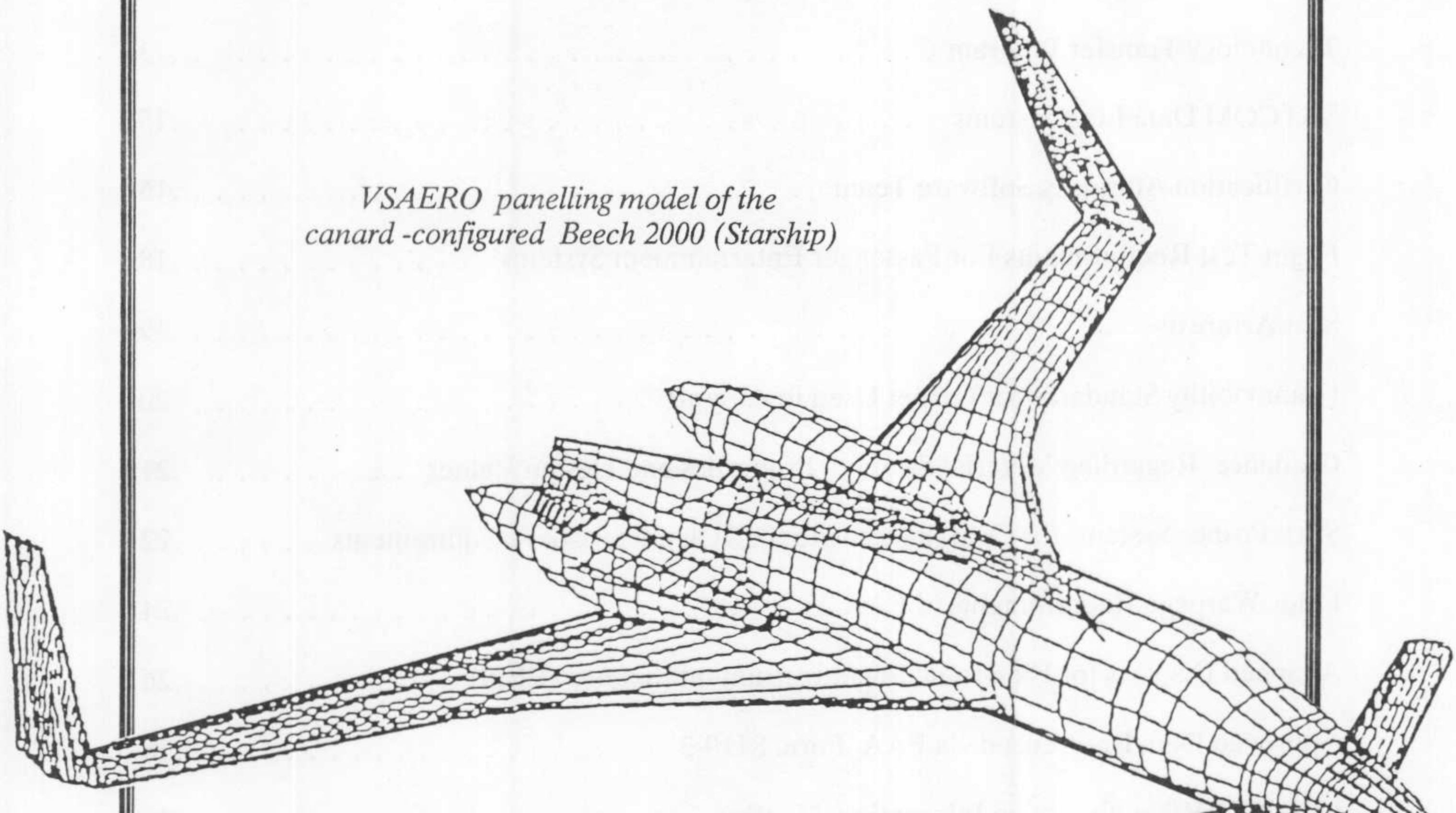
U. S. Department
of Transportation
**Federal Aviation
Administration**

DESIGNEE NEWSLETTER
Transport Airplane Directorate

Aircraft Certification Service; Northwest Mountain Region
Edition 14, September 1992

VSAERO panelling model of the canard -configured Beech 2000 (Starship)



Canard Certification Loads

. . .See article on page 30

Table of Contents

The purpose of The Designee Newsletter is to provide designees with the latest information concerning regulations, guidance material, policy and procedures changes, and personnel activities involving the certification work accomplished within the Transport Airplane Directorate's jurisdictional area. Although the information 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 means, or other materials/documents. If you are in doubt about the status any of the information addressed, please contact your cognizant Aircraft Certification Office (ACO), Manufacturing Inspection District Office (MIDO), or other appropriate FAA office.

New Top Officials

Since the last edition of the Designee Newsletter, a number of changes have taken place among high-ranking government personnel with responsibilities for aviation:

Andrew H. Card, Jr., former Deputy White House Chief of Staff, has been named as the new Secretary of the Department of Transportation, succeeding Samuel Skinner. Born on May 10, 1947, in Brockton, Massachusetts, Mr. Card holds a bachelor of science degree in engineering from the University of South Carolina and attended the United States Merchant Marine Academy and the John F. Kennedy School of Government at Harvard University.

A native of Holbrook, Massachusetts, Mr. Card served in the Massachusetts House of Representatives from 1974 to 1983.

In private industry, Mr. Card served as vice president of CMIS Corporation, a computer software company in Vienna, Virginia. Mr. Card also worked as a design engineer first with Maurice A. Reidy Engineers in Boston and then with David M. Berg, Inc. in Needham, Massachusetts.

From April to August 1988, Mr. Card served in the Reagan Administration as Director of the Intergovernmental Affairs Office and prior to that as an assistant to the President in that office. He was Deputy Chief of Staff since President Bush moved into the White House, and was top aide to former White House Chief of Staff John Sununu.

General Thomas C. Richards, retired four-star Air Force general, has been named as the new Administrator of the Federal Aviation Administration, succeeding Adm. James B. Busey III.

Born on February 13, 1930, in San Diego, California, General Richards holds a bachelor of science degree in business administration from Virginia Polytechnic Institute; a master's degree in communication from Shippensburg State College; and attended the Army War College in Carlisle Barracks, Pennsylvania.

General Richards' career in the Air Force included service in Germany, Vietnam, Thailand, and Laos, where he served in the U.S. embassy. His last assignment was as Deputy Commander-in-Chief of the U.S. European Command. As a flier, he had combat crew training, followed by a number of commands, including a three-year stint as commandant of cadets at the Air Force Academy. Prior to the Air Force, General Richards served as an Army platoon sergeant in the infantry during the Korean War.

General Richards was a member of a U.S. Presidential Commission that investigated the terrorist bombing of Pan Am Flight 103 that crashed over Lockerbie, Scotland.

Since leaving the Air Force, General Richards has worked as a corporate consultant.

General Richards has more than 5,000 flight hours and is qualified in propeller-driven airplanes, as well as single- and multi-engine et aircraft. He has flown combat missions in Cessna 0-1's (Bird Dogs), North American T-28's, Helio U-10's (Couriers), and U-17's (Cessna 185's).

Ronald T. Wojnar has been named as the new Manager of the Transport Airplane Directorate in Renton, Washington, succeeding Leroy Keith.

Born December 3, 1949, Mr. Wojnar holds a Bachelor of Science degree in aeronautical and astronautical engineering from Purdue University.

Mr. Wojnar started his FAA career in 1975 as an Aviation Safety Inspector in Des Plaines, Illinois; moved to Milwaukee, Wisconsin, in a similar position; and then back to Des Plaines, Illinois, where he was promoted to Manager of the Manufacturing Inspection Branch.

From 1987 to 1989 he served as Manager of the Manufacturing Inspection Office in the Small Airplane Directorate in Kansas City, Missouri. From 1989 to the present, he was Manager of the Aircraft Manufacturing Division in the FAA's Aircraft Certification Service in Washington, D.C.

Mr. Wojnar's interest in aviation goes beyond his FAA career and his educational background, however: he holds a commercial pilot's license and an airframe and powerplant mechanic's license.

SPECIAL TOPIC:

U.S., CIS Work Towards a Bilateral Airworthiness Agreement

Background

In April 1991, the FAA agreed to conduct an assessment of the Soviet Union's aircraft certification process for a possible bilateral airworthiness agreement (BAA). A BAA, when concluded, will allow the reciprocal airworthiness certification of one country's aeronautical products with the other country's airworthiness authorities.

At that time, the Soviet Union's civil aviation system was organized as a series of ministries reporting to the Supreme Soviet of the USSR. The Soviet authority responsible for civil aviation safety matters was the State Supervisory Commission for Flight Safety (Gosavianadzor, or GAN). The chairman of GAN reported to the Supreme Soviet and had the rank of minister. The lead organization within GAN responsible for aircraft certification matters was the State Aviation Register (Gosaviaregister, or GAR). In general terms, GAN was similar to the FAA, and GAR was similar to the Aircraft Certification Service. In addition to GAN, other key ministries of direct interest were the Ministry of Aviation Industry, with responsibility for the design bureaus and production facilities; and the Ministry of Civil Aviation, with responsibility for the civil airlines (i.e., Aeroflot).

During the same timeframe, the FAA accepted applications for U.S. type certification of two Soviet designs, the Tupolev TU-204-200 and Ilyushin IL-96M. These two type designs are the first Russian transports intended for Western markets, both in Europe and here in the U.S. Both type designs are derivatives of existing Soviet transports and will incorporate U.S.-manufactured engines and avionics systems. The TU-204-200 is a twin-engine, medium range, single-aisle airplane with a seating capacity of 178 to 212 passengers, which looks much like a Boeing 757. The IL-96M is a four-engine, long range, wide-body airplane that seats 300 to 375 passengers. Both airplanes are powered by Pratt & Whitney PW2240 engines and will be equipped with either Honeywell or Collins avionics, making them the first Russian aircraft equipped with U.S. engines and avionics.

Ideally, the FAA targeted to issue the type certificates for these two designs immediately following the conclusion of the BAA. The anticipated date for concluding the BAA was projected to be sometime in 1995 or 1996.

A BAA assessment team was formulated in May 1991, consisting of eight teams made up of specialists representing the various technology disciplines associated with a typical FAA certification program: airframe, crashworthiness, electrical systems, mechanical systems, propulsion, flight test (pilot and engineering), and manufacturing inspection. Each team consists of 4 to 6 members, most of whom are from the Transport Airplane Directorate.

The FAA's National Resource Specialists agreed to act as advisors to the special discipline teams. Another team, made up of members of the Aircraft Evaluation Group (AEG), which is a part of the FAA's Flight Standards Service, was assembled later.

Generally speaking, the task of any BAA assessment team is to ensure that the regulatory and certification systems of the Exporting Civil Airworthiness Authority (ECAA) -- in this case, the Soviet Union -- are sufficiently similar in structure and meaning to those of the U.S. The following 11 categories reflect the general characteristics of the U.S. system that are usually evaluated:

- **Legislation**
- **Mission**
- **Mission priorities**
- **Organization**
- **Personnel**
- **Products**
- **Standards and practices**
- **Design, production, and airworthiness certification processes**
- **Certificate management activities, including:**
- **Monitoring activities**
- **Continued airworthiness**
- **Communications**
- **Environment**

An assessment team relies on a variety of methods to assess the ECAA's aircraft certification system. Primary among these are:

- **document reviews,**
- **data analysis,**
- **analysis and discussion of ECAA practices,**
- **witnessing of tests, and**
- **shadow inspections.**

Wherever possible, the team's approach is to educate and inform ECAA officials of the FAA's interpretations of U.S. standards and requirements, and to reconcile possible differences.

The Soviet BAA assessment program kicked off in July 1991, when the assessment team leaders met in Moscow to obtain familiarization briefings on the two aircraft type designs and to develop familiarity with the Soviet aircraft certification system. This was followed by specialists meetings in Moscow during September involving four technical discipline teams: crashworthiness, mechanical systems, propulsion, and a joint flight test team.

In October 1991, a team of five Transport Airplane Directorate flight test pilots and engineers participated in the very first flight test of a Soviet civil transport airplane conducted with non-Soviet citizens. The flight test, lasting 1.4 hours, was conducted on an Ilyushin IL-96-300 airplane from the Flight Research Institute in Zhukovsky City, just outside Moscow, and was intended to familiarize the FAA flight test pilots with a modern Soviet airplane's flying capacity. The two FAA pilots who participated took turns sharing the flight controls with the Soviet pilots.

Program Review Meetings were planned to be conducted semi-annually, alternating between Washington D.C. and Moscow, to monitor the progress of the program. The next meeting was planned for early December 1991 in Washington D.C.

However, in December 1991, the dissolution of the Soviet Union took place and a "Commonwealth of Independent States (CIS)" was created. Because of the continued turmoil and the uncertainty as to the future of the government of the region, the Program Review Meeting was canceled and the entire BAA assessment program was put on hold.

New CIS Civil Aviation Authority Organization

In December 1991, the heads of twelve former republics of the Soviet Union signed an Agreement on Civil Aviation and the Use of the Airspace, referred to as the "Minsk Agreement." This agreement identified the certification of aircraft as an area of common responsibility and regulation between the former republics. The Interstate Aviation Committee (MAK) was established to implement the terms of this agreement. The chairperson of MAK is Ms. Tatyana Anodina.

In February 1992, a sub-committee of MAK was established and named the Aviation Register (AR), chaired by Valentine Sushko. The AR is recognized by the heads of the 12 former Soviet republics, as well as by Latvia and Estonia, as their aircraft certification authority.

(See the diagrams of the new organizational structure of the CIS Civil Aviation Authority and the AR that follow this article.)

The AR is the successor organization of the GAR and is responsible for the development of airworthiness and certification regulations, aircraft and their component certification, and continued airworthiness. In general, the AR is similar to the Aircraft Certification

Service of the FAA in organization and areas of responsibility. The AR will continue as GAR did before to utilize the various technical capabilities provided by the research institutes.

Since the new CIS is not recognized by the U.S. Department of State as an independent country, the FAA cannot conclude a BAA with the CIS. At this time, we consider the BAA assessment program to be with the Russian Federation, which legally acknowledges the AR as its certification authority. There is some speculation that, at the same time that we sign a BAA with Russia, we also may sign one with three other former Soviet republics: Georgia, Uzbekistan, and Ukraine. The overwhelming majority of transport category airplane activity from the former Soviet Union remain in these four countries.

The Sukhoi SU-29

A new development in the program leading to a BAA with Russia occurred during the latest Program Review Meeting that took place in June 1992. The FAA agreed to accept an application for type certification for the Sukhoi SU-29, a small 2-person acrobatic airplane. A U.S. customer has purchased 24 of these airplanes and would like to use them for broader purposes than allowed under a restricted category airworthiness approval.

The FAA agreed to accept a type certification application for the SU-29 for purposes of conducting an assessment program leading towards a limited-scope BAA. This assessment program will use specialists from the Small Airplane Directorate, and will be managed by the FAA's Aircraft Certification Service (International Airworthiness Program Officer, AIR-4C) in Washington, D.C., and the Small Airplane Directorate's Standards Office (ACE-110) in Kansas City. This should result in the U.S. concluding a first-step BAA with Russia within a very short time (approximately 1 to 2 years). The transport category airplane assessment program thus would conclude in an expansion to the BAA.

Harmonization of Airworthiness Standards

The CIS Aviation Register (AR) is currently in the process of harmonizing its airworthiness standards, referred to as the NLG code, to the U.S. Federal Aviation Regulations (FAR). The civil airplane standard is "NLGS-3." In summary:

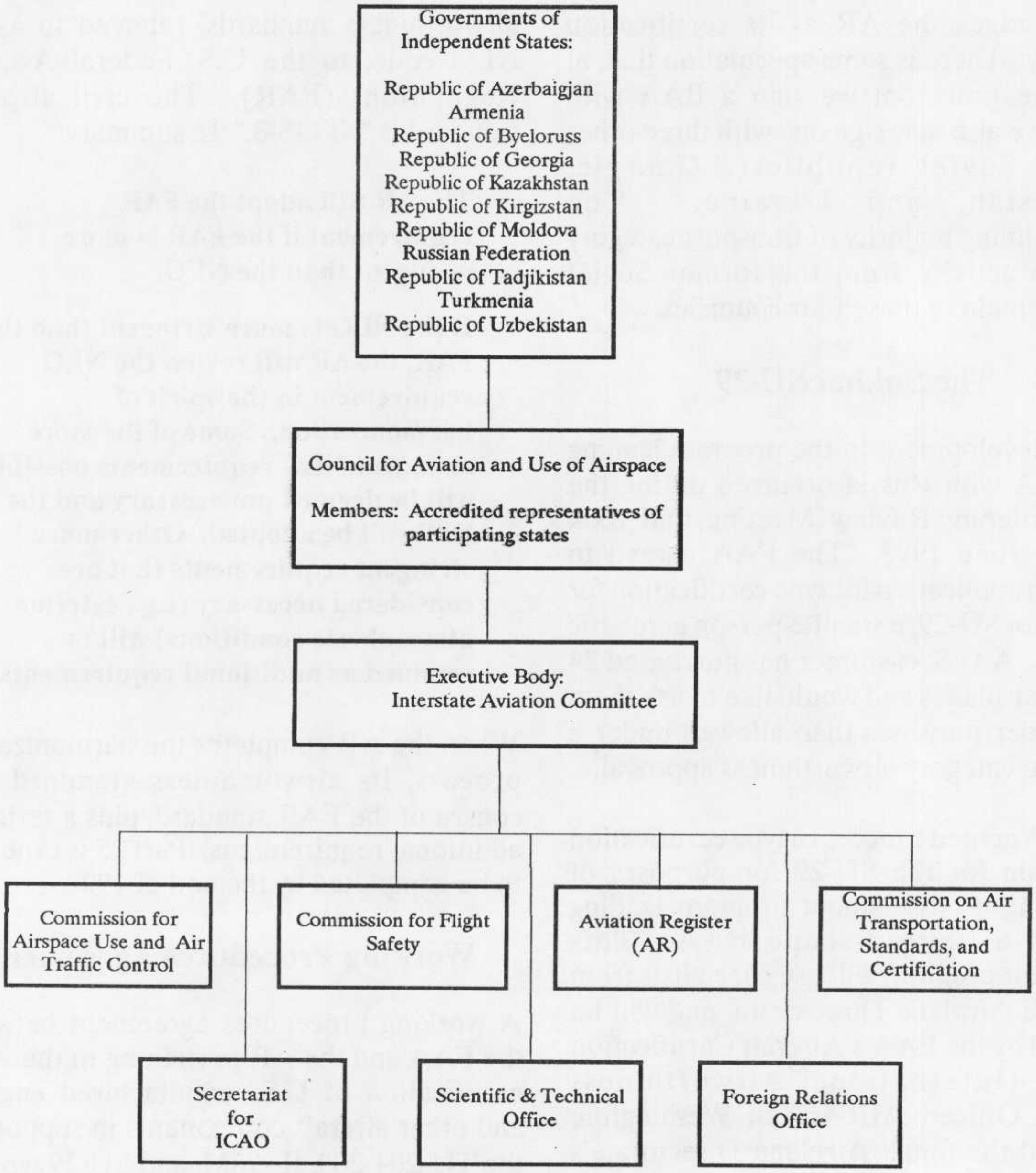
- **The AR will adopt the FAR requirement if the FAR is more stringent than the NLG.**
- **If the NLG is more stringent than the FAR, the AR will review the NLG requirement in the spirit of harmonization. Some of the more stringent NLG requirements possibly will be deemed unnecessary and the FAR will be adopted. Other more stringent requirements that are considered necessary (e.g., extreme atmospheric conditions) will be retained as additional requirements.**

When the AR completes the harmonization process, its airworthiness standard will consist of the FAR standard, plus a series of additional requirements. Part 25 is expected to be completed by the end of 1992.

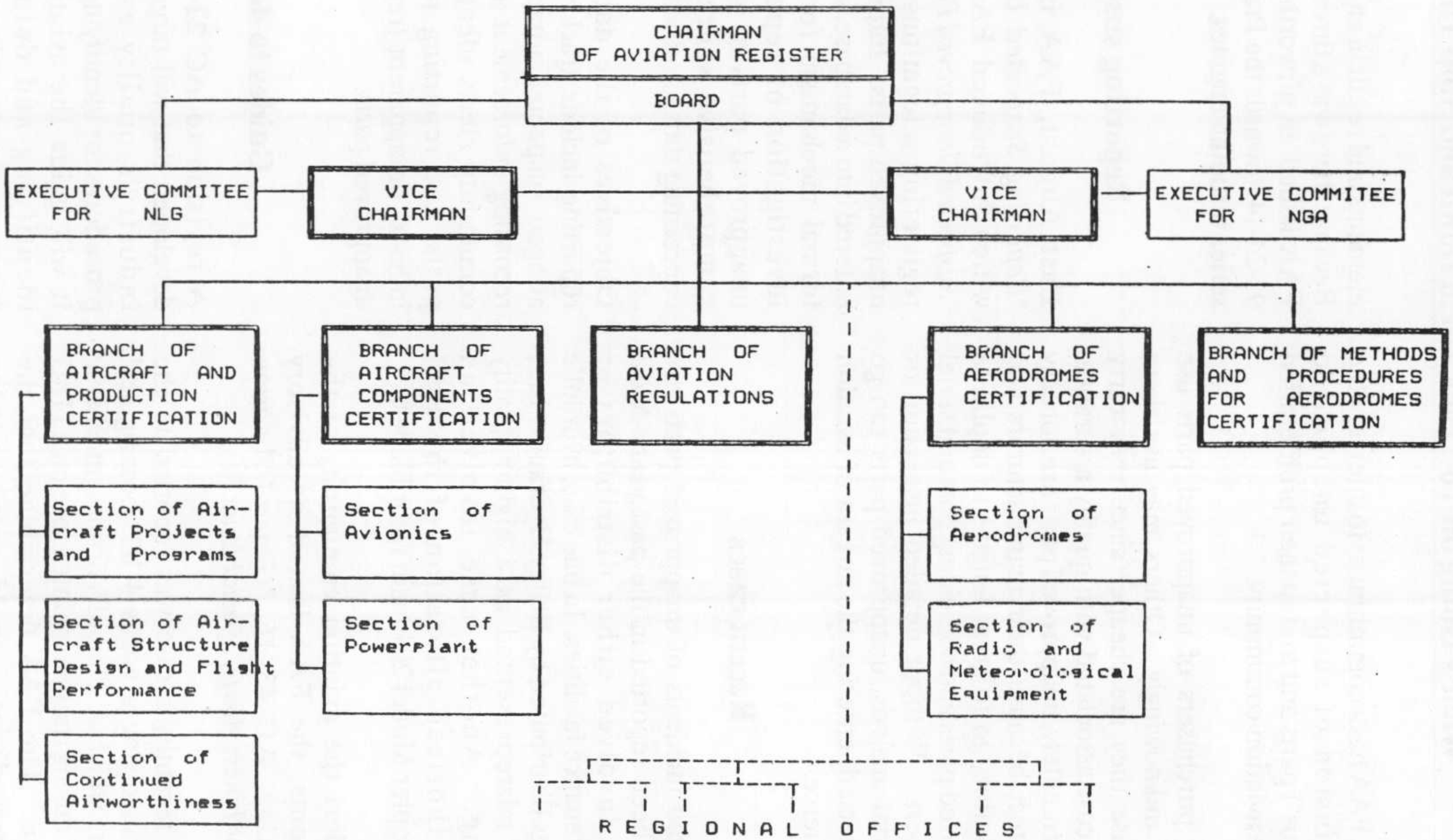
Working Procedures Agreement

A working procedures agreement between the FAA and the AR pertaining to the AR's certification of U.S.-manufactured engines and other aircraft components in support of the TU-204-200, IL-96M, and SU-29 type designs, was concluded at the latest Program Review Meeting. This agreement authorizes certification responsibility for engines to the AR; TSO components to the FAA; non-TSO components to the AR; and the integration and installed performance of all components to the AR. It also outlines the conditions and guidelines under which the FAA will provide technical support to the AR during its certification activity here in the U.S.

Organization of the CIS Civil Aviation Authority



Interstate Aviation Committee, Aviation Register



FAA's Attack on "Bogus" Parts: What's Going on To Track Them Down and Stop Their Use

The FAA has a commitment to intercept the infusion of suspected unapproved ("bogus") parts and to stop their proliferation in the aviation community.

Most purchasers of unapproved parts use them unknowingly. Others may use them because they are cheaper since they carry little cost associated with quality assurance. Unfortunately, unapproved parts are not easy to detect because their manufacturers and distributors go to great lengths to duplicate approved parts and coinciding part and serial numbers. Without detailed inspection or material analysis, unapproved parts can go undetected, entering the stream of aviation commerce.

Recent cases

Isolated incidents of unapproved parts use have been reported in the past year. Most have involved either distributors or maintenance facilities. In one case, hydraulic fittings distributed by Bailey Hydraulic, Inc., were misrepresented as a higher quality fitting. Another case involved an unauthorized alteration of the Bell Helicopter Model 204 main rotor blades.

To alert the aviation community of the incidents, the FAA issued its advisory circular, AC 43-16, "*General Aviation Airworthiness Alerts, Special Issue.*"

Most recently, a case was reported to the FAA involving a bogus 4-1/2" bearing seal spacer, which a United Airlines mechanic found during routine maintenance on a JT8D engine. The FAA determined that the unapproved spacers would contribute to the rapid deterioration of the bearing seal elements and result in an early engine failure. Because there was a threat to flight safety, the FAA issued an airworthiness directive, AD 91-24-14, towards the Pratt & Whitney JT8D series turbofan engines.

Reporting suspect parts

Last August, FAA issued AC 21-29, "*Reporting Suspected Unapproved Parts,*" which introduced FAA Form 8120-11, "*Suspected Unapproved Parts Notification*" for registering allegations about the use of unapproved parts. Information collected is entered into a database, which is the agency's formal mechanism for coordinating the investigation of reports of suspected unapproved parts as well as the single, comprehensive source of information concerning those notifications.

Objectives of the data collections and reporting include tracking investigations of alleged suspected unapproved parts use, recording enforcement actions and aviation community alerts identifying unapproved parts, and reporting to the agency and industry on apparent trends associated with unapproved parts.

Guides to detection

A revision to AC 21-29 is now being developed that will target ways to improve industry's quality assurance/control procedures for identifying unapproved parts. It will guide the aviation community in identifying and detecting suspected unapproved parts and screening out potential unapproved parts suppliers.

For instance, it is suspicious when:

- **Quoted prices or prices advertised in trade magazines for a part are significantly lower than the price quoted by other suppliers of the same part.**
- **Delivery schedule is significantly shorter than other suppliers of the part.**
- **Suppliers are unable to provide drawings, specifications, or substantiating data to demonstrate the conformity of the part.**

Buyers are advised to:

- **Inspect product containers for required markings or possible damage.**
- **Cross check purchase orders with the delivery receipts for proper part numbers.**
- **Verify that part identification requirements have been met--for instance, checking to see that serial numbers are not stamped over, labeling is proper, and vibro-etch or serial numbers are in normal locations.**
- **Inspect parts for defects or abnormalities--altered or unusual surfaces, absence of required plating, evidence of prior use, scratches, new paint over old, attempted exterior repairs, pitting, corrosion, and the like.**

Another way the FAA is combating the proliferation of unapproved parts is the development of procedures to initiate, prioritize, and terminate investigations, while ensuring the confidentiality of a reporter's information. This program will alert FAA offices and production approval holders of unsafe conditions related to unapproved parts allegations.

When warranted, copies of allegations will be provided to the Office of Aviation Security for coordination with government investigative agencies.

Task force participation

In other activities to combat the proliferation of unapproved parts, the Aircraft Manufacturing Division (at FAA Headquarters in Washington, D.C.) during the past 17 months has participated in a joint task force formed by the Aerospace Industries Association of America (AIA) and aimed at helping the aviation industry and the FAA work together to develop some solutions to unapproved parts issues.

Additional members of the task force include: General Aviation Manufacturers Association (GAMA), Air Transport Association (ATA), Aeronautical Repair Station Association, and representatives from Boeing, General Electric, Pratt & Whitney, United Airlines, Delta Airlines, and Northwest Airlines.

Spreading the word

The task force has cited the need for an education program to increase understanding of FAA regulations and procedures with regard to detecting and reporting suspected unapproved parts use. In response, the FAA volunteers from various industry organizations formed the Joint Task Force Education Program subcommittee to develop a training program.

Audiences targeted to received training include personnel at repair stations, airline material/part receipt inspection stations, and airline purchasing departments; suppliers/distributors; mechanics; pilots; and FAA field inspectors. Fifteen to 20 minute long videotapes will be produced to give an overview of regulations pertaining to airline and repair station's quality assurance procedures; the perspective of suppliers/distributors; and general aviation's position on part installation, including end-user liability and compliance with regulations for mechanics, pilots, and individual owners/operators. They will also explain agency regulations on unapproved parts and their use.

A cooperative task

It's clear that combating the spread of unapproved parts takes cooperation and teamwork from both government and industry. In continually striving for greater levels of safety, aviation industry associations and the Aircraft Certification Service will continue to cooperate in halting the use of unapproved parts.

Aircraft De-icing Conference Attracts 800 Worldwide

A two-day international conference on how to fight ice buildup on planes attracted approximately 800 aviation experts, including 65 international representatives. Represented at the conference were aircraft manufacturers, de-icing equipment manufacturers, airport operators, universities and research institutions, government agencies, and airline maintenance, operations, and dispatch employees.

Held in suburban Washington, D.C., on May 28-29, the turnout at the FAA-sponsored event showed a global "common concern" about aircraft icing hazards, FAA Deputy Administrator Barry Harris told the group. Over the years, he said, international aviation experts have collaborated to reduce the hazards of windshear, midair collision, aging aircraft, and terrorism. "We've pooled information and technology to meet each new challenge," Harris said. "And through our collective efforts, we've made air travel the safest form of transportation in the world."

FAA officials said the agency is working on preliminary decisions regarding a new de-icing policy and expect to have a safety program on the books before the winter. The new policy will replace FAA's existing rule, which Harris characterized as "frustratingly simple." The rule sates that no person shall take off in a aircraft with ice, snow, or frost adhering to the wings.

Many airline pilots have made many "go" or "no-go" decisions in adverse weather conditions. "Luckily, they were almost never wrong," said Harris. "The problem is, luck should have nothing to do with this decision. The pilot must have the best information possible..."

The conference followed the crash of USAir Flight 405 (a Fokker Model F28) in March, after takeoff in a snow storm at New York's La Guardia Airport. Ice buildup on the wings is being investigated as a probable cause of the crash in which 27 of the 51 on board died.

The conference concentrated on numerous areas, including aircraft and wing designs; de-icing fluids and how they work under various weather conditions; hazards of de-icing fluids on people and the environment; air carrier and airport operator recommendations on placement of de-icing stations; ground crew advice on procedures for de-icing; pilot and crew training in ice detection and recognition; special maintenance training for various types of de-icing fluids; and aircraft dispatching and sequencing.

"I find it sad, even ironic," Harris concluded, "that with all our great technology, ordinary winter weather, like snow, ice, and frost, is still capable of bringing down the most sophisticated aircraft and the most experienced pilot. . .we must move swiftly and decisively in seeking to reduce the hazards of aircraft icing."

Technology Transfer Program

In an effort to maintain preeminence in the world market of technological and economic development, Congress enacted the "Federal Technology Transfer Act of 1986." This Act requires each Federal agency to establish a program to provide a means to improve transfer of commercially useful technologies to the private sector.

More than $20 billion is spent each year on research and development (R&D) at 700 Federal laboratories, but only about 5 percent of this technology reaches the private sector. The Act commits the government to transfer Federally-owned and -originated technology to state and local governments and to the private sector. The Act's purpose is to stimulate technology development through economic incentives, cooperation between corporations and Federal labs, and the channelling the flow of knowledge among universities, private companies, civilian government agencies, and the military.

In October 1989, FAA Order 9550.6, "*Technology Transfer Program,*" established this program in the FAA. It has been designed to achieve the maximum national benefit from FAA scientific and technical efforts. It establishes as FAA policy the following:

- **The encouragement of dissemination of scientific and technical information, data, and know-how developed by or for the FAA to state and local governments and to the private sector, consistent with the requirements of U.S national security.**

- **Promotion of the sharing of technology that fosters the advance of science or that has commercial potential and, thus, should be employed to the greatest advantage for the security and socio-economic well-being of the U.S.**

- **Support of coordination between the industrial, academic, and government research and development activities of the U.S. by cooperating in the sharing of plans for future research efforts and the sharing of facilities as appropriate.**

The Act designated certain Federal laboratories as the nuclei for technology development. The Office of Research and Technology Applications at FAA's Technical Center, in Atlantic City, New Jersey, is the FAA's focal point for the technology transfer program. This office is responsible for approving the FAA's Cooperative Research and Development Agreements (CRDA) with industry, universities, and other government agencies.

CRDA's permit company representatives to work side by side with government scientists to maintain a steady flow of information and allow commercialization of inventions. These agreements will open doors to aviation research not touched on in the past. Resources both from government and from private industry are pooled for specified R&D efforts. These joint programs will spur the ability to conduct research without slowing the process through procurement.

An example of the FAA's technology transfer effort is the Traffic Alert and Collision Avoidance System, better known as *TCAS*. The FAA, two avionics manufacturers, and two major airlines collaborated to develop the design standards for this system. In a more recent effort, the FAA Technical Center and Northwest Airlines are working together to develop a system to match checked baggage with passengers to ensure that all baggage placed on a airplane belongs to a passenger who is also on that airplane.

The program means huge incentives:

- **The idea that generates a program can be initiated either by a government worker or by a private sector worker.**

- **Long-standing technological problems that have not yet been solved may be accomplished with a team effort.**

- **Innovation, especially in small businesses, could be stimulated with the availability of pooled resources.**

- **Federal workers' creativity and productivity are encouraged through patents and royalties for their work.**

If you would like more information about this program, contact:

Federal Aviation Administration
Technical Center
Office of Research and Technology Applications, ACL-1
Atlantic City International Airport, New Jersey 08405.

SATCOM Data Link Systems

The Transport Airplane Directorate recently received a request for guidance concerning the certification of satellite communication (SATCOM) data link systems for automatic dependent surveillance (ADS). Specifically the following questions were raised:

Question: *What criteria and standards should be used in certification of such development systems? Does a development program agreement constitute waiver of applicable Federal Aviation Regulations (FAR) paragraphs?*

FAA response: An applicant who desires to evaluate a system in an aircraft during revenue service should meet installation requirements via an amendment to the Type Certificate (TC) or a Supplemental Type Certificate (STC) for the aircraft.

As an evaluation system, the SATCOM data link system can be installed on a non-interference basis. In other words, to demonstrate compliance with Section 25.1309 of the FAR, the applicant must show that the installation does not interfere with other equipment on board the aircraft. If the system interfaces other systems, then a Failure Modes and Effects Analysis (FMEA) and/or Fault Tree or Reliability Block Diagram Analysis (refer to AC 25.1309-1A) may be required depending on the nature and extent of the interface and the criticality of the systems interfacing the SATCOM data link system.

The applicant must also show that the additional workload required by the flight crew to conduct the evaluation does not impose an unacceptable workload on the flight crew during normal operations. This evaluation should be accomplished via ground and flight functional tests.

If the normal operation or failures of the development system adversely affect other equipment or flight crew workload, its installation should not be approved.

Question: *When a system, such as the one described, cannot be certified for use in its intended function within the development program, how should such deficiencies be documented? Should the deficiency be a limitation on the TC?*

FAA response: When a development system performs functions which could affect flight safety, the applicant should be encouraged to evaluate its design and operation as a part of the certification project. If the applicant will not or cannot conduct an acceptable evaluation, or if the system clearly has deficiencies that are not corrected prior to certification, appropriate restrictions on the operation of the system should be included in the limitations section of the flight manual.

The airplane flight manual limitation should make it explicitly clear to the flight crew that the SATCOM data link system has been installed for evaluation purposes and should not be used for air traffic control (ATC) communications. Exact wording for the flight manual limitation should be coordinated with the Flight Test Branch of the cognizant FAA Aircraft Certification Office (ACO) and the cognizant FAA Aircraft Evaluation Office.

Appropriate placards may also be necessary, contingent on the results of an FAA flight test evaluation. A limitation on the TC is not necessary.

Question: *Once the development program is complete, how are system limitations enforced? If a system must be upgraded for continued use, how is this requirement levied on the operators.*

FAA response: Limitations in the flight manual are enforced similar to other limitations contained in the flight manual - through the FAA Flight Standard's surveillance of the air carrier's operations. Limitations on the use of the SATCOM data link system can only be changed or removed by the FAA Aircraft Certification Service. If upgrades to the system are necessary to allow use of the SATCOM data link for ATC communications, then the applicant would be required to submit an application for an amendment to the TC or STC to obtain approval of the upgrades.

The Transport Standards Staff of the Transport Airplane Directorate currently has an advisory circular (AC) project underway to develop policy and guidance for airworthiness approval of aeronautical telecommunications network compatible airborne data link systems. This AC does not address ADS, but does address the FAA's data link program. However, the FAA envisions that it will incorporate ADS requirements in the near future.

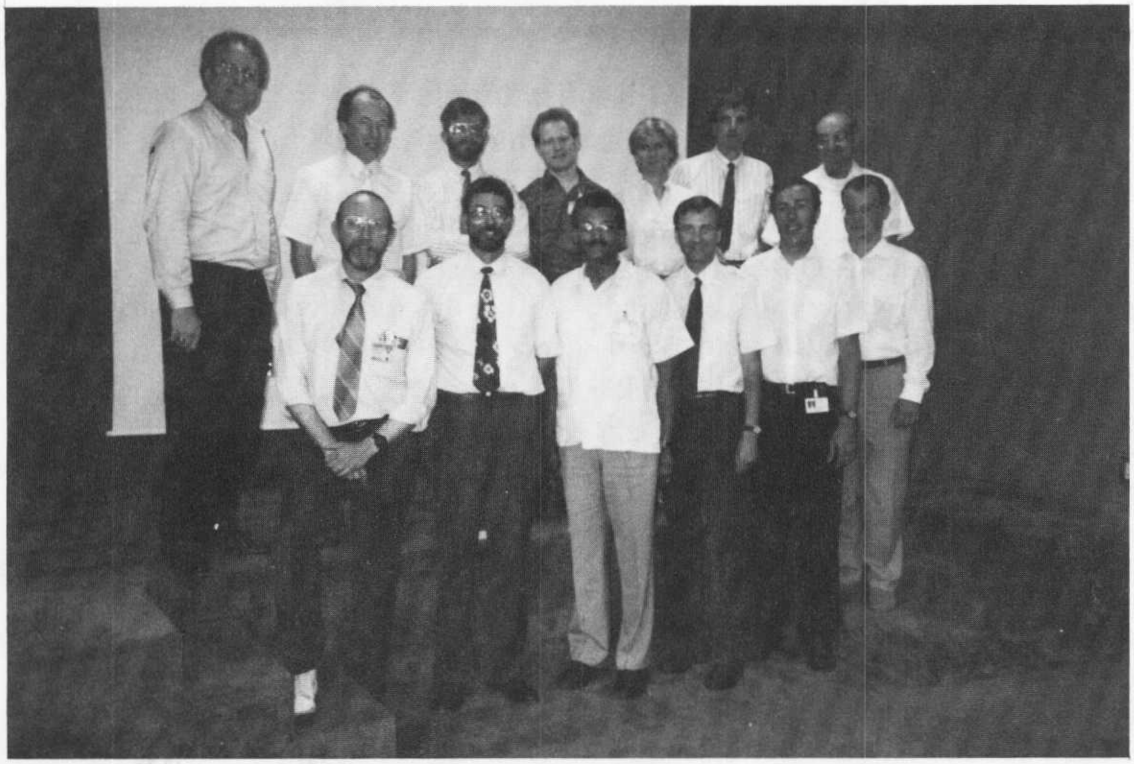
The proposed AC will be published in the Federal Register in the near future and a time for public comment on it will be provided.

Certification Authority Software Team

The Certification Authority Software Team (CAST) is comprised of systems and software engineers from the Joint Airworthiness Authority (JAA), all of the Directorates within the FAA, and the Canadian Ministry of Transport (MOT). It was formed as part of on-going efforts supporting FAA/JAA "harmonization" activities.

The team was originally established at the request of the FAA to support a joint effort by the Radio Technical Commission for Aeronautics (RTCA) and its European community equivalent, EUROCAE, to revise RTCA Document DO-178A, "*Software Considerations for Airborne Systems and Equipment Certification,*" and its parallel document, EUROCAE ED-12A. However, both the JAA and FAA are in the process of chartering CAST to address all policy and guidance issues related to software.

Advisory material issued by both the FAA and JAA recognizes RTCA DO-178A/ EUROCAE ED-12A as an acceptable means of compliance for the software in airborne systems and equipment. These parallel documents were developed to establish software considerations for developers, installers, and users when the aircraft equipment design is implemented



CAST Members: l. to r. (Back row): Jim Williams, Atlanta Aircraft Certification Office (ACO); Dan Hawkes, CAA (United Kingdom); Jozef van Baal, RLD (The Netherlands); Mark Perini, Transport Airplane Directorate; Rosanne Ryburn, Los Angeles ACO; Jean Beijard, DGAC/CEAT (France); Cosimo Bosco, Engine & Propeller Directorate. (Front row): Mike DeWalt, FAA Software National Resource Specialist; Tom Kraft, Transport Airplane Directorate; Geoff McIntyre, FAA, R&D; Geoff Burtenshaw, CAA (United Kingdom); Claude Secher, DGAC/CEAT (France); Peter Tiechert, LBA (Germany)

using microcomputer techniques. The documents outline verification, validation, documentation, and software configuration management and quality assurance disciplines to be used in microcomputer systems.

Members of CAST will review the adequacy of these existing guidance documents, provide direction to industry to revise these documents, and ensure a consistent interpretation and application of the guidance internally among the FAA Directorates and externally among the participating certification authorities.

CAST is currently meeting on a four-month cycle during the RTCA/EUROCAE activities. The revised version of RTCA DO-178A (to be titled RTCA DO-178B) is scheduled to be completed by the end of 1992.

After RTCA/EUROCAE activities are complete, CAST is planning to continue meeting on a four-month cycle.

Suggestions for topics for discussion at CAST meetings may be forwarded to **Tom Kraft, FAA, Transport Airplane Directorate, ANM-111, 1601 Lind Avenue SW., Renton, Washington 98055-4056.**

Flight Test Requirements For Passenger Entertainment Systems

The Transport Airplane Directorate has conducted a review relative to establishing unified criteria for flight testing of audio/video entertainment systems to confirm that electromagnetic interference (EMI) from these systems does not interfere with other systems in the airplane.

The following guidance will apply:

Flight testing, in addition to ground EMI testing, of an initial installation may be required when the avionics installed on the airplane provide an FAA-certified capability to perform any navigation and/or guidance function that has been assigned a safety criticality classification of "Essential" or "Critical," and that can be invoked while the entertainment system is powered. These functions would include, for example, flight director speed command takeoff guidance, area navigation, Category II or III approach, and autoland operations.

If an airplane's primary control is provided by a fly-by-wire system, it will always be flight tested; however, if an airplane's powerplants incorporate a Full Authority Digital Engine Control (FADEC) system, it will be presumed that the airplane will be flight tested, unless it can be clearly shown that the airplane should not be subject to flight tests.

Ground EMI tests consistently have been found to be adequate for follow-on approvals of like or identical equipment types, irrespective of the airplane model used for the initial approval. However, flight testing could be required when:

- **results of ground EMI tests reveal any questionable or marginal phenomenon;**
- **it is evident that ground tests cannot adequately simulate the in-flight environment; or**
- **the systems being tested for susceptibility to interference cannot be operated fully on the ground (e.g., autoland system multi-channel engagement).**

In any event, the test plan must address the effects due to EMI on the operation of all avionic elements and flight deck displays associated with the functions for which testing is required. This requirement includes all the supporting systems that provide the means for monitoring the performance of the functions being tested.

Flight testing, if required, will be necessary only to substantiate each Supplemental Type Certificate (STC) applicant's initial certification of the installation of a specific entertainment systems aboard a particular airplane model. For subsequent approvals (via either a new or an amended STC) of similar installations on the same airplane model, or on an "electronically similar" variant of that model, only ground tests would be required.

"Electronic similarity" is established when neither the applicant nor the FAA can identify changes to the equipment or installation that are potentially capable of significantly altering the EMI environment of the airplane or the susceptibility of the avionics installation to EMI. Such changes might include, for example, the installation of new types of avionics, revision of the wiring routing defined for the original STC, or differences in the makeup of existing wire harnesses installed in various eligible airplanes. The significance of any changes would be determined in accordance with collective engineering judgment of the applicant and the FAA.

Additionally, flight testing would not be waived if the information provided in an STC package, which satisfactorily supported the initial installation, is found to be inadequate to support an unequivocal finding of similarity for an installation that was not identical.

Seat Armrests

The Transport Airplane Directorate has received several questions concerning seat armrests, specifically:

What is the amount of offset for seat armrests that is permissible without having to substantiate the armrest end cap for headstrike?

When seats are located directly behind one another, the armrests are lined up longitudinally, and the headstrike zone is treated is a 35" arc measured over the width of the seat, between the armrests. When the seats are offset, which may occur in the non-constant section of an airplane, a 35" arc measured in this manner would intersect an armrest of the forward seat. The FAA considers that this situation has two aspects:

The first of these occurs where the forward seat is an aisle seat and has an armrest that is exposed (bounded on one side only). In this case, an offset that positions the forward armrest within the projected headstrike path of the rear occupant, as described above, is not acceptable unless the armrest is substantiated for headstrike. Depending upon the certification basis of the airplane, this substantiation may take different forms:

For airplanes with a certification basis prior to Amendment 25-64 to Part 25 of the Federal Aviation Regulations (FAR), the substantiation may be a test, or an analytical comparison to the other components in the headstrike path, showing that the armrest is no worse. For airplanes with Amendment 25-64 in the certification basis, a Head Injury Criterion measurement of 1,000 or less must be shown.

The second aspect occurs when the offset armrest is not exposed. In this case, due to the protection afforded by the surrounding seatbacks, the FAA considers that an offset of 2" is acceptable without further substantiation of the armrest. Offsets greater than 2" must be substantiated as described above.

Are video monitor systems that are stowed in seat armrests permissible?

Section 25.785(e) of the FAR requires that projecting objects that could injure seated persons must be padded. The deployed video monitor is an unpadded projecting object that could be struck by the viewing passenger during turbulence.

While it may be possible to show that a *serious* injury would not be suffered by the passenger, it is the position of the Transport Airplane Directorate that even injuries such as eye injuries (caused by striking one of the corners of the unit), broken/bloody noses, or facial lacerations should not be caused by contact with the video monitors.

This position is based on the premise that such injuries may be inflicted on passengers, who are making full and proper use of the seats and safety belts provided on the airplane, by furnishings which are installed in areas that historically have been clear. Even relatively minor injuries, as discussed above, are covered by the intent of the regulation, particularly when these injuries would be caused by items that are installed for convenience and entertainment purposes.

If the monitors are suitably padded, as required by the regulation, the requirement is met. If padding is not installed, the applicant must show that injuries will not occur. In any case, the monitor should be stowed for taxi, takeoff, and landing.

Flammability Standards for Carpet Used in Aircraft

The Transport Airplane Directorate has received a request for clarification on flammability standards for carpet used in the U.S. commercial airline industry. This Directorate offers the following response to specific questions received:

Are there other Federal Aviation Regulations (FAR) that are applicable to the supplying of carpet to the commercial airline industry, other than the "vertical flame test?"

Depending upon the use of the carpet in a transport category airplane, flammability tests may be required beyond the vertical flame (Bunsen burner) test. If the carpet is installed as a decorative treatment on a vertical bulkhead in an airplane with more than 20 passenger seats, the total material build-up (base panel, adhesive, and carpet) may need to pass the "*rate-of-heat release*" and "*smoke emissions*" tests described in Parts IV and V of Appendix F to Part 25 of the FAR.

This would be the case if the airplane in which the carpet is installed has a type certification basis that includes Amendment 25-61 or later, or if the airplane is manufactured after March 20, 1990, and is to be used in Part 121 (air carrier) operations.

Why do some airplane manufacturers perform numerous other tests, including smoke and toxic emissions tests, electrostatic propensity tests, etc.? Are these other tests also required by the FAA?

As stated above, other tests (including smoke emissions) may be required in order to obtain FAA approval of a carpet installation. Additionally, manufacturers are free to require whatever additional, non-FAA required, tests they wish, as part of their contract with an airline or a material supplier.

Who may carry out the flame tests? Are such organizations "accredited" by the FAA in some way? If so, how does an organization go about becoming "accredited?"

Numerous test facilities in the U.S., including some located at supplier facilities, are recognized by the FAA as being capable of producing acceptable test results from the various flammability tests in Appendix F of Part 25. These facilities are inspected and evaluated by representatives of the cognizant FAA aircraft certification office (ACO) before results will be accepted by the FAA.

However, the FAA does not evaluate facilities that are outside of the U.S., since it would not be feasible to provide for the initial and ongoing surveillance of these facilities.

Guidance Regarding Material Strength Properties and Design Values

The Transport Airplane Directorate has combined the requirement in Federal Aviation Regulation (FAR) Section 25.613, "*Material strength properties and design values*", with Section 25.615, "Design properties."

The probability bases contained in MIL-HDBK-5 for establishing allowables was incorporated in a new Section 25.613(b)(1) subparagraph and the MIL-HDBK references were deleted. This regulatory change to Part 25 was made effective by Amendment 25-72 (published in the Federal Register on July 20, 1990, at page 29776).

It has come to our attention that deleting the reference to the MIL Handbooks could cause inconsistency in the methods used in developing the design allowable. There was no intention during the amendment to Section 25.613 and Section 25.615 to deviate from the methods defined in MIL-HDBK-5 ("*Metallic Materials and Elements for Flight Vehicle Structure*") and MIL-HDBK-17 ("*Polymer Matrix Composites*"). Since the methods acceptable to the FAA were the MIL handbook methods, it was thought that all manufacturers developing their own allowables would continue to use these methods.

The design allowables established for metal structures should continue to be developed using the methodology in MIL-HDBK-5. The allowables for composite structures should continue to be based on the procedures defined in MIL-HDBK-17.

Since basic airframe structure will on occasion require repairs, the allowables for materials used in primary aircraft structures must be made available to airplane manufacturers, owners, and operators. The operators are required to have FAA-approved maintenance programs. These programs are based on long-established maintenance practices which allow the operators to make, and in some instances approve, repairs to their airplanes. The owner of an airplane must be able to make repairs to its airplane without total reliance on the material suppliers. So, as a practical matter, design allowables for aircraft materials should not be considered proprietary information.

All applicants electing to develop their own allowables should be made aware of this guidance.

Stick Pusher Systems for Compliance with Stall Characteristics Requirements

Section 25.203 of the Federal Aviation Regulations (FAR) specifies requirements for the stall characteristics of transport category airplanes. Despite the best efforts of aerodynamicists during an airplane's development phase, it is not always possible to satisfy the requirements of Section 25.203 in a normal aerodynamic stall. Some typical failure criteria are:

- **an excessive roll-off tendency,**
- **longitudinal control force lightening or reversal,**
- **lack of natural pitch-over tendency with potential for entry into a "deep stall," and**
- **loss of control in turning flight stalls.**

These unacceptable stall characteristics may be present in some, or all, wing flap/slat and landing gear configurations.

Various solutions have been utilized to overcome these stall characteristics shortfalls: aerodynamic fixes to compensate for roll-off tendencies, stick nudgers to compensate for longitudinal control force lightening, and stall prevention systems to prevent the airplane from reaching the angle-of-attack (AOA) at which the adverse characteristic occurs.

The most prevalent type of stall prevention system is the "*stick pusher*," so named because it applies a force directly to the primary longitudinal control system of the the airplane.

The typical stick pusher system uses a forward body-mounted vane (one on each side) to sense angle-of-attack. The AOA vane is attached to a transducer which supplies a varying electrical signal, as a function of AOA, to a stick pusher computer. The computer also receives other inputs such as flap and landing gear positions to determine the airplane configuration. From the information received, and the stall schedules programmed into the computers as a function of configuration, angle-of-attack, and in some cases time rate-of-change of angle-of-attack (d /dt), the computers actuate the stick pusher which provides a finite stroke "push" to the control column.

The "push" event should provide unmistakable notice to the pilot that a hazardous flight condition is being averted; the operating characteristics of the stick pusher should be such that it is unlikely that a crew member would prevent or delay its operation. A typical stick pusher actuation will require a pilot hand force of 50 to 80 pounds to restrain the control column movement. The stick pusher applies this force in a fraction of a second. The resulting control surface movement should result in the angle-of-attack being reduced sufficiently below that for pusher actuation to minimize the probability of re-attaining the pusher angle-of-attack.

The determination of stall speeds, for stick pusher equipped airplanes, is dependent on the severity of the stall characteristics for any given configuration. The stall speed may be defined as the minimum speed in the maneuver provided the stall characteristics are shown to be acceptable at an angle-of-attack at least 10 percent beyond that for activation of the stick pusher. If the airplane is unable to perform this stall characteristics demonstration, the stall speed is taken as the speed at which the stick pusher activates. Guidance on this subject is provided in Section 6 of Advisory Circular (AC) 25-7, "*Flight Test Guide for Transport Category Airplanes,*" dated April 9, 1986.

As indicated in AC 25-7, if the airplane has a stall prevention system (i.e. stick pusher), stall characteristics should be evaluated at entry rates of up to 3 knots/second to evaluate any adverse effects of entry rate on the actuation point of the system.

In accord with the requirements of Section 25.207 ("*Stall Warning*") of the FAR:

"*. . .stall warning must begin at a speed exceeding the stalling speed by seven percent or any lesser margin if the stall warning has enough clarity, duration, distinctiveness, or similar properties.*"

For stick pusher defined stall speeds, this margin will obviously be relative to a speed that is dependent on the results of the stall characteristics testing described in the preceding paragraph. The stall warning must provide the minimum required stall speed margins in all power, flap/slat, and landing gear configurations. Additionally, the stall warning should not activate in normal maneuvering flight.

Reliability and **safety** are important design considerations for stall prevention systems--stick pushers in particular due to their inherent level of primary control authority. Reliability is viewed in terms of tolerable failure rate, *i.e.*, the probability of the system not to operate when required. Safety is viewed in terms of the probability of unwanted operation of the system.

Reliability

The FAA requirement for stall prevention system reliability is that the combination of reaching the stall angle-of-attack and failure of the stall prevention system must be extremely impossible. In accord with the quantitative definition of "extremely impossible" provided in AC 25.1309-1A, "*System Design and Analysis,*" dated June 21, 1988, the occurrence of this combined condition must have a probability on the order of 1×10^{-9} per flight hour, or less [reference paragraph 10.b.]. The FAA assumes that the probability of reaching the stall angle-of-attack is 1×10^{-5} per flight hour, which means the stall prevention systems must have a failure rate of 1×10^{-4} per flight hour or less.

Safety

The unwanted operation of a stall prevention system, that would jeopardize continued safe flight, should not result from any single failure. This concern is normally addressed by system redundancy; each AOA vane/transducer sends its signal to its own dedicated computer. If unwanted operation of the stall prevention system would result in the limit load factor being exceeded in any part of the airplane's structure, the probability of unwanted operation must be less than 1×10^{-7} per flight hour.

Similarly, if unwanted operation would result in the ultimate load factor being exceeded in any part of the airplane's structure, the probability of unwanted operation must be less than 1×10^{-9} per flight hour.

Other safety considerations that are of particular concern for stick pusher systems are:

- **the system should be designed so that flight in atmospheric turbulence will not result in unwanted operation, and**
- **if unwanted operation would result in catastrophic ground contact during takeoff and landing, the probability of unwanted operation must be extremely improbable (*i.e.*, less than 1×10^{-9} per flight hour).**

The entire subject of stall speeds and stall prevention systems is a current topic of discussion between the FAA and the European Joint Aviation Authorities (JAA). Rulemaking action and policy changes are being coordinated as part of the "harmonization" process which will eliminate many long-standing regulatory and policy detail differences. The revision of AC 25-7, currently in-process, will include new and expanded material related to the regulatory changes and certification of stall prevention systems.

These changes will be addressed in future issues of the Designee Newsletter.

Floor Warpage Requirements of FAR 25

The Transport Airplane Directorate has been requested to provide guidance concerning the requirement to apply floor warpage to flight crew seats before performing the longitudinal 16g dynamic test.

The FAA recently granted an exemption (to a manufacturer) from the floor warpage requirement of FAR 25.562 ("*Emergency Landing Dynamic Conditions*") for pilot seats on an airplane with more than 40 inches of frangible airframe structure below the seats. The relief granted from the requirement to misalign the seat tracks was limited to the flight deck seats.

Based on this exemption and the reasons that justified it, the FAA is planning to include a similar provision in the next amendment to FAR Section 25.562.

Service experience was the primary justification for "relaxing" the floor warpage requirement for pilot seats.

Pilot seats are individually mounted single seats, with both vertical and horizontal adjustments to accommodate the differences in the size of crewmembers. Further, the flight deck floor structure construction, strength, and deformation characteristics differ from that of the cabin floor structure. Accident review data indicates that the flight deck floor structure typically has remained intact and undistorted up to the point where structural integrity of the airplane was lost. At that point, the flight deck structure and the flight deck seats are usually ejected from the airplane as a unit.

The FAA considers that complete floor failure or complete seat failure are the more common modes of failure in flight deck crew seats on narrow body and larger airplanes. Even with some distortion in the floor, crew seats generally remain attached. Most of the observed failures during crash conditions are considered outside the strength envelope envisioned by Amendment 25-64 to FAR Part 25 ("*Seat Safety Standards*") and, therefore, are not considered survivable accidents. Amendment 25-64 was intended to correct observed design deficiencies in seats and seat restraint systems; there was no intention of restraining the seat beyond the ultimate strength of the airframe structure.

The recent relaxation relative to floor warpage takes into account the fact that many flight decks are not in the parallel section of the fuselage and that the flight deck floor on some airplanes may not be horizontal with respect to the fuselage reference line (FRL). The 40 inches of frangible structure is measured vertically from the flight deck at the center of the pilot seats to the lower fuselage contour at the constant fuselage section. This is a characteristic dimension taken from the narrow-body airplanes, and applies to narrow-body and larger airplanes having 40 inches or more of frangible structure below the cockpit floor. The floor height is considered an acceptable indicator of the degree of protection it is afforded.

The amount of frangible structure in this area is an indication of the ability of the fuselage to absorb energy before the basic airframe fails. This guidance applies to all transport category airplanes that have a characteristic round, elliptical, or ogival fuselage in the cockpit area.

There are no plans for providing any similar relief concerning warpage requirements for narrow track seats on smaller airplanes. Currently FAR Part 23.562 requires testing up to 10 degrees of floor warpage (vertically). The basis of this requirement lies not in any particular spacing of the seat tracks, but in the service history of commuter category airplanes. The requirement to warp the floor was intended to encourage the seat manufacturers to design seats to accommodate some degree of floor distortion without failure of the seat structure or attachment fittings.

Service experience on commuter category airplanes has shown that floor warpage of 10 degrees or more has occurred in survivable accidents. Floor warpage was considered a primary factor in some of the seat failures found in those accidents.

Some seats with less than 20 inches of track spacing have successfully passed the dynamic tests with 10 degrees of floor warpage.

These tests were conducted at the FAA's Civil Aeronautical Medical Institute (CAMI) facility.

The FAA has reviewed arguments both in support and in opposition to the current policy, and has concluded that the service history of flight deck seats on larger airplanes supports the proposed relief provision. Although some cockpit floor distortions have been observed after accidents, there has not been a major problem with flight deck seat separations due to floor buckling on narrow body and larger airplanes that have a minimum of 40 inches of frangible structure between the flight deck floor and the lower fuselage contour.

The FAA now considers that testing pilot seats with floor warpage cannot be justified on a cost effective basis for narrow body and larger airplanes.

Sideward facing seats on larger airplanes currently are also required to meet all requirements of FAR Sections 25.561 and 25.562. At this time, the FAA has no plans to amend the regulations to account for sideward facing seats.

Airspeed Displays for Electronic Flight Instrument Systems (EFIS)

A recent Type Certification program raised an important issue related to airspeed awareness cues presented by Electronic Flight Instrument Systems (EFIS) displays, in particular, linear tape airspeed displays with moving scales.

As a result, the following is provided as supplementary guidance information to that contained in paragraph 7.d.(2)(i) of Advisory Circular (AC) 25-11, "*Transport Category Airplane Electronic Display Systems,*" dated July 16, 1987.

Whether pneumatically or electronically driven, the traditional display of airspeed has been via a round dial with a rotating needle pointing to airspeeds presented on a graduated arc.

In some cases, this display may have also been supplemented by an analog drum type presentation of the present value of the airspeed. As noted in paragraph 7.d.(2)(i) of AC 25-11, the round-dial and pointer airspeed indicator displays are "*...able to convey to the pilot a quick-glance sense of the present speed...*" just by observing the angular position of the pointer.

Due to the wide operating speed range capabilities of transport category airplanes and limited EFIS display area, it is not possible to accommodate this same type of fixed scale with moving pointer for EFIS airspeed display.

Consequently, the moving scale display has been adopted with centered display of present airspeed in larger digits.

Since the moving scale display does not provide any inherent visual cue of the relationship of present airspeed to low or high airspeed limits, many EFIS displays utilize an amber and red bar adjacent to the airspeed tape to provide this quick-glance low/high speed awareness. The amber bar display will begin at some multiple of the stall speed and the red bar at the stall warning speed.

The subject airplane of the Type Certification program, referenced in the opening paragraph, utilized such an airspeed awareness visual cue system. The system was found not to present adequate and accurate low airspeed awareness information due to its invariability with airplane weight and flap configuration. The applicant had selected a fixed intermediate speed above which the EFIS gave low airspeed caution and warning, regardless of airplane gross weight and flap position.

Subsequent investigation revealed that several transport category airplanes had similar EFIS installations incorporated by Supplemental Type Certificates (STC).

As a result of this finding, this guidance has been formulated to warn against the approval of any EFIS airspeed awareness display, be it low or high speed, that does not take into account all independent parameters that may affect the speed against which protection is being provided.

This is most important in the low speed regime, where all transport category airplanes have a wide range of stall speeds due to multiple flap/slat configurations and potentially large variations in gross weight.

The regulatory basis of this policy is as follows:

Section 25.1501(b) states:

> "*The operating limitations and other information necessary for safe operation must be made available to the crewmembers as prescribed in Sections 25.1541 through 25.1587.*"

Section 25.1503 states:

> "*When airspeed limitations are a function of weight, weight distribution, altitude, or Mach number, limitations corresponding to each critical combination of these factors must be established.*"

Section 25.1541(a)(2) states:

> "*The airplane must contain any additional information, instrument markings, and placards required for the safe operation if there are unusual design, operating, or handling characteristics.*"

The EFIS low and high airspeed awareness cues are interpreted as "*instrument markings*" that provide information to the crewmembers that is necessary for safe operation of the airplane.

These cues provide crew awareness of encroachment upon an airspeed limitation and should therefore comply with the requirements of Section 25.1503 when the associated airspeed limitation is a function of airplane and operating variables.

Approved Data Referenced via FAA Form 8110-3

FAA Action Notice N8300.106, issued February 21, 1992, identifies continuing FAA and aviation industry efforts to resolve the conflict that exists between FAA Principal Maintenance Inspectors (PMI) and operators, regarding the ability to obtain FAA Form 8110-3 following the approval of data for major repairs.

Background

Air carriers have traditionally asked the manufacturers for assistance in obtaining FAA approval for major repairs performed on their aircraft. The manufacturer's Designated Engineering Representative (DER) will recommend for approval or will approve data for the major repair. The DER will document these data on FAA Form 8110-3 for submission to the cognizant Aircraft Certification Office (ACO). In some cases, the DER has refused to supply a copy of FAA Form 8110-3 when requested by the operator or the PMI, stating that the information contained in the form is proprietary.

FAA Form 8110-3 is the only means by which a DER may approve or recommend for approval engineering data. The form itself does not contain any proprietary data. It identifies specific FAA-approved data to a specific project. These data are identified in detail by document number, title, and revision. FAA Orders 8110.4 ("Type Certification") and 8110.37 ("Designated Engineering Representative Guidance Handbook") describe the procedures for distributing FAA Form 81109-3.

Procedures

The aircraft operator has the responsibility of ensuring that the data it uses for major repairs and alterations is FAA-approved. When PMI's require assurances that the data has been FAA-approved, the PMI should contact the cognizant ACO and verify that these data for the particular major repair have been approved by the DER, the date of that approval, and that the DER is authorized to approve these data. Also, the PMI should ensure that the drawing revision level of the data used is the same revision level as reflected on FAA Form 8110-3.

In some cases, the DER will provide additional information with these data. Examples of some standard statements are:

> *"Data associated with this [repair, modification, etc.] have been FAA-approved for [aircraft model, registration number, serial number, etc.]. For additional information or verification of approval, please contact the cognizant ACO. The regional DER is supervised and assigned to [(e.g.) the Transport Airplane Directorate, ANM-100]."*

or

> *"Data associated with this [repair, temporary repair, modification, etc.] have been FAA-approved for [aircraft model, registration number, serial number, etc.], contingent upon the following special [inspection, repetitive inspection, flight restriction, etc.] requirements. These*

requirements must be coordinated with the cognizant regulatory authority and recorded in the operator's appropriate documents. For additional information or verification of approval, please contact the cognizant ACO."

The following are examples of statements that would be acceptable from a DER recommending for approval a major repair:

"Data associated with this [repair, modification, etc.] have been submitted to the ACO with the DER's recommendation for approval on [aircraft model, registration number, serial number, etc.] on a [month, date, year] basis. You will be advised upon receipt of ACO approval. For additional information or verification of approval, please contact the cognizant ACO.

NOTE: The subject aircraft CANNOT be returned to service until ACO approval has been received."

or

"Data associated with this [repair, modification, etc.] have been submitted to the ACO with the DER's recommendation for approval on [aircraft model, registration number, serial number, etc.] on a [month, date, year] basis, contingent upon the following special [inspection, repetitive inspection, flight restriction, etc.] requirements. These requirements must be coordinated with the cognizant regulatory authority and recorded in the operator's appropriate documents. You will be advised upon receipt of ACO approval. For additional information or verification of approval, please contact the cognizant ACO.

NOTE: The subject aircraft CANNOT be returned to service until ACO approval has been received."

If these statements or similar statements are not included with major repair data from the DER, it will be necessary for the operator to contact the DER to obtain this information in order to be assured that these data have been FAA-approved.

PMI's should review their operators' continuing airworthiness maintenance program to ensure that the program contains a procedure for determining whether a repair is major or minor, as provided in FAR Part 43, Appendix A. Procedures review should also state how the operator reviews data received from a DER and how a determination is made to return aircraft to service based on data received. There should be a clear distinction between data that are FAA-approved and data that have been recommended for approval by a DER and submitted to the FAA.

Use of DER Number in an International Setting

Civil airworthiness authorities in other countries recognize the authority of FAA-designated DER's. The international authorities in some cases have devised a form similar to the FAA Form 8110-3 for use in approving data. Please be advised that, FAA-appointed DER's are not authorized to sign and put their DER authorization numbers on any document other than an FAA Form 8110-3.

SPECIAL TOPIC:

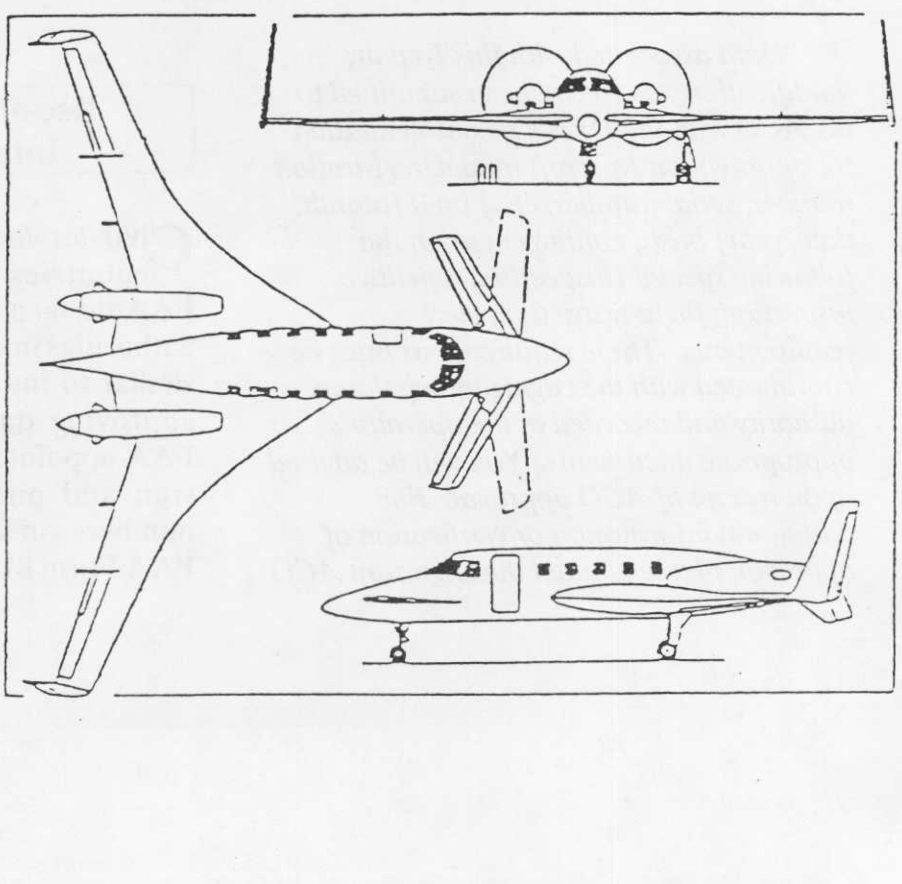
Canard Certification Loads -- Progress Toward Alleviating FAA Concerns

A new era began on June 14, 1988, when the canard-configured Beech 2000 Starship was certified by the FAA. Other small canard-configured airplanes have since been certified or are currently under development.

Since the first airplane was certified in 1927, the standard configuration has been with the main lifting surface or surfaces forward of the stabilizing surface. Although some of the advantages of the canard configuration were recognized quite early -- by the Wright Brothers, for example -- until recently, canard surfaces have been used only as additional control surfaces on some military airplanes, and on some amateur-built airplanes. As a result, the Federal Aviation Regulations (FAR) addressed tail aft configurations.

When the FAA was first approached regarding certification of a canard-configured small airplane, an FAA/Industry Empennage Loads Working Group was formed to develop technical proposals for the necessary rule changes and policy. The working group is chaired by **Terence J. Barnes**, the FAA's National Resource Specialist for structural loads.

Figure 1.→



The Beech Starship.

Longitudinal control is by trailing edge surfaces on the forward wing and outboard on the wing (elevons). Roll control is by elevon outboard on the main wings. Directional control is by a rudder on each wing tip fin. There are fowler flaps on the main wing; when they are retracted, the forward wing is swept back 30 degrees. At low speeds, with wing flap extended, the foward wing pivots forward to a near zero sweep position (minus 4 degrees).

Now that the FAA has certified canard-configured small airplanes, it is time to review how the FAA concerns regarding loads development and validation have been addressed.

Airplane Pitching Maneuvers

The elevator surface of a canard-configured airplane may be on the forward wing, main wing, or both. Maneuvers which correlate up elevator with airplane nose up pitching acceleration needed redefinition. The FAA has redefined these to associate aft movement of the airplane pitching control with airplane nose up pitching, etc.

Airplane Gust Response

A canard-configured airplane may respond differently from a conventional airplane in vertical gusts. The forward wing penetrates the gust first, and causes the airplane to pitch up. This results in an increase in the main wing angle of attack and in the resulting wing airload, when compared with a conventional airplane. The FAA considers the 1-cosine shape and the gust velocities of FAR 23 ("*Airworthiness Standards: Normal, Utility, and Acrobatic Category Airplanes*"), Section 23.333 ("*Flight Envelope*"), to be adequate for certification of canard and tandem wing configurations. However, this requires a time history analysis to determine the loads on the lifting surfaces.

The shape of the gust per FAR Section 23.333 is:

$$U = \frac{U_{de}}{2}\left[1 - \cos\frac{2\pi s}{25c}\right]$$

Where:
s = Distance penetrated into gust (ft.);
c = Mean geometric chord of wing (ft.); and
U_{de} = Derived gust velocity (ft./sec.)

The time required to traverse the gust will depend on the forward speed of the airplane. The results of a typical 2-degrees of freedom analysis of a canard-configured airplane are presented in *Figure 2,* below. Note that the maximum airloads on the forward and main wings occur at different times, and neither occurs at the time of maximum airplane vertical load factor.

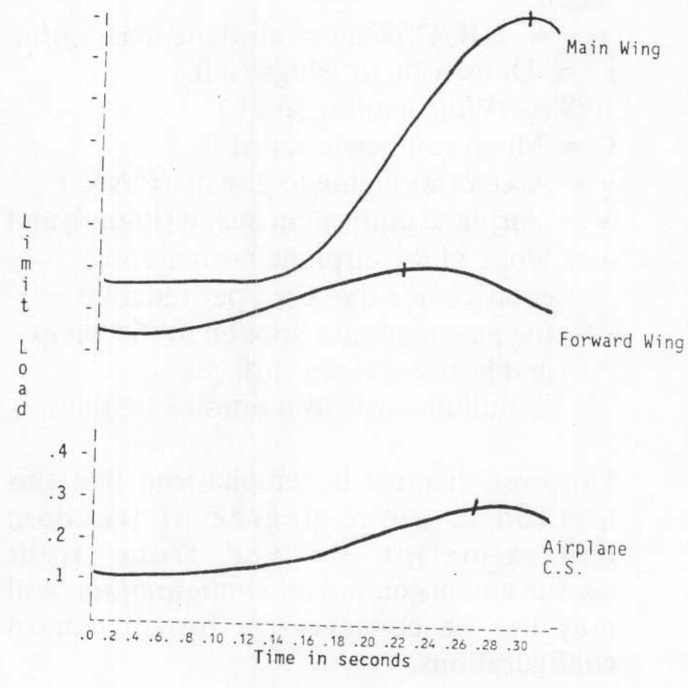


Figure 2.
Canard airplane response to 1-cos gust.

A manufacturer may want to avoid running time histories for all critical conditions. A simplified method may be proposed; however, it must be shown to be conservative when compared with the 1-cosine gust rational analysis.

Depending on the configuration, it may be possible to use the "Pratt Formula" gust equation of FAR Section 23.341:

$$n = 1 + \frac{K_g U_{de} V a}{498\ (W/S)}$$

Where:

K_g = $0.88\mu_g/5.3 + \mu_g$ = gust alleviation factor;

μ_g = $2(W/S)/p C a g$ = airplane mass ratio;

p = Density of air (slugs/cu.ft.)

W/S = Wing loading (p.s.f.)

C = Mean geometric chord (ft.)

g = Acceleration due to gravity (ft./sec.)

V = Airplane equivalent speed (knots); and

a = Slope of the airplane normal force coefficient curve C_{NA} per radian if the gust loads are applied to the wings and horizontal tail surfaces simultaneously by a rational method.

However, it must be emphasized that this method is a one degree of freedom approximation derived from flight measurements on tail aft configurations, and may not be conservative for all canard configurations.

Typically, manufacturers have found relatively small differences between the loads developed from the time history and those from the "Pratt Formula."

Airload Distributions

The total aerodynamic loads on the wing and tail surfaces of a conventional airplane can be predicted with reasonable accuracy using geometry, airfoil section data, and empirical equations to account for wing downwash effects. Furthermore, the total surface aerodynamic loads can be distributed spanwise simply, and with reasonable accuracy.

The influence of the forward wing on the main wing varies with its location and with flight condition. The main wing can be twisted to improve the span loading.

To evaluate the effect of the forward wing and any out-of-plane surfaces, such as winglets, some form of lifting surface or full configuration modelling aerodynamic theory is recommended. Many analysis techniques are already available commercially, and others are under development. A comparison of several production codes is presented in the American Institute of Aeronautics and Astronautics (AIAA) Paper AIAA-85-0280, "*Subsonic Panel Methods - A Comparison of Several Production Codes.*"

A typical analysis proceeds as follows:

First, the external surface of the airplane is represented by a "panel model," as shown in *Figure 3,* below.

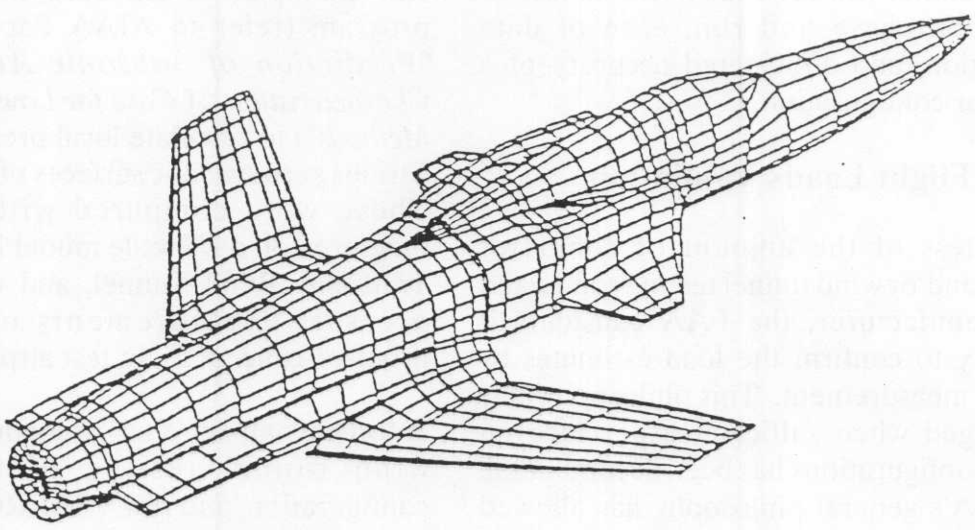


Figure 3.
Airplane external surface is represented by a grid structure.
Grid spacing is more dense where there are intersecting surfaces or high pressure gradients.

This is a grid structure made up of quadrilateral (or triangular) elements with the panel density being increased in regions where surface curvature and, hence, flow velocity and pressure gradients, are higher. This would typically be around lifting surface leading edges, at aerodynamic surface intersections, and near and on control surfaces. It is important that final surface models focus on providing sufficient panelling in areas where the solution shows high pressure gradients. It may be necessary to vary surface panelling with airplane attitude in order to accurately define the critical airload distributions.

Each panel is represented in the solution by a mathematical function, the precise form of this function and the way in which the surface is represented varying with the analysis method. In the most widely used programs, the panels are flat and the conditions are assumed constant over the surface of each panel.

The panelling representation is carried onto the wake, as shown in *Figure 4*, below, with wake deflections being included as part of the calculation procedure. This allows the wakes from the various surfaces and their interactions to be studied under various flight conditions.

Using the selected analytical method, panel pressures are calculated in terms of the free stream pressure. For each flight condition, these unit pressures are then converted to actual pressures and integrated to develop shear, moment, and torsial loads on the components.

The actual method used to develop the local surface pressures and the resulting structural loads may be chosen by the manufacturer, and the choice will depend on factors such as cost to purchase and run, ease of data preparation, and anticipated accuracy of a particular configuration.

Flight Loads Validation

Regardless of the amount of computer analysis and/or wind tunnel testing conducted by a manufacturer, the FAA considers it necessary to confirm the load estimates by in-flight measurement. This philosophy may be changed when sufficient experience on canard configurations has been accumulated. The FAA's general philosophy has allowed great flexibility in the approaches taken by the various manufacturers.

For example, Beech used the VSAERO program (refer to AIAA Paper 81-0252, "*Prediction of Subsonic Aerodynamic Characteristics: A Case for Low-Order Panel Methods*") to calculate local pressures on the various aerodynamic surfaces of the Starship. These were compared with pressures measured on a 1/7 scale model in the Boeing Transonic Wind Tunnel, and with in-flight pressure measurements on the 85% proof-of-concept flight test airplane.

Another company plans to conduct low speed wind tunnel testing of their final configuration, and run VSAERO analyses at full scale Reynolds number and wind tunnel

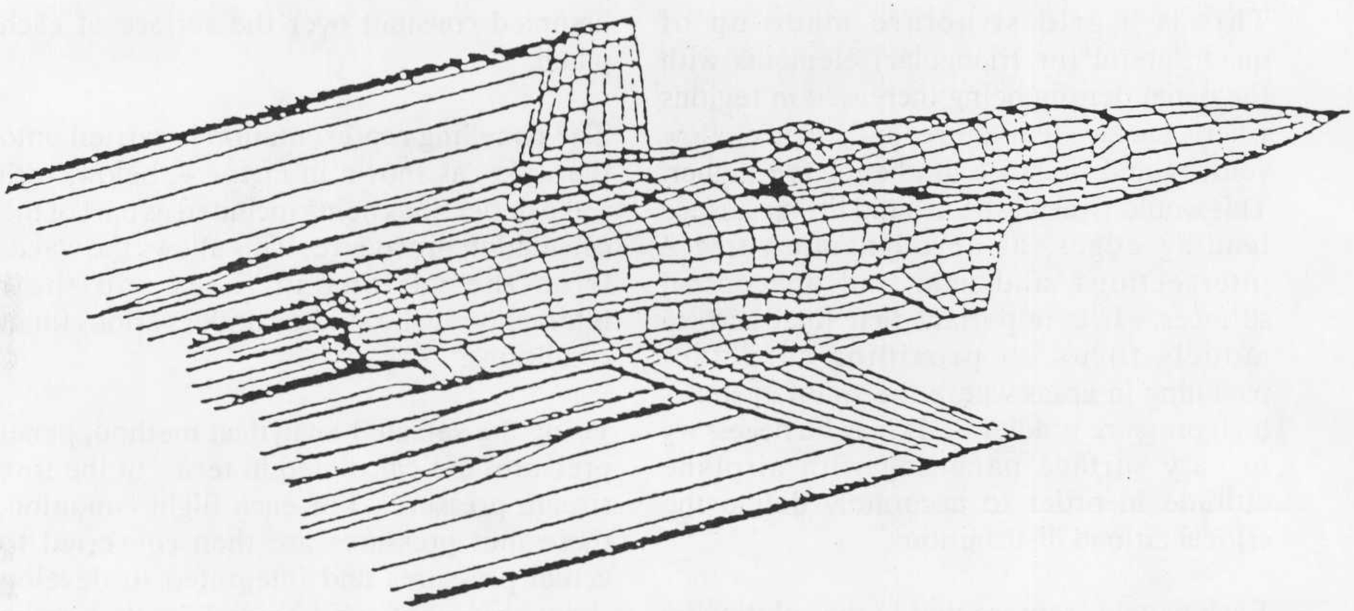


Figure 4.
Airplane model defined with wakes. Pressures are calculated at each grid point.

Reynolds number. They will then compare wind tunnel results to computer modeling, and "tailor" the computer model predicated on the wind tunnel results. This is especially applicable in the stall and post-stall region. The prototype airplane will be instrumented to measure forward and main wing pressure distributions -- the locations will be based on review of the wind tunnel and computer model forecasted pressure distribution (i.e., concentration on areas of significant mutual interference).

Another company is using the VORTEX-LATTICE Program, described in NASA TN D-6142, "*Vortex-Lattice Fortran Program for Estimating Subsonic Aerodynamic Characteristics of Complex Platforms,*" to calculate the airload on the forward and main wings, including the effects of mutual aerodynamic influence. The total airloads are correlated with wind tunnel model data. The horizontal tail loads are calculated using airplane coefficients determined from wind tunnel model data, and the spanwise airload distribution is determined using the VSAERO program.

A flight loads survey was conducted to verify the airloads determined for the major structural components.

Laminar Flow

Concerns that the loss of extensive laminar flow due to minor damage or surface contamination would result in significant changes in aerodynamic coefficients were not justified. From a structural loads standpoint, these effects appear to be no greater than on a conventional small airplane configuration.

Fatigue

Because the forward wing of a canard configuration is a flight critical structure, carries significant lift, and is subjected to a repeated and variable load cycle, the fatigue criteria for a wing are applicable.

Status of FAA Regulations and Advisory Material

Rule changes that cover the points discussed above have been incorporated in FAR Part 23 by Amendment 23-42, dated January 3, 1991. An Advisory Circular that will provide guidance for the application of the rules is currently in development.

Additional guidance on this subject can be found in FAA Advisory Circular (AC) 23-9, "*Evaluation of flight Loads on Small Airplanes with T, V, +, or Y Empennage Configurations,*" issued January 27, 1988.

The FAA's Small Airplane Directorate (located in Kansas City, KS) is the office responsible for the development of regulatory and guidance material.

[The foregoing article was taken from AIAA Paper AIAA-88-4462, prepared by Terence J. Barnes (FAA's National Resource Specialist for Loads/Aeroelasticity - Fixed Wing) and Edward A. Gabriel (FAA Aerospace Engineer, Policy and Guidance Section, Small Airplane Directorate).]

Transport Airplane Directorate
DESIGNEE NEWSLETTER
(Published semi-annually; 14th Edition)

Federal Aviation Administration
Northwest Mountain Region
Transport Airplane Directorate
1601 Lind Avenue, S.W.
Renton, Washington 98055-4056

RONALD J. WOJNAR
Manager
Transport Airplane Directorate

DARRELL M. PEDERSON
Assistant Manager
Transport Airplane Directorate

R. JILL DeMARCO
Technical Programs Specialist
Newsletter Editor
Technical & Adm. Support Staff

SUSAN WEBB, PETE GALINS,
ROSE UPTON, JUNE QUEMADO
Technical Pub. Writer/Editors
Technical & Adm. Support Staff

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:

Federal Aviation Administration
Transport Airplane Directorate
ATTN: Editor (J. DeMarco), ANM-103
1601 Lind Avenue ,S.W.
Renton, Washington 98055-4056

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

Transport Airplane Directorate
Northwest Mountain Region
1601 Lind Avenue S.W.
Renton, Washington 98055-4056

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE, $300
FAA FORM 1360-12 (12-71)

POSTAGE AND FEES PAID
FEDERAL AVIATION ADMINISTRATION
DOT-515

U.S.MAIL