS signal in high latitudes;**
- **exchange of information to establish ground monitoring systems; and**
- **investigating the potential for improvement of GPS navigation to eventually use it as a precision approach aid.**

Both Annexes were signed by Joan W. Bauerlein, the FAA's Director of the Office of International Aviation, and Brian O'Keeffe, General Manager of the R&D and ICAO Division of CAA Australia.

The Australian CAA sets and maintains safety standards for civil aviation in Australia and protects the environment from the effects of aircraft. It is responsible for the safety regulations and surveillance of the aviation industry and for providing regulatory services, such as licensing industry personnel.

The authority provides air traffic control and flight advisory services, aviation search and rescue, and fire-fighting services at the major airports of the country.

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General News

FAA Opens New Office in Moscow

Recent political and economic changes in Russia have opened up new areas of opportunity in the aviation industry.

Foreseeing Russia's pivotal aviation role over the next decade, the FAA began working with Russian civil aviation authority organizations to integrate the country's operations into the global aviation industry. As part of this effort, the FAA recently established an agency post in Moscow.

Dennis Cooper, former Manager of the FAA's International Research Program Office, will serve as the FAA's first representative in the former Soviet Union. Cooper, who has 15 years experience in negotiation skills and is fluent in Russian, will serve a two-year tour. He has worked extensively with foreign government officials and agencies -- including Russians -- to form cooperative agreements with the FAA.

Cooper is one of 10 representatives stationed overseas. The FAA has representatives in Amman (Jordan), Paris, London, Rome, Dakar, Rio de Janeiro, Beijing, Singapore, Tokyo, and, now, Moscow.

"Airspace in far eastern Russia can be used to shorten certain global air traffic routes, " Cooper says. "Additionally, the airspace can make the routes safe and more efficient, resulting in cost savings for carriers."

The former Soviet Union may also become a business attraction for U.S. aviation firms. Ventures could include all facets of aviation -- aircraft manufacturing, air traffic control, aircraft maintenance and repair, and training for aviation personnel. Currently, commercial aviation service between Russia and the United States is increasing, and additional applications for Russian carriers are anticipated in the future. New airlines from Russia, Ukraine, and other Newly Independent States (NIS) plan to serve U.S. cities.

The FAA is now engaged in several major programs with the Russian Federation and other NIS countries. These include efforts toward:

- **A U.S./Russian bilateral airworthiness agreement.**
- **New, more efficient North American/Asia-Pacific air routes through Russian Far East airspace.**
- **Modernization of air traffic control systems in Russia and other NIS countries.**
- **Use of civil signals from U.S. and Russian navigation satellites to implement the worldwide Global Navigation Satellite System (GNSS) endorsed by the International Civil Aviation Organization (ICAO).**

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General News

Rivet-Checking Robot Mechanical Device to Inspect Aging Aircraft

Airline safety inspectors may one day have new additions to their teams -- seven-footed robots designed to detect structural flaws in aging aircraft. The FAA's Technical Center in Atlantic City, New Jersey, is taking the lead in investigating the use of a robotistic maneuvering device to assist in automation of data collection and interpretation of traditional nondestructive inspection equipment. The mechanical inspector would be capable of searching for flaws in aircraft skins and underlying structures with more reliability, a high probability of detection, greater uniformity, and at faster rates than can be accomplished by human inspectors.

The project was initiated in June 1991, with a conceptual design delivered to the Technical Center in December by Carnegie Mellon Research -- the organization developing the device with the FAA. Investigators at the research center constructed and tested a prototype of the system earlier this year.

The robot, given the name ***"ANDI"*** -- short for automated nondestructive inspector -- is currently equipped with an eddy current inspection probe. ANDI sports a three-foot modified "T"-shape, weighs about 30 pounds, and is equipped with suction cups on each of its seven feet to walk along the surface of an aircraft. Future plans call for an operational robot to weigh around 20 pounds. The mechanical inspector prototype is remotely controlled by an operator using a personal computer. All electrical and control cabling, as well as compressed air for the suction cups, is delivered to ANDI through an umbilical line. Locomotion is achieved through electric stepping motors.

"Using an FAA-supplied, 10' x 6' curved section of fuselage, the prototype was able to maneuver in one direction, scan a sliding eddy current probe along a row of rivets, and collect crack detection data," said Dave Galella, project engineer, Aging Aircraft Research Branch at the Technical Center.

Over the next two years, the focus will be on developing a rugged field prototype system, using a menu-driven operator interface, improved control software for maneuverability, collision avoidance device, and miniature video cameras for providing visual data to an operator workstation.

USAir's maintenance inspectors in Pittsburgh, Pennsylvania, have been working with Carnegie Mellon on the design considerations for the first ANDI system. Subsequent prototype versions may be demonstrated at USAir's facilities, although testing of the new mechanical device will be on a Boeing 737 at FAA's Aging Aircraft Nondestructive Inspection Validation Center at Sandia National Laboratories in Albuquerque, New Mexico.

Field testing of the second version of ANDI is planned for mid-1994.

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General News

New News about GPS

The following material provides some updates on activities concerning the Global Positioning System (GPS).

FAA Approves Supplemental Use of GPS

In June 1993, the FAA approved supplemental use of Global Positioning System (GPS) in oceanic, domestic enroute, terminal, and nonprecision approach phases of flight. This release marks the first operational authorization to use GPS in less than VFR conditions using avionics certified in accordance with Technical Standard Order (TSO) C-129. Also included in this approval are provisions for TSO certified avionics to be used to fly all existing nonprecision approaches (except localizer-based) to over 2,500 airports. That adds up to nearly 5,000 GPS approaches available for immediate use. GPS-specific approach procedure design criteria is also in place to develop what is estimated to be another 10,000 procedures in the future for qualified airports currently not serviced by a ground navaid.

The approval process is divided into three phases, all requiring TSO C-129 avionics:

- The **first phase**, currently ongoing, allows use of GPS with several constraints, the most critical being active monitoring of the appropriate ground navaid to provide integrity.

- The **second phase** begins with declaration by the Department of Defense of Initial Operational Capability of the GPS constellation. With a fully operational constellation, active monitoring of the ground navaid will no longer be required, since integrity will be provided by Receiver Autonomous Integrity Monitoring.

- **Phase three** involves the actual changing of procedure names to include GPS in the title. For example, existing "VOR RWY 36" would be changed to "GPS or VOR RWY 36". Probably the most significant change in phase three is that the ground navaid supporting the approach at the destination airport does not have to be operating. However, the required navaids to the alternate airport, if required, must be operational. Look for this in less than 2 years.

This marks the completion of a significant milestone for FAA: It is the first time that the FAA has had avionics specifications, operational procedures, and certification criteria ready for implementation before user equipment was available. Clearly, near term advantages are not overwhelming, but this phased process begins the institutionalization of GPS into the National Airspace System, and demonstrates the FAA's strong commitment to early implementation of satellite technology.

In June 1993, Transport Canada announced an identical authorization and urged the

International Civil Aviation Organization (ICAO) to being a global transition to satellite-based navigation. Transport Canada was a key contributor to the flight trials which validated the FAA supplemental approval.

□

Satellite Program Office Wide Area Differential GPS Test Program Underway

The FAA is investigating the application of geostationary satellites and an independent network of monitoring stations to augment GPS for use by civil aviation as a sole means navaid for phases of flight from enroute through CAT I or "near CAT I" approaches. A testbed is being developed to evaluate the Wide Area Integrity Broadcast (WIB) and Wide Area Differential GPS (WDGPS) concept to provide GPS integrity warning, correction data for accuracy enhancement, and additional ranging for improved GPS availability.

Extensive flight testing began in August 1993 at the FAA's Technical Center in Atlantic City, New Jersey. The testbed will initially be comprised of four wide area reference monitor stations (WRS) up to 500 miles away; a wide area master station to determine GPS integrity and differential correction data; a geostationary satellite (INMARSAT-2) to transmit "GPS-like" signals at L-Band with the WIB/WDGPS data message; and a use platform on board an FAA test aircraft.

Tests in March 1993 provided a preliminary comparison of aircraft positioning performance (sensor accuracy) based on a single wide area reference monitor station about 500 miles away. Along a 3-nautical mile final approach, the WDGPS results, as compared to the laser tracker, were 4.6 meters horizontal and 6.1 meters vertical at the 95% probability level. Test pilot reaction to the CDI display indicated no perceptible difference compared to a standard ILS-based approach. Additionally, the WIB integrity warning statistics indicated a worst case time to alarm of 5.95 seconds, comparable to the CAT I requirement of 6 seconds.

The testbed was expanded at the end of 1993 to support a cross-country WDGPS demonstration flight using up to eight wide area reference monitor stations located throughout the U.S. Cooperative international test flights will begin sometime this year.

□

Fiji First to GPS

Fiji will be the first country in the world to test GPS on a national scale with all domestic air carriers using GPS exclusively for all enroute and terminal operations. This 6-month test will have significant impact on the on-going work of understanding GPS capability and reliability. The FAA will work in conjunction with the Fiji CAA to provide support in the development of GPS-specific procedures for air traffic control, certification, installation, data collection and analysis, and instrument procedure design.

GPS receivers have been installed into all 17 domestic air carrier aircraft; however, these receivers do not meet TSO C-129 standards for receiver autonomous integrity monitoring (RAIM). Until TSO C-129-certified GPS receivers can be installed, a GPS integrity monitor will be placed in the control tower at Nadi. An alarm in the integrity monitor will be triggered when the local GPS accuracy

cannot be guaranteed to within one nautical mile. Tower controllers will then pass that information to aircrews via radio. Additionally, crews will be required to make system checks using airport reference points prior to takeoff.

Fiji provides an ideal environment for this type of demonstration due to its low number of pilots and aircraft, and its vast areas of low density airspace. Additionally, other factors making Fiji well-suited for this proof-of-concept is that it is a nation of approximately 300 islands spread over nearly 400,000 square miles with 19 airfields serviced by only five navigation aids. Typical operations demand flight over as much as 150 miles of ocean in visibilities of less than 5 miles without navigation guidance.

This project will go a long way to prove the viability of GPS and associated prototype pilot and controller procedures planned for future implementation into the U.S. National Airspace System. □

GPS Information to Aid in Reduced Vertical Separation Minimums (RVSM) Height Monitoring

The international aviation community plans to reduce the vertical separation standard over the North Atlantic between FL 290 and FL 410 from 2,000 feet to 1,000 feet beginning in the 1996-97 timeframe. The objective is to increase the capacity of oceanic airspace as a means for increasing the flexibility of flight operations and permitting more aircraft to fly on routes where winds are favorable. In support of this initiative, the FAA is leading an effort to monitor the height-keeping performance of aircraft over the North Atlantic to verify that safe aircraft separation will be assured with the reduced separation standard.

A specially designed data collection system placed aboard an aircraft records four-dimensional GPS position fixes (latitude, longitude, geometric height, and time) at a rate of once per second. After completion of a flight, GPS position fixes will be further processed to add differential corrections. The geometric height information obtained from GPS data will then be combined with flight level height and assigned altitude data to determine aircraft height-keeping performance.

This data collection program is supported by several organizations within the FAA, including Flight Standards, Air Traffic, the FAA Technical Center, the Satellite Program Office, and Oceanic System Manager. Industry and interagency involvement in the test program include the Air Transport Association (ATA) of America; American, Delta, and United Airlines; British Airways; the National Business Aircraft Association (NBAA); and the U.S. Air Force. Approximately 100 test flights will be conducted from May to October of this year. Results will be analyzed and presented to the aviation community throughout the test program. A final report will be available in the December timeframe.

If GPS is proven to be a viable and robust method to monitor height-keeping in an RVSM airspace, the North Atlantic user population may save $25 million in RVSM implementation costs.

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General News

Two Teams Formed to Address New Avionics Navigation and Communication Technology

The introduction of a potential world-wide navigation aid based in space that will provide high levels of accuracy, and the move towards the replacement of air traffic system routes -- defined by ground-based navigation aids giving the freedom for aircraft to proceed on any desired flight path -- will revolutionize the conduct of civil aviation in the years ahead.

The obvious and basic benefits to aviation derived from these new systems will be supplemented by the introduction of other time and labor saving procedures and devices, all leading to increased reliability and reduced expense. Although the cost benefits accruing are as yet undefined, preliminary studies indicate the potential for considerable savings while maintaining, as a minimum, the standards of safety required today.

The nature of aviation, the changing nature of navigation aids, and the potential for direct communications between computers will lead to the replacement of local national procedures and approval processes with an international network of communication and navigation services. In a sense, nations will continue to be providers, but the standards and procedures set will transcend international boundaries and will be derived in international form.

The International Civil Aviation Organization (ICAO) has already outlined the evolutionary process whereby the systems of today will be superseded. The conversion of this outline's stated principles into certification of equipment and operating procedures dictates that more than basic rules be adopted by national aviation communities.

To this end, the production of international standards requires international consultation and cooperation at a working level, where those responsible for authorizing the use of equipment and operating procedures convert principles into practical use. Two teams have been established to address these issues:

Communications/Satellite Operational Implementation Team (C/SOIT)

The C/SOIT comprises a broad spectrum of FAA personnel, including representatives from the FAA Operating Services as well as the System Engineering and Development community. This team has been tasked with the responsibility for the operational implementation of satellite communications, surface movement surveillance systems, and data link technologies for aviation applications in the National Airspace System (NAS), oceanic, and other worldwide operations.

Traditionally, the FAA has been able to assess the safety impact of a new technology system when it is introduced in the NAS at

the *component level* within each responsible service/office in the FAA. Emerging communication and surveillance technologies, however, require a *total systems approach* to realize rapidly and efficiently the full benefits that these technologies provide. The objective of C/SOIT is to promote such a total systems approach to the implementation of satellite communications and surface movement surveillance systems, and data link technologies.

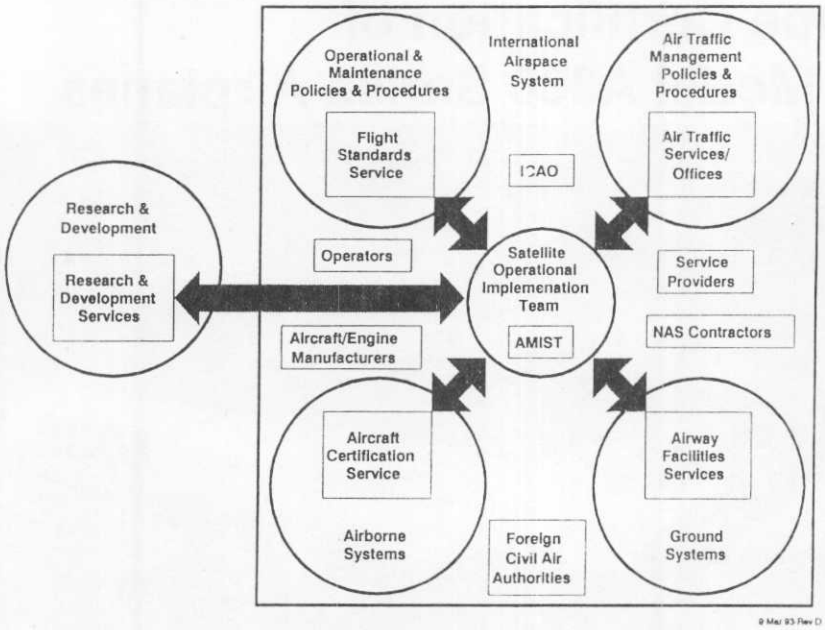
C/SOIT's activities and recommendations will have international implications. Therefore, coordination with the international aviation community will be accomplished by establishing close working relationships with international counterparts and participating in recognized international forums.

The activities of C/SOIT will include the participation of industry as well as academia and other advisory groups in order to ensure that all issues involving the development and execution of the implementation plan are fully addressed. In order to achieve these objectives, C/SOIT has been authorized to undertake the following activities:

- **Assess the adequacy of existing FAA policies and procedures as they relate to aircraft systems, operations and maintenance, air traffic management, and recommend changes, as needed.**
- **Provide guidance in directing the development of industry and government standards and consider them for possible adoption or reference in FAA policies and procedures.**
- **Provide guidance in directing the research and development of satellite communications, data link, and satellite surveillance technology.**
- **Investigate means to assess the impact on safety from a total system perspective.**
- **Investigate the impact of a dynamic, evolutionary environment on the total system, including performance, reliability, integrity, and safety.**
- **Provide technical input to other offices, as necessary, such as the Office of Aviation Policy, Plans, and Management Analysis (APO), which analyzes cost/benefit.**
- **Identify major issues that cross service/office organizational boundaries and recommend solutions.**
- **Develop, review, and recommend technical guidance to be used in advisory circulars (AC), notices, technical standard orders (TSO), policy, rulemaking, and other technical documents.**
- **Provide a forum for technical studies, reviews, and research.**
- **Assist services/offices to implement recommendations, as appropriate.**

The C/SOIT team aims to maximize the benefits of additional services and capabilities to the aviation industry while minimizing the cost of implementation.

Relationship between International Airspace System and FAA Services/Offices



The diagram above provides an overview of the relationship that the C/SOIT has with the FAA services/offices, with industry, and with the foreign civil aviation authorities. Additionally, it identifies the relationship between the services/offices and each of their responsible areas of the international airspace system.

International Coordination Panel on Navigation/Communication (ICPN)

This panel is currently comprised of systems engineers and operations specialists from the FAA, the Canadian Ministry of Transport, the European Joint Airworthiness Authorities (JAA), and the Civil Aviation Authority (CAA) of Australia. (Membership is open to all international certification authorities, however.)

The ICPN's charter is primarily to "harmonize" airworthiness criteria for navigation and communication functions so that it can be applied internationally. Panel members will be reviewing current certification guidance materials, with the objective of promoting commonality. This panel also is tasked with anticipating and resolving international policy issues in this area.

Its work also will involve undertaking specific reviews with a view toward advising international certification authorities on criteria that meet the certification objectives for the deployment of new technology as applied to the navigation and communication functions.

The aim of the ICPN's ambitious work program will be to ensure maximum commonality in the development and application of technical standards and airworthiness criteria used for the approval of navigation and communication systems and equipment. This work will also take into account operational aspects.

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General News

FAA Type Certification of Airbus Model A330 Series Airplanes

Airbus Industrie Model A330

On October 21, 1993, the Transport Airplane Directorate presented the U.S. Type Certificate of the Airbus Model A330 to Airbus Industrie at a joint ceremony in which Airbus also received type certificates for the A330 from the European countries that comprise the Joint Airworthiness Authorities (JAA). This airplane is the first transport category airplane to receive concurrent certification by the FAA and JAA.

The A330 is a wide-body airplane powered by two General Electric CF6-80E1 engines. The airplane was developed jointly with the four-engine Model A340, which was type certificated for operation in the U.S. in May 1993. The A330 is designed to carry 335 passengers in a two-class arrangement.

While Model A340 series airplanes serve very long range routes, the A330 is designed to serve high growth, high density regional routes. The A330 has the capability to serve extended range international routes, as well, having a range of over 4,500 nautical miles with a full complement of passengers and baggage. ■

General News

Dornier 328 Receives U.S. Type Certificate

Dornier Model 328

On November 10, 1993, the Transport Airplane Directorate presented the U.S. Type Certificate of the Dornier 328 to Dornier Luftfahrt GmbH, a member of the Deutsche Aerospace Group. This is the first transport category airplane certification program to take place between the Luftfahrt Bundesamt (LBA), which is the airworthiness authority for Germany, and the FAA.

The Dornier 328 is a twin-engine, turbopropeller commuter airplane with high-wing, T-tail design. The airplane is designed to carry 30 passengers.

The Dornier 328 has a maximum cruise speed of 335 KTAS (620 km) and a range of 730 nautical miles (1,350 km).

Dornier made application for FAA type certification of the Dornier 328 on October 1, 1987. The first flight of the airplane took place in December 1991, and the airplane was type certificated in Europe by the Joint Airworthiness Authority (JAA) member nations on October 15, 1993. The airplane has been in service in Europe since that time.

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Special Topic

Tailplane *Stall*?

Summary

There have been a number of fatal and non-fatal accidents and incidents of uncommanded pitch-down resulting from ice contaminated tailplane stall (ICTS) during or following flight in icing conditions. In response to these events, the FAA has issued airworthiness directives (AD) applicable to the appropriate airplane types to correct this potential unsafe condition.

The AD's increased the tailplane stall safety margin by requiring one or more of the following:

- **reducing or limiting the maximum flap extension angle during or following flight in icing conditions;**
- **decreasing the maximum flap extended speed (V_{fe}) for the maximum flap angle;**
- **modifying the ice protection system; or**
- **modifying the tailplane airfoil geometry.**

In November 1991, NASA and the FAA sponsored an International Tailplane Icing Workshop. In April 1993, a second workshop was held. There were a number of recommendations resulting from these workshops, including emphasis on improving flight crew awareness of ICTS.

This article is only one product of those recommendations. It explains the mechanism involved in tailplane stall, the symptoms of tailplane stall, and recovery techniques emphasizing the importance of retracting the flaps to recover and/or reduce heavy nose down control forces.

For the longer term, a review of the Federal Aviation Regulations (FAR) and revision of advisory material involving ice-protection/detection and tailplane aerodynamic issues is also underway. There currently is no requirement defining specific criteria for tailplane stall margin similar to the requirement for wing stall margin at 130% of the stalling speed in the landing configuration (1.3 V_{SO}).

Background

Most, if not all, of the ICTS accidents on record could have been prevented if the flight crews had understood what was happening and had promptly applied appropriate corrective actions. Pilots generally are knowledgeable about the adverse effects of ice accretion on the wing, but this has not been found to be the case with ice accretion on the tailplane. Perhaps there is a misplaced sense of complacency about the effects of ice on the tailplane, or simply that the effects of tailplane stall are not well understood.

ICTS accidents of record have occurred with reported ice accretion from 3/16" to 1" thick

on the leading edge of the tailplane. In other cases, pilots have successfully landed the same model airplane and reported finding ice 3-1/2" on the leading edge of the tailplane. The primary differences between accidents and airplanes that landed safely were the shape, texture, and location of the ice; the airplane's approach speed; gust environment; and flap, power, and pitch control inputs by the pilot. ICTS accidents most often result in fatal injuries to all occupants of the aircraft.

Tailplane Stall -- in Detail

Not all airplane designs have the same susceptibility to ICTS. The most susceptible designs have some features in common, such as aerodynamically balanced or assisted elevators, and highly effective flaps. Susceptibility is directly related to the angle-of-attack (AOA) of the tailplane and the sensitivity of the airfoil to degradation by contamination, often associated with efficient airfoil design.

ICTS and related aerodynamic conditions have occurred on piston, turboprop, and jet airplanes configured with stabilitator, "T," cruciform, and conventional fixed or variable incidence tailplanes. Foreplane (canard) designs with ice accreted in freezing rain have stalled during takeoff roll, resulting in the inability to rotate.

The relatively higher frequency of ICTS events on turboprop airplanes used in airline service is believed to result, primarily, from the demands of the application with greater exposure to icing conditions and more limited options for effective ice avoidance by route, altitude, or schedule variations. About the stall itself -- on the main wing, a "stall" is said to occur as the airflow becomes detached from the upper surface. This is associated with high AOA, often at low airspeed. Attitude anomalies in all three axes may be present, possibly preceded or accompanied by aerodynamic buffeting.

The most adverse effects of stalled flow occur on the suction surface of the airfoil. When the airfoil is lifting "up" (positive lift), the suction surface is on the top. When the airfoil is lifting "down" (negative lift), the suction surface is on the bottom of the airfoil. Simply stated, either positive or negative, the tailplane airflow will become detached from the airfoil and stalled flow will occur when the local stall AOA is exceeded.

Positive Tailplane Stall

While far less common than negative tailplane stall, there have been a few reports of positive tailplane stall. These events have occurred at just above takeoff speed when the airflow over the horizontal stabilizer is at a positive AOA. A positive tailplane stall may be accompanied by a range of symptoms, including buffet to uncommanded longitudinal (pitch) control movement which, if unrestrained, may move fully aft in the nose-up direction.

In the reported cases, ice was found on the upper surface of the horizontal stabilizer after landing, while the rest of the airplane was totally clear of any contamination. The ice, accumulated during ground operation, was not detected because of a high "T" tail and so was not removed prior to flight.

Positive tailplane stall, in many cases, can be corrected by increasing speed or extending flaps. These actions cause a change from positive to a negative AOA of the stabilizer, with suction on the lower surface. In that state, ice on the upper surface has little adverse effect on the lower surface airflow.

Negative Tailplane Stall

This discussion primarily addresses negative tailplane stall, which occurs when the stall AOA for the tailplane is exceeded. The result can be a loss of lift, or a change to the desired pressure distribution over the lower surfaces of the horizontal stabilizer and elevator.

A stall where the flow is detached over the entire stabilizer will result in loss of tail-down load and, without this balancing force, the nose will pitch down. In another, more subtle way, detached or altered flow over the aerodynamic balance element can alter the pressure distribution of the elevator enough to result in adverse changes to the stick forces. This mode can occur on designs with unpowered mechanical control.

The pilot may sense a tailplane stall event as a pitch instability or control anomaly. In other cases, the pitch control may be forced to the nose-down stop and the airplane responds accordingly by pitching nose down -- often violently. If the pitch-down occurs during approach, there may be insufficient altitude to recover.

Stick force is a significant, but not the only, concern. For manual systems, the magnitude of the stick force depends upon the size of the airplane and the difference in static pressure between the upper and lower surfaces. Generally, larger elevators found on larger airplanes would require the highest recovery forces.

Consider one of the most adverse effects of a tailplane stall to be similar to a stick pusher that doesn't quit when the nose is well below the horizon. There is usually a means available to the crew to disconnect the stick pusher. Similarly, if a tailplane stall occurs as a result of flap extension, retracting the flaps to a smaller flap angle will remedy the problem.

In some tailplane stall conditions, the stalled flow will reattach to the airfoil if the pilot can muster enough strength to raise the elevator trailing edge to a nose-up configuration, resulting in a change of airplane attitude and AOA less prone to stall. With no other changes, the improvement would only be temporary until elevator nose-down control input caused the stall to recur. The resultant vertical profile on final approach could resemble a roller coaster ride.

If the onset of the stall is sudden, and the stall extensive, then the onset of the high stick forces will be sudden. Swept tailplanes tend to have a slower onset of stall than unswept tailplanes, but most significantly, susceptibility to stall is related more to the leading edge geometry of the horizontal stabilizer airfoil than the sweep angle of the horizontal stabilizer/elevator. Advantages of sweep angle are often negated by the leading edge geometry.

Airplanes with irreversible or powered controls are less affected by tailplane stall. The powered elevator doesn't decrease the susceptibility of the tailplane to stall; it just means that hinge moment effects tend to be more manageable since the high hinge moment can be overcome by the elevator power system. If a tailplane stall starts to develop, the pilot simply moves the yoke back, reconfiguring the tailplane to one less prone to stall, and the airflow becomes reattached to the airfoil. This measure also may only be a temporary reprieve. A powered elevator may have little effect when the stall results in total loss of lift of the tailplane.

Another mechanism -- simply a reduction in the maximum lift due to stabilizer contamination -- may be the cause of controllability problems after flap extension with ice accretion on an airplane configured with variable incidence tailplanes. Reports describe insufficient nose-up trim to land with flaps extended with ice on the tailplane. In one report, the pilot applied and held nose-up control force. Corrective measures for negative tailplane stall described below are also effective for this anomaly as well.

A stall on airfoil contaminated by ice almost always occurs at a lower AOA than a clean airfoil. On the wing, for example, the stall may occur at an unexpected AOA or attitude without natural warning (buffet). For airplanes with a stall warning or protection system using leading edge stagnation point sensor vanes or an AOA sensor calibrated to the clean wing stall, stall of the wing contaminated with ice may occur without artificial warning (horn, stick shaker) or pusher. In addition, wing stall warning devices are designed to provide indication of wing stall, not tailplane stall.

Because of different characteristics of each airplane configuration and interactions caused by the myriad possible ice accretions, it is not possible to provide a precise list of differences of the symptoms for each airplane between wing and tailplane stall. From the pilot's viewpoint, perhaps the most important characteristics of a tailplane stall are the relatively high airspeed at the onset of the symptoms and, if it occurs, the suddenness and magnitude of the nose-down pitch, most often accompanied by unusual stick forces. Because of increased wing downwash, the AOA of the tailplane becomes more negative with extension of flaps. Therefore, the stall is most likely to occur when the flaps are approaching the fully extended position, or after nose-down pitch and speed changes following extension of flaps.

During and after flap extension, there are often several actions taking place at the same time that may present complex and possibly confusing indications to the pilot as to cause and effect. A number of pilots have reported that they used the logic that if a problem occurred after extending the flaps, they would "undo" it by retracting the flaps.

The most adverse combination of factors for tailplane stall is :

- **ice accretion of critical shape, texture, location, or thickness;**
- **maximum flap deflection;**
- **forward center-of-gravity (c.g.);**
- **high airspeed;**
- **elevator input in the nose-down (trailing edge down) direction;**
- **headwind or downward gusts or pilot response to upward gusts; and**
- **possibly for some configurations, increase engine power.**

Elevator nose-down input adds two distinctly adverse components to tailplane negative AOA: As the nose pitches down, the tail pitches up, causing the tailplane AOA to become more negative. Also significant is the contribution to increased negative AOA of the tailplane due to the tail-up pitching velocity of the airplane. For some designs, higher engine power settings at high speeds may also tend to increase the downwash angle at the tailplane because of increased inboard wing lift. This would add to the overall tendency to pitch down.

Like a wing stall, there may be a progression of symptoms in an ICTS. One of the many

symptoms may be a mild buffet on the tail at the onset of a tailplane stall. One pilot who experienced a tailplane stall-induced buffet reported that it was sensed as a high frequency, perhaps twice the frequency of a wing stall buffet. Another pilot reported that he felt buffeting through the yoke.

Further complicating the situation in attempting to identify whether buffeting is caused by wing or tail ice is that usually the crew can view the wing surfaces to verify their condition, but, in most cases, the crew cannot view the tail. The pilot's assessment of whether a buffet originates from a tailplane stall or a wing stall merits attention because the corrective procedures for a wing stall are exactly the opposite of those for a tailplane stall. Increasing speed improves wing stall, but aggravates negative tailplane stall, and vice versa.

Buffet may also be sensed in some designs at or below normal climb speed if ice is present on the unprotected inboard leading edges of the wing.

Proper and precise speed control is essential to avoid a tailplane stall or correct the situation after it occurs. Most of the accidents and incidents occurred on airplanes being operated well above the recommended approach speed, and some were operating in gusting conditions. Some were both fast and above the glide slope. Some pilots have reported that they used higher than recommended approach speed to add their own increased safety margin above wing stall because of visible ice on the wings and the presence of turbulence, windshear, or gusting surface winds.

Windshear or gust encounters can also add to the airspeed controlled by the pilot. A headwind or downward gust can increase the negative AOA on the tailplane directly. An upward gust can prompt the pilot to respond with a rapid nose-down pitch input. Higher final approach speeds to accommodate traffic mix with jet airplanes can also be a factor. Whatever the reason for exceeding the recommended approach speed, added airspeed increases the safety margin for the wing but decreases the safety margin for the tailplane. **Figure 1**, below, shows the relationship of the stall margin for the wing and the stall margin for the tailplane as a function of speed.

Retract the Flaps

Because of the significant contribution of the extended flaps to the tailplane AOA, and the relative rapid change of flap deflection, there may be no precursor of impending negative tailplane stall. In the worst case, either there is no precursor, or the precursor is misdiagnosed and the tailplane stall progresses to its most severe mode. The remedy is the same: ***Retract the flaps.***

There are two schools of thought regarding which recovery technique should be used first -- reduce the flap setting or pull back on the yoke. The yoke pull seems to be a "no-brainer" -- every inclination for survival is an attempt to set a new work record in the "lateral chest pull" with the yoke. The desired response is to pull back AND retract the flaps to the next smaller flap angle setting OR command the non-flying pilot to immediately retract the flaps to the next smaller flap angle setting.

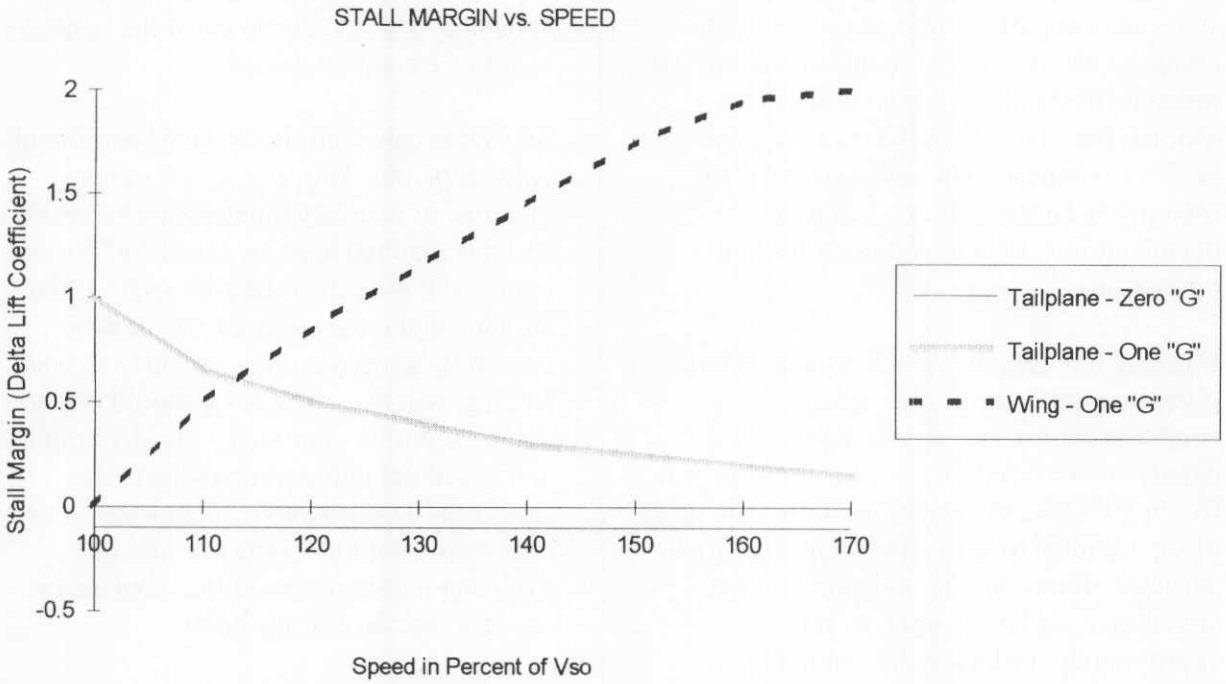

Figure 1

Timely application of proper corrective measures is critical. Not only may the airplane be attempting an outside loop, but as the airplane continues in the nose-down direction, increasing airspeed makes the situation worsen and recovery by brute force on the yoke even more difficult. Estimated pitch control recovery forces can range between 100 and 400 pounds!

One fatal accident occurred with the flaps found at the maximum setting. About a year later, the same operator flying the same model of airplane into the same airport at close to the same temperature and dew point spread experienced ICTS. In this later incident, the crew retracted the flaps and made an uneventful landing. There was, however, an unidentified source of buffet after the recovery.

Another unpleasant surprise may come if the airplane is being flown on autopilot, which has been slowly and silently retrimming nose up and reaches the trim limit in the nose-up direction. When flaps are selected down, the autopilot may self-disconnect and pitch control of the airplane may require four very strong arms. The flap selector is the place to reach in this case, as well.

All Ice is Not the Same

There seems to be an informal pilot skill rating proportional to the thickness of ice on the airplane that one has flown without mishap. Critical ice shape, location, and

texture are often more important. Having successfully flown with a thick non-critical shape may impart an unfortunate sense of complacency or, at least, confusion about the relative effects of ice. Accretion characteristics and the effects of ice shapes are very complex. The safest policy is to treat any ice accretion exceeding the manufacturer's thickness criteria for boot operation as "critical."

It is worth noting the certification standards provide protection for atmospheric conditions in the majority of supercooled clouds encountered, but not for freezing rain, freezing drizzle, or conditions with a mixture of supercooled droplets and snow and/or ice particles. Pilots should understand these limitations and be prepared to act appropriately, including discontinuing exposure by exiting the condition. Some airfoils are drastically degraded by even the thin ice accretion aft of the deicing boots that can occur in freezing rain or freezing drizzle conditions.

Accident/incident reports document that most events occurred at reported airport temperatures at ground level between 20°F and 36°F (-1°C and 2°C), and high humidity indicated by a dew point spread of 9°F (5°C) or less. These environmental conditions may be associated with large droplet sizes that may be greater that 40-50 microns and outside the ice accretion envelope used in certification. The large droplets collect with higher efficiency on airfoil leading edges than smaller droplets, and probably impinge aft of the ice protection system coverage.

Tailplane Ice Without Wing Ice is Possible

Some pilots have reported observing (after landing), and accident airplanes have been found with, ice on the tailplane, but without any ice visible on the wing. This unlikely sounding situation can occur if the tailplane is not or cannot be deiced.

Several accident airplanes have been found with inoperable tailplane ice protection systems, or operable tailplane ice protection systems that had been switched "off" or not operated during the final approach. If the airplane flight manual does not allow a system to be used on the ground or during landing, that doesn't mean it should not be operated during approach. Accident reports and anecdotal information indicate that exposure to certain icing conditions for as little as *three minutes* has resulted in sufficient ice accretion on the tailplane to cause an accident or incident!

Another effect has also been suggested that merits further investigation for airplanes that have the tailplane immersed in the propwash. Limited ground testing shows that local conditions associated with certain wing/tail geometry, temperature and moisture conditions may be favorable for ice accretion on the tailplane with little ice visible on the wing.

High velocity in the propwash and near the airfoil means reduced pressure. Reduced pressure results in reduced temperature in the near-adiabatic (no heat added or removed) process. A visible clue to such a process can be observed on humid days when vapor clouds are visible behind a propeller, rotor, or even an airfoil with the temperature at the dew point. This effect must, of course, offset the kinetic heating effect of the higher velocity airflow. This effect can occur on the ground at zero indicated airspeed with high engine power setting. A temperature depression of 4.5°F

(2.5°C) has been reported in dry air, and 9°F (5°C) in the presence of moisture.

At Mach 0.4 (257 knots) at 32°F (0°C) a theoretical temperature depression could be in order of about 2°F (1°C). While 1°C doesn't sound like a significant "window," there have been several reports of in-flight power loss on modern in-service turboprop engines that resulted from ingestion of ice that had accreted in a temperature window only 1°C wide. This and the higher collection efficiency of many tailplane designs may be a factor for icing in certain environmental conditions or airplane configurations.

It is also important to note that there is a difference in the kinetic heating effect (compressibility of "ram" rise) between dry air and saturated air. When flying from dry air to saturated air (a cloud), a drop in total air temperature can be observed at the same altitude and airspeed. The magnitude of the change depends upon the air speed. At 250 knots, the temperature drop would be about 7°F (4°C). At 150 KTAS, the difference would be about 2.5°F (1.5°C).

The Tailplane as an Ice Collector

The tailplane is generally a more efficient collector of ice than the wing because it generally has a smaller leading edge radius than the wing. There have been pilot reports of ice accretion on the tailplane that was 3 to 6 times thicker than ice on the wing, and up to about 2 times thicker than ice on the windshield wiper arm. Some airplane flight manuals require ice to build up to 1/2 inch before operating the deicing boots. Some make a practice of allowing an inch of ice to build up on the wing before they operate the deicing boots to minimize residual ice on the wing. In certain environmental conditions, this practice could result in as much as 3 to 6 inches of ice on the tail, which may not be shed. Of course, the crew usually cannot see the tail, and typical deicing system pressure sensors provide no indication of unshed ice. Even if ice on the tail was the same thickness as ice on the wing, it would generally be more adverse to the shorter chord of the tailplane.

Concerning the effects of the flap position, ice accreted on the leading edge of the tailplane with the flaps retracted will generally be more adverse to the tailplane after the flaps are extended than ice accreted on the leading edge of the tailplane while the flaps are already extended. This is not to suggest extending the flaps to minimize the effects of ice on the tailplane, however.

Ice-bridging

Because of the concern about ice-bridging from premature boot operation, there seems to be a tendency to protect against bridging by overreacting and delaying operation of the boots until ice accretion is "thicker." Ice-bridging where the ice is moved enough to allow the boot to flex underneath it without shedding the ice is usually associated with soft or "slush" ice. The option here is to find colder temperatures to freeze it so that it can be shed, or warmer temperatures to melt it. It is very important to follow the manufacturer's instructions precisely regarding operation of the deicing system. This may require extra vigilance by the crew, especially at night.

Conclusion

Pilot action resulting from proper training using appropriate information can have an immediate benefit in minimizing the hazards of ICTS.

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Policy and Guidance

Cabin Air Quality

This article has been prepared in response to many questions received in the Transport Airplane Directorate regarding air quality on commercial flights.

Transport airplanes are pressurized by introducing fresh air, bled from the engines before passing through the combustion section, through the airplane air conditioning system, and into the cabin and cockpit of the airplane. The "altitude" inside the airplane is controlled by allowing air to exit the fuselage through an electronically controlled valve.

The Federal Aviation Regulations (FAR) used to certify transport category airplanes require that the cabin altitude be maintained at no more than 8,000 feet for crew and passenger comfort and safety. The actual airplane altitude can be in the 25,000 to 45,000 feet range.

There is always more air introduced into the airplane than is needed for pressurization, to cool avionics equipment and to provide air conditioning to keep the interior comfortable. However, any additional air bled from the engines results in lost thrust, which in turn impacts the cost of operation.

There are also rules which require that the airplane passenger and crew compartments be adequately ventilated. Fresh air requirements for the crew compartment are high in order to ensure that the crew will remain alert to operate the airplane and because the electronic equipment in the cockpit requires cooling air. Because the passenger cabin is occupied by largely sedentary passengers, fresh air requirements there are less stringent. There are limits on concentrations of carbon dioxide, carbon monoxide, and ozone for the passenger cabin, which dictate the minimum requirements for the amount of fresh air introduced into the airplane.

The air *quality* is directly affected by the amount of fresh air supplied to the passenger cabin. Air is introduced into the airplane and allowed to exit the airplane by an automatic pressurization control system. The amount of air introduced into the cabin is determined by the designers and approved as part of the FAA certification process.

Air circulation, which influences perceived air quality, can be influenced by "recirculation fans" which are part of the design on newer airplanes. The air recirculated by the fans is filtered by High Efficiency Particulate (HEPA) "hospital" filters.

While the efficiency of the filters varies with airflow, they are rated to remove from 92 to 98 percent of the particles larger than 0.3 microns. This means that they are effective in removing the majority of odors, dust, and bacteria. It is worth noting that the airplane passenger cabin air quality is in all probability better than that found in most office buildings and restaurants.

However, low relative humidity in the cabins of airliners, which results from the introduction of dry outside air, may cause passengers to perceive the air quality as worse than it actually is.

The original airplane design, established at the time of certification, dictates the fresh air flow rate that must be supplied to meet certification requirements, but the air supply systems have some flexibility in terms of the fresh air supplied in meeting these requirements.

The flight crew can vary the amount of fresh air introduced into the airplane while still meeting the required minimum dictated by the airplane design. When the fresh air inflow is reduced, the passenger cabin air supply may be less than is desirable for passenger comfort, in which case ventilation is augmented by recirculated air. Usually, passenger comfort rather than health or safety considerations dictates to what extent the crew reduces the fresh air supply in the airplane.

Different airlines have different philosophies on the subject, but rising fuel costs certainly have impacted the decisions. As long as the fresh air supply meets the minimum flow rate established for the airplane during certification, which is stipulated for the cockpit only, and there is no specific unsafe condition identified, the FAA does not have the regulatory authority to mandate ventilation decisions.

"Airline Cabin Environment: Containment Measurements, Health Risks, and Mitigation Options," Report No. DOT-P-15-89-5, was prepared for the Department of Transportation by GEOMET Technologies, Inc., and published on December 15, 1989. The level of various pollutants was measured on 92 actual commercial flights and the results are discussed in the report. According to the report, the bacteria and fungi present in the airliner cabins as measured in the study

> *". . . do not appear to be present at concentrations generally thought to pose risk of illness. The taxa normally encountered in indoor environments characterized as 'normal' are also found in cabin air environments . . ."*

(Taxa as used in this context means the class of living organisms usually found together.)

This statement from the report indicates that indoor environments such as offices and homes have pollutant levels comparable to that found in commercial airplanes.

As an additional note, there is always a risk of contracting a contagious disease from someone seated in close proximity in a confined area, such as airliner cabins, theaters, restaurants, and offices. While increasing the fresh air flow to an airliner cabin or other enclosed areas will improve the overall air *quality*, it cannot protect a person from such an exposure.

If you are interested in obtaining more information about the DOT report described above, copies of it are available in larger library systems.

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Policy and Guidance

Designee Terminations

A recent decision of the 9th Circuit Court of Appeals has affirmed the FAA's position that the FAA may terminate designees for any reason that the FAA deems appropriate. The court holds that it has no authority to review the FAA's reasons for termination. This confirms the FAA's position that, as long as the procedures set forth in FAA Order 8130.24 *("Procedures for Termination/Nonrenewal of Aircraft Certification Service Designees and Delegations")* are followed, our actions to terminate designees will not be overturned by the courts.

The court of appeals recently dismissed a petition for review of a decision of the FAA to terminate the Pilot Examiner Designation of a designee. The court held that it lacked jurisdiction to review a decision of the FAA not to renew the Pilot Examiner Designation because the Federal Aviation Act committed such decision to agency discretion by law.

The FA Act provides that the Secretary of Transportation may rescind any examiner delegation at any time for any reason deemed appropriate. The Act [ref. 49 United States Code Section 1355(a)] states:

> "In exercising the powers and duties vested in him by this chapter, the Secretary of Transportation may, subject to such regulations, supervision, and review as he may prescribe, delegate to any properly qualified person, or to any employee or employees under the supervision of such person, any work, business, or function respecting (1) the examination, inspection, and testing necessary to the issuance of certificates under subchapter VI of this chapter, and (2) the issuance of such certificates in accordance with standards established by him. The Secretary of Transportation may establish the maximum fees which such private persons may charge for their services, and *may rescind any delegation made by him pursuant to this subsection at any time and for any reason which he deems appropriate*." [Emphasis added]

Additionally, Federal Aviation Regulations Section 183.15(d) *("Representatives of the Administrator; Duration of Certificates")* states in part:

"(d) A designation made under this subpart terminates --

(1) Upon the written request of the representative;

(2) Upon the written request of the employer in any case in which the recommendation of the employer is required for the designation;

(3) Upon the representative being separated from the employment of the employer who recommended him for certification;

(4) Upon a finding by the Administrator that the representative has not properly performed his duties under the designation;

(5) Upon the assistance of the representative being no longer needed by the Administrator; or

(6) *For any reason the Administrator considers appropriate*. [Emphasis added.]"

In sum, although the Federal Aviation Act grants the court of appeals jurisdiction to review orders issued by the Secretary of Transportation, the Administrative Procedure Act restricts such review when the agency's action is committed **by law** to agency discretion, as was the case here.

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Policy and Guidance

Passenger Cabin Fire Extinguishers

The Transport Airplane Directorate has been in contact with the Fire Safety Branch of the FAA Technical Center in an effort to define the minimum fire extinguisher requirements in the passenger cabin of transport category airplanes.

Based on information obtained, the Directorate has developed the following guidance for evaluating compliance with the fire extinguisher provisions of Federal Aviation Regulations (FAR) Section 25.851(a)(1) and (a)(7) (*"Fire Extinguishers"*):

Halon 1211 extinguishers may be used in lieu of water fire extinguishers to combat Class A fire, provided that a sufficient amount of agent is installed (*i.e.*, 5 pounds of Halon 1211).

For airplanes with passenger capacities between 7 and 30, one extinguisher is sufficient. Alternatively, the following are sufficient:

- **two** Halon 1211 extinguishers with 2-1/2 pounds or more of agent; or
- **one** Halon 1211 and **one** water fire extinguisher.

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Designee News

Designee Management Database System (DMS)

The FAA has developed a nationwide database system focusing on designee management. The goal of this database is to enhance the maintenance and supervision of the designees and their activities, and to provide a more efficient service to designees. This system will enable designees to access more information needed in order to effectively operate their authorized designee functions.

Part of this system will ensure that all designees receive the appropriate information, training, and guidance needed to perform their designee duties effectively. Aside from designee appointment, renewals, and publications updates distribution, this system also tracks all other designee activities, such as FAA Principal Inspector interviews, training, and current designee status.

During the annual renewal process of designee authority, some designees have received a new designee card from the Seattle Manufacturing Inspection District Office with a designee number on it different from the one that was assigned previously. This new six digit number is the *"DMS identification number,"* which will be used as a tracking point whenever any designee actions are processed in the DMS.

[NOTE: This new system does not include designated engineering representatives (DER) at this time.]

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Designee Training Seminar Schedule

Order 8000.60F, "ODAR/DAR AND DMIR/DOA/DAS Standardization Seminar 1994, 1995, 1996, and 1977 Tentative Schedules," dated November 17, 1993, lists the schedule of classes for both Designated Airworthiness Representatives (DAR) and Designated Manufacturing Inspection Representatives (DMIR) within the Seattle Manufacturing Inspection District Office's jurisdiction.

The schedule is as follows:

DMIR Standardization Training Dates:

March 1-3, 1994	**Denver, Colorado**
August 9-11, 1994	**Everett, Washington**
July 11-13, 1995	**Seattle, Washington**
July 9-11, 1996	**Everett, Washington**
July 22-24, 1997	**Denver, Colorado**

DAR Standardization Training Dates:

July 26-28, 1994	**Renton, Washington**
April 18-20, 1995	**Coeur D'Alene, Idaho**
April 23-25, 1996	**Everett, Washington**
April 22-24, 1997	**Portland, Oregon**

For more information, contact your cognizant FAA office.

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New Advisory Circulars (AC)

AC 25.9A
Smoke Detection, Penetration, and Evacuation Tests, and Related Flight Manual Emergency Procedures

Issued January 6, 1994, this revision to the original AC provides guidelines for the conduct of certification tests related to smoke detection, penetration, and evacuation, and for evaluating related airplane flight manual (AFM) procedures. These guidelines may be used to reduce the number of decisions based solely on judgment in conducting tests and evaluating test results. In some cases, designers have chosen to design beyond that prescribed in the airworthiness requirements. A limited discussion of the use of such designs/devices is included in this AC.

AC 25-18
Transport Category Airplanes Modified for Cargo Service

Issued January 6, 1994, this AC provides guidance for demonstrating compliance with the airworthiness regulations pertaining to transport category airplanes converted for use in all-cargo or combination passenger/cargo (combi) service, and the relationship of those regulations to the requirements of Parts 121 and 135 of the Federal Aviation Regulations.

The information contained in this AC is based on the assumption that there are no changes in airspeed, weight, or center of gravity limitations, and that there are no major structural changes such as a stretched fuselage or added cargo door.

AC 25.785-1A
Flight Attendant Seat and Torso Restraint System Installations

Issued January 6, 1994, this revision to the original AC provides guidance relative to the close proximity of aft-facing flight attendant seats and forward-facing passenger seats. This guidance is intended to address the adequacy of new designs, and is not intended to require that in-service airplanes be modified solely for the purpose of meeting the guidelines.

Copies of any of these or any other Advisory Circulars may be obtained by contacting:

Department of Transportation
Utilization and Storage Section
M-443.2
Washington, DC 20590

(Please cite the advisory circular number with your request.)

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Transport Airplane Directorate Designee Newsletter

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