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of Transportation
**Federal Aviation
Administration**

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FAA Northwest Mountain Region
17900 Pacific Highway South
C-68966
Seattle, Washington 98168

DESIGNEE NEWSLETTER

Aircraft Certification Division
Transport Airplane Certification Directorate

About The Cover

BOEING 737-300 SHORT-TO-MEDIUM RANGE JETLINER

One of the most recent developments in the 737 program is the advent of the 737-300. Since being given the go-ahead in March 1981 as a re-engined, longer version of the 737-200, it has incorporated much of the new technology of the 757 and 767 and has become a new-generation jetliner in its own right. Designed for the newly available high bypass CFM56-3 engine, which is more efficient and quieter, the airplane has been lengthened 104 inches (2.6m) to accommodate up to 21 more passengers. The 737-300's fuel burn per seat is significantly reduced over the -200 and it has lower direct operating costs. On a typical 500-mile trip, the -300 will burn 25 percent less fuel per seat, putting it in the same class as Boeing's new-generation 757 and 767 jetliners.

In addition to the new-technology high-bypass ratio engines, the 737-300 will have the same application of composites as the other new-generation airplanes, and the same use of new aluminum alloys. Flight control surfaces will be of composite structure and the newly developed lightweight interior will save 732 pounds and be more spacious than current 737's.

The digital avionics which recently have become available on the 737-200 will be standard on the 737-300, including an automatic flight control system very similar to that being incorporated into the 757 and 767. This will include a Category II visibility rated autopilot with Category IIIA as an option.

Final assembly of the -300 will be on a combined line with the -200 at Beoing's Renton, Washington production facility. Rollout will be January 1984, and first flight is scheduled for March 1984. Certification and first delivery are planned for late November 1984.††

Regulation By Objective (RBO) - New Part 120.

Our previous Newsletter contained an article on Regulation By Objective (RBO). Right after publication of the Newsletter, the Administrator withdrew Notice 82-13 which proposed to remove Parts 121 and 135 in order to implement a new concept in aviation safety regulations entitled "Regulation by Objective (RBO)." Notice 82-13 has elicited voluminous and detailed public comments, many of which reflected considerable confusion and misunderstanding of this complex proposal. Based on the extensive time and resources that would be required to review and analyze the proposal in light of the comments, the Agency considered it prudent to withdraw the notice and concentrate on amendments to Parts 121 and 135 that are required in the near term.††

Notes from the Editor

If you, or someone you know, has been inadvertentley left off the mailing list, please submit their names and addresses to the Newsletter Editor, FAA, Aircraft Certification Division, ANM-100, Northwest Mountain Region, 17900 Pacific Highway S., C-68966, Seattle, WA 98168.††

Our special thanks to the following:

Iven Connally, Regulations and Policy Office; Jerry Mack, Technical Support Group; William Roberts, Airframe Branch, Los Angeles ACO; and the Flight Standards Division, Northwest Mountain Region, for contributing articles for this issue of the Newsletter. Also, our thanks to the Boeing Company for pictures and the article on the B-737-300.

Dear Designee:

In our original issue, I emphasized the importance of good communication in our working relationships. This newsletter is intended to serve as one medium for creating and maintaining a good communication system. It is our intention that it provide you, as well as our own certification personnel, with information about regulations, policy changes, procedures, guidance, and personnel activities involving the certification work accomplished within the Aircraft Certification Division's jurisdictional area.

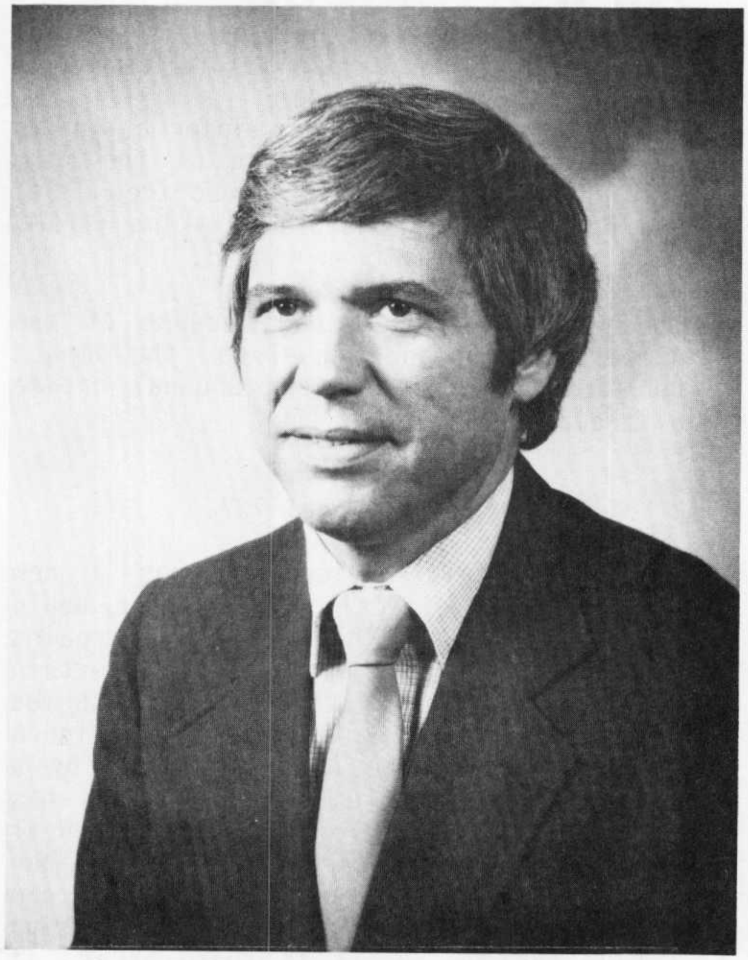
I believe that communication can be further enhanced by holding periodic group meetings for discussions on topics of interest to you. The best way to be able to discuss these issues is hold these meetings according to your individual disciplines, i.e., structures, environmental/mechanical systems, propulsion, etc. I have presented the idea of FAA-designee meetings to the managers of our Aircraft Certification Offices, and they were enthusiastic in agreeing to sponsor the meetings.

In the near future, you will be hearing from your local Aircraft Certification Office regarding dates for these designee meetings and requesting your input on agenda items. I hope that you will be able to attend and help keep our communication lines open. All of us in the Directorate look forward to meeting you and working with you at these meetings.

I also want to invite you to send letters to the Editor of this Newsletter to express your opinions, ask for information, suggest improvements, and share your accomplishments with all of us. Take advantage of this opportunity and let us hear from you.

Leroy A. Keith

Leroy A. Keith



Leroy A. Keith, Manager, Aircraft Certification Division

U.S. Department of Transportation
Federal Aviation Administration

DESIGNEE NEWSLETTER

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Airworthiness Directives

Reprinted below for your information is the summary section of some of the more significant airworthiness directives (ADs) and notices of proposed rulemaking (NPRM) that have recently been issued.

These have been selected because of the number of airplanes involved, the impact upon the industry, or the unusual nature of the problem.

Boeing Model 727

SUMMARY: This notice proposes a new airworthiness directive (AD) which would require structural inspections and repairs or replacements, as necessary, on certain high time Boeing Model 727 series airplanes to assure continued airworthiness. The AD is prompted by a structural reevaluation which has identified certain significant structural components as likely to develop fatigue cracks as these airplanes approach and exceed the manufacturer's original design life. Fatigue cracks in these areas, if left undetected, could result in a compromise of the structural integrity of these airplanes and catastrophic failure. Comments must be received on or before February 7, 1984. For Further Information Contact: Mr. Don Gonder, Seattle ACO, telephone (206) 431-2927.††

Boeing Model 747

SUMMARY: This amendment adds a new airworthiness directive (AD) applicable to certain B-747 series airplanes which require inspection of trailing edge flap tracks for corrosion and cracking. This AD is prompted by reports of heavy corrosion on three airplanes and resultant cracking of two trailing edge flap tracks. The failure of the aft end of the flap track could cause the trailing edge flap to separate from the airplane. For Further Information Contact: Mr. Owen Schrader, Seattle, ACO, telephone (206) 431-2923.††

Boeing Model 747

SUMMARY: This amendment adopts a new airworthiness directive (AD) which requires inspection, repair, or replacement, as necessary, of BFGoodrich Emergency Evacuation Slide/Rafts P/N's 7A1340 series, 7A1342 series, 7A1371 series, and 7A1373 series installed in Boeing 747 airplanes in accordance with STC SA574GL or SA575GL. This AD is prompted by reports of leakage due to fabric porosity, which in one case was severe enough to significantly degrade the functioning of the slide/raft as a slide after approximately one minute of inflation, and in several cases was severe enough to prevent continued functioning as a raft. It has been determined that the inspection and repair procedure contained in BFGoodrich Service Bulletin 25-081 will correct the problem. For Further Information Contact: Mr. Charles Smalley, Chicago ACO, telephone (312) 694-7126.††

Boeing Model 767

SUMMARY: This amendment adds a new airworthiness directive (AD) applicable to Boeing Model 767 aircraft equipped with Pratt and Whitney JT9D-7R4 series engines, which requires (1) modification of certain engine idle control circuitry; and (2) installation of Package B type hydromechanical engine fuel controls, if not presently installed. These actions are necessary to minimize the possibility of engine stall conditions during low power (idle) descent operations. At least one incident of low power engine stall has occurred in service. For Further Information Contact: Mr. Daniel Cheney, Seattle ACO, telephone (206) 431-2959.††

Seat Frame Braces

SUMMARY: This amendment adds a new airworthiness directive (AD) that requires installation of seat frame braces on AMI Industries, Inc. Seat Model 716 and 865 crew seats. This AD is required to preclude seat failure which could result in injuries under forward loading conditions less than those required by TSO-C39. For Further Information Contact: Mr. Woodford R. Boyce, Manager, Denver ACO, telephone (303) 340-5575.††

Proposed Rules

NEW FIRE SAFETY RULES PROPOSED FOR AIRLINE SEATS & EMERGENCY LIGHT MARKING SYSTEM. The Agency has proposed two new rules designed to increase the chances of passengers surviving an aircraft fire.

One proposed rule would require installation of airline seats covered with fire-blocking layers that make them more difficult to burn. The purpose is to delay the spread of fire and give passengers and crew more time to evacuate a burning aircraft. Airlines would have three years from the effective date of the final rule to install the new seats.

The fire-blocking layer concept involves the use of a thin layer of highly fire-resistant cloth or foam material to completely encapsulate and protect the polyurethene seat cushions. FAA tests have shown that the use of this fire-blocking layer can delay the critical "flashover" point in a cabin fire by 40 to 60 seconds.

The second proposal calls for the installation of a new emergency light/marking system. It would be located near the floor level to guide passengers and crew to the exits when smoke has filled the cabin and obscured overhead emergency lighting. This proposal would establish a performance standard for "floor proximity emergency escape path marking." The performance standard would require that any system used would (1) illuminate each passenger exit marking and location sign, and (2) provide enough general lighting so that the average illumination when measured at 40-inch intervals along the aisle center line at seat armrest height is at least 0.05 foot-candles.

Compliance with the new rules would be required within two years of the adoption of the final rule. Comments on both proposed rules are due in February.††

FIRE PROTECTION REQUIREMENTS FOR AIRPLANE CARGO COMPARTMENTS. The Directorate is preparing a Notice of Proposed Rulemaking (NPRM) to amend FAR Part 25 to prescribe new improved fire protection requirements for airplane cargo and baggage compartments. The NPRM proposes a new method for testing the burn through resistance of compartment liners. The proposed test methods will be in addition to the flammability requirements currently prescribed for liners by the FAR. The NPRM also proposes to impose a 1000 cubic foot volume limit for Class D category compartments.

We anticipate that the NPRM will be published in the Federal Register for comment by February 1984.††

Advisory Circulars (AC)

AC 20-27C, Certification and Operation of Amateur-Built Aircraft, approved April 1, 1983, limits the number of FAA inspections required prior to the issuance of an unlimited special airworthiness certificate to one inspection, and expands the categories of FAA field offices that may perform the certification of amateur-built aircraft to include General Aviation District Offices (GADO) and Flight Standards District Offices (FSDO). The assignment of this new responsibility to GADO's and FSDO's is also addressed in Order 8000.56 which was issued concurrently with AC 20-27C. (AWS-200)††

AC 91-60, Continued Airworthiness of Older Airplanes, dated June 13, 1983, provides information on, and recommendations for, the development and use of programs to assure the continued airworthiness of older airplanes not covered under AC 91-56, Supplemental Structural Inspection Program for Large Transport Category Airplanes. (AWS-300)††

AC 135-11, dated March 31, 1983, contains a listing of all commuters and air taxi operators as of March 12, 1983. This

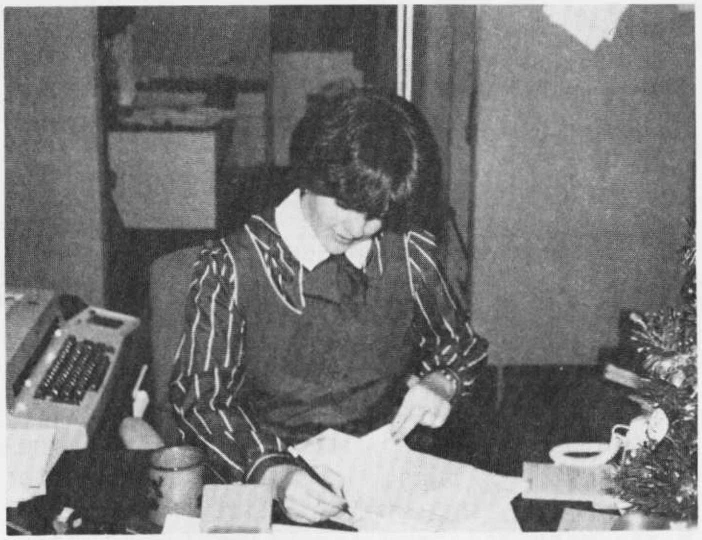
AC's Continued...

listing is now for public sale from the Government Printing Office for $4.50. It was formerly printed for use by FAA personnel only. (AFO-200)††

AC 43-10A, Mechanical Work Performed in U.S. and Canadian Registered Aircraft, recently revised, provides updated information on changes to FAR 43.7 which allows, in part, that the Canadians may perform any inspection required by FAR 91.169 except an annual inspection. (AWS-300)††

FAR 25 Advisory Circulars. Since the recodification of CAR 4b into FAR 25 almost 20 years ago, there has been little activity in developing advisory circulars setting forth acceptable means of compliance. The Transport Airplane Certification Directorate has begun a project to fill this void. Engineers in Seattle and Southern California are reviewing old policy files, letters, Joint Airworthiness Requirements (JAR) AC's, etc., to establish a data base from which to begin drafting AC's. The first AC's from this effort are expected to be ready for internal FAA coordination by the end of 1983. The project will continue for several years until all of FAR 25 is covered.††

FELICIA MASTEN
Secretary, Regulations Branch



GAIL ROGERS
Secretary, Regulations and Policy Office

Auxiliary Fuel System Installations
A new advisory circular is being developed which will provide guidance and criteria for the installation of auxiliary fuel systems in transport category aircraft. It is intended primarily for older airplanes that are modified to incorporate auxiliary fuel systems; however, it is equally applicable to auxiliary fuel systems included as part of the initial design of new airplanes. The advisory circular is being prepared by the Los Angeles Aircraft Certification Office and should be available by late 1984.††

Notices

Notice 8000.237, Airborne Navigation System Airworthiness Guidelines, issued June 15, provides inspectors and engineers with guidelines concerning installations of airborne navigation systems including LORAN-C, Omega and Omega/VLF systems. (AWS-300)††

Notice 8600.35, Isopropyle Alcohol Systems, issued July 8, requires inspectors to alert operators and maintenance agencies during routine surveillance and safety clinics to a potential hazard connected with the use of plastic hoses and fittings in isopropyl alcohol distribution systems. (AWS-300)††

Notices Continued...

Notice 8600.36, Approval of Standby Vacuum Pump Installations, issued July 28, responds to a Central Region request to notify inspectors that approval of vacuum pump installations must be accomplished through supplemental type certificate procedures. (AWS-300)††

Notice 8130.39, Amateur-Built Aircraft - Determination of Major Portion, issued for a trial period of 1 year, provides checklists to help define "major portion" of an amateur-built aircraft. (Under FAR 21.19(g), an aircraft is eligible for certification as amateur-built when the major portion has been fabricated and assembled by persons who undertake the construction project solely for their own education or recreation.) The field offices may reproduce the checklists for amateur builders, Experimental Aircraft Association designees, or manufacturers who wish to produce eligible kits for amateur-built aircraft. (AWS-200)††

Order 8000.40A, Maintenance of Pressure Cylinders in Use as Aircraft Equipment, dated July 17, updates procedures for determining the status of pressure cylinders manufactured in accordance with military specifications and explains inspection procedures for foreign and U.S. manufactured cylinders not made in compliance with DOT specifications. (AWS-300)††

Change 12 to Order 8320.12, Air Carrier Airworthiness Inspector's Handbook, signed June 1, updates Chapter 3, Section 28, Special Field Reporting Requirements, to include Boeing 757/767 aircraft. (AWS-300)††

Change 72 to Order 8340.1A, issued on May 19, transmits Maintenance Bulletin 52-12 entitled, "Nikon YS-11 Series Aircraft - Aircraft Interior Overwing Exit Markings." The bulletin directs field inspectors to assure that their assigned operators are aware that emergency exit catches and handles should be marked so that they are distinguishable and can be easily located during an emergency. (AWS-300)††

Notice 8000.236, Designated Airworthiness Representative (DAR) Monitoring Program, establishes a temporary monitoring program of the DAR selection and appointment procedures. The monitoring program is intended to obtain information on the extent of the DAR program, its impact on FAA resources, and the adequacy of the procedures set forth in Notice 8000.233, Interim Qualification Criteria, Selection, and Appointment Procedures for Designated Airworthiness Representatives. (AWS-200)††

Notice 8610.20, Qualification of Airworthiness Inspectors for Inspection Authorization, issued on April 4, provides information on the applicability of experience gained in certain FAA positions to the eligibility requirements for an inspection authorization (IA) as set forth in FAR 65.91(c)(2). (AWS-300)††

Change 11 to Order 8320.12, Air Carrier Airworthiness Inspector's Handbook, approved on March 11, incorporates into Chapter 3 all information and guidance on maintenance programs, inspection programs and inspection requirements for air carrier and operating certificate holders conducting operations under FAR Parts 121, 127, 129, and 135. (AWS-300)††

Have any comments, questions, or articles you'd like published in the Newsletter? Send them to: Editor, Aircraft Certification Division, ANM-100, FAA, Northwest Mountain Region, 17900 Pacific Highway S., C-68966, Seattle, WA 98168.

General Notice (GENOT) Maintenance Alert 8120.8 was issued to provide a definition for the word "manufactured" as used in FAR 45.29, as amended. That part requires that registration marks on aircraft must be at least 12-inches high except under certain conditions, one of which is that the aircraft was "manufactured" after November 2, 1981, but before January 1, 1983. The GENOT defined "manufactured" as meaning that the aircraft had been completed, painted (including registration marks) and flight tested. (AWS-200)††

Notices Continued...

Notice 8010.34, The Service Difficulty Reporting (SDR) Program, issued May 27, states, among other things, that the SDR Program will be reevaluated and revised as needed to make it compatible with present organizational structures and functions; make it responsive to current FAA and industry needs; reduce its cost to the FAA; reduce its regulatory burden on the public; and make it a viable building block of the Aviation Safety Analysis System (ASAS). (AWS-300)††

Notice 8600.34, Availability of Unapproved "Rebuilt" Slick 4000 Series Magnetos, signed May 10, advises inspectors to alert mechanics and repair stations of the unairworthy condition of the "rebuilt" magnetos which were "sealed" by the manufacturer and were not intended to be serviced in the field. There are no replacement parts provided by Slick and no instructions regarding maintenance or overhaul procedures for the units. The "rebuilt" magnetos are apparently being sold without an approval for return to service.††

GENOT 8320.281 instructs Principal Maintenance Inspectors to assure that their assigned operators of large aircraft are using only those wheel bearings designated by the aircraft manufacturers' wheel overhaul manual. (AWS-300)††

GENOT 8130.37 was issued to alert field offices to the provisions of Order 8130.2B that require the display of a weight and airspeed placard in gliders having experimental certificates. The need for the GENOT was generated by a complaint from a foreign glider manufacturer that experimentally-certificated gliders were being operated in competition at weights in excess of manufacturers' recommended weights. (AWS-200)††

Notice 8000.234, Airborn Navigation System Airworthiness Guidelines, issued May 6, provides field inspectors and engineering personnel with guidelines on airborne navigation system airworthiness installations including LORAN-C, Omega, and Omega/VLF systems.††

Part 120, Air Transportation Regulation. A proposed advisory circular was published in the March 31 Federal Register. The AC contains the administrative procedures and acceptable methods of compliance for the safety objectives of a new proposed Part 120. Part 120 and the AC are intended to provide regulatory flexibility to the air transportation industry while continuing to achieve the same high safety standards required by existing Parts 121 and 135. (ASF-400)††

Notice 8600.33, issued April 22, clarifies GENOT 8600.32, Written Test Eligibility, and provides an alternate procedure for meeting the experience requirements of FAR Section 65.77.††

Notice 8000.235, Reinstatement of TSO-C91 Authorizations Applicable to Certain ELT Replacement Battery Packs, signed May 25, advises field inspectors of the cancellation of Notice 8000.231 and indicates that TSO-C91 authorizations have been restored for the Artex Aircraft Supplies ELT replacement battery pack P/N 00-22-006 and for the Anderson Manufacturing Company ELT replacement battery pack P/N RA-65.††

Notice 8320.282, Emergency Equipment Failures, signed May 17, requests that Principal Maintenance Inspectors provide details of recent reported failures and malfunctions of emergency evacuation slide systems and emergency exits. (AWS-300)††

Transport Category Airplanes--Shoulder Harness. FAR Amendment No. 91-183 became effective on March 31. Its application, however, was retroactive to March 6. This amendment brings the shoulder harness rule contained in Part 91 in harmony with Part 121 and, accordingly, relieves transport category airplanes certificated before January 1, 1958, from being required to be equipped with shoulder harness installations at each flight-deck station unless required by the type certification rules under which they were manufactured. (ASF-400)††

Notices Continued...

Notice 8320.284, Portable Fire Extinguishers Manufactured by Graviner, issued July 12, advises airworthiness inspectors of a potential safety problem with certain Graviner portable fire extinguishers. (AWS-300)††

Aircraft Lavatory Maintenance/Inspection. The Office of Airworthiness, FAA, Washington, D.C., issued notices (GENOT 8320.283 and 8320.285) to the field in July to initiate a specal emphasis program to assure the fire integrity of aircraft lavatory trash receptacles of all transport category aircraft being operated by U.S.-certificated operators. FAA principal airworthiness inspectors are to reevaluate operators' maintenance/inspection programs to check that emphasis is being placed on the servicing and maintenance of lavatories and verify that operators have adequate programs for both the removal of waste from all areas of lavatories and the inspection of areas susceptable to accumulation of fluids. This will be done during normal surveillance and en route, ramp, and spot inspections. Results of inspections and comments on the adequacy of the programs are to be sent to the Aircraft Maintenance Division for analysis. (AWS-300)††

General News

Damage Tolerance Topic Of Wide Interest. The National Resource Specialist for Fracture Mechanics/Metallurgy, Tom Swift, recently presented a paper at the International Committee on Aircraft Fatigue Conference in Toulouse, France. Mr. Swift's objective in presenting the paper, entitled, "Verification of Methods for Damage Tolerance Evaluation of Aircraft Structures," was to outline the general requirements for a damage tolerance evaluation of commercial transport airplanes under FAR 25.571 and to resolve some of the controversial issues which have arisen since adoption of the requirement in October 1978.††

FAR 25 Review. The Transport Airplane Certification Directorate will issue a Notice of Proposed Rulemaking (NPRM) this winter proposing changes to over 100 sections in Part 25. The objectives of this project are to incorporate proposals appropriate to small transports into Part 25 and reduce regulatory burden where possible without reducing safety.

Because the overall intent of the FAR 25 review is to reduce the regulatory burden, many of the changes proposed in the NPRM are intended to clarify the regulation, not to impose additional regulations. The NPRM has had extensive internal FAA coordination. Copies of the draft have been provided to the European Joint Airworthiness Requirements (JAR) Group and the Canadian Department of Transportation.††

FAA Releases CVR/FDR Evaluation Report. The FAA has completed an evaluation of alternative scenarios requiring the use of cockpit voice recorders (CVR) and flight data recorders (FDR) in certain aircraft. The evaluation, led by the Office of Aviation Safety, responded to several recommendations made by the National Transportation Safety Board (NTSB) on the use of CVR/FDR. As a result of the evaluation, FAA will initiate rulemaking action which will change the CVR/FDR requirements for certain aircraft operating under FAR Parts 121 and 135.††

Regulatory Negotiation. The FAA and aviation industry representatives continue to work on Regulatory Negotiation (RN) in the hope of reaching final conclusions on recommended changes to the flight and duty rules of Parts 121 and 135. Most of the alphabet groups, including Airline Pilots Association, Helicopter Association International, Airline Transport Association, and various airlines, are attending the RN. A representative of the Federal Mediation and Conciliation Service chairs the meetings. Aviation Standards representatives are Ken Hunt, Bill Brennan, and Larry Bedore from the Office of the Flight Operations, and Joe Sullivan, Executive Secretary, from the Office of Aviation Safety. (AFO-200)††

General News Continued...

Transfer of Responsibility for MMF. The primary certificate responsibility for repair stations with limited ratings at manufacturers (known as manufacturer's maintenance facilities (MMF)) has been transferred from the Flight Standards Field Offices to the Aircraft Certification Directorates. The transfer of MMF responsibility will result in more efficient use of FAA resources by combining the production and MMF audits and reducing the number of FAA elements auditing the manufacturer. FAA Order 8120.2A(Change 2) and Order 8600.1 (Change 14) contain the transfer guidance. (AWS-200)††

FAA issued TSO-C69a, Emergency Evacuation Slides, Ramps and Slide/Raft Combinations on June 3, 1983. It updates the previously published criteria for slides and establishes new criteria for slides/rafts. It also establishes new radiant heat resistance criteria for material used in inflatable slide construction and requires that only material meeting the new criteria be used in TSO'd slides manufactured after December 3, 1984. (AWS-100)††

The FAA recently issued TSO-C99, Protective Breathing Equipment, which establishes minimum performance requirements for emergency equipment designed to provide flight deck and cabin crewmembers with eye and respiratory system protection from toxic substances. (AWS-100)††

Exemptions Granted To Boeing And Cessna. On May 12, the Director of Airworthiness granted exemptions from FAR Part 21 to permit Boeing and Cessna to apply individually to the Transport Airplane Certification Directorate in Seattle for Delegation Option Authorization (DOA) that would allow the companies to conduct type, production, and airworthiness certification programs on derivative models of existing transport category airplane manufactured by them.

If Boeing and Cessna are issued DOA's, many compliance functions will be conducted by their own personnel rather than by the FAA Aircraft Certification Office (ACO). Prior to the granting of the exemptions in May, the companies could apply for DOA's to conduct such programs only on non-transport category airplanes, small gliders, helicopters, and certain engines and propellers. (AWS-100)††

New National Resource Specialist. Terence Barnes has been appointed to the National Resource Specialist Program team to work in the area of Flight Loads/Aeroelasticity - Fixed Wing. His responsibilities will include: management of the overall activities involved in flight load (including aeroelastic load) design aspects of fixed wing aircraft; and development of research and development programs and technical training courses needed to assure continued FAA technical competence in the aircraft certification process. Mr. Barnes was formerly employed by the Boeing Commercial Airplane Company as the Senior Specialist Engineer of Loads and Dynamics. He may be contacted at the Seattle Aircraft Certification Office, ANM-105N, on FTS: 446-2848 or COMM: 206-431-2848. (AWS-100)††

Damage Tolerance Paper Now Available. Joseph R. Soderquist, the NRS for Advanced Materials/Nonmetallic, presented a paper entitled, "Damage Tolerance Certification of Civil Composite Material Aircraft Structure" at the 6th Conference on Fibrous Composites in Structural Design in New Orleans earlier this year. The paper delineates a recommended approach to conducting a damage tolerance evaluation of composite material aircraft structure. State-of-the-art issues are highlighted and discussed. This paper may be obtained from :

Joe Soderquist
Aircraft Engineering Division,
AWS-100,
800 Independence Ave.
Washington, D.C. 20591

General News Continued...

LORAN-C For Nonprecision Approaches Under Study. Increasing demands from industry have led to a formal review of the operational/certification questions associated with the use of LORAN-C for nonprecision approaches. A major step in this process was taken in March when FAA specialists met to outline a basic plan for obtaining the needed answers. The working group report will be used as a basis for an advisory circular on criteria for LORAN-C approach certification/operations. A joint Coast Guard/FAA standard describing the limits of LORAN-C signal device is being negotiated by FAA's Development and Logistics (ADL) office. The first report was distributed for regional/office/ service comments in late April. (AFO-740)††

Pressurized Cabin Loads - FAR 25.365 (e)

Some confusion over the application of FAR 25.365(e) has developed in regard to the required opening size given by the equation $H_O=PA_S$. Section 25.365(e)2 defines A_S as the maximum cross sectional area of the pressure vessel. Inasmuch as transport airplanes are designed with the occupied portion of the fuselage comprising a single pressure vessel, there is only one value of A_S for the airplane, regardless of which compartment is being analyzed. The hole size (H_O) thus determined is located anywhere within the pressure vessel including the pilot's compartment.

The location of openings created by engine disintegration or equipment failures (FAR 25.365(e)1, 3) may be limited to probable strike areas on the fuselage.††

Microfiche Availability. The Aviation Standards National Field Office has been beseiged with requests from field inspectors wanting information on how the mechanics and authorized inspectors can get microfiche copies of the Type Certificate Data sheets. They can now be ordered from the Government Printing Office on a subscription basis which includes the six basic volumes and monthly updates from January through December of the year in which ordered. The price is $105 for domestic mailing and $131.25 for foreign mailing. When ordering you should specify Type Certificate Data Sheets and Specifications - Microfiche, TCDSM, and submit your request to the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. (AVN-100)††

FAA Auxiliary Fuel System Forum. The FAA sponsored a public technical forum to bring together FAA and industry experts to discuss improvements to the current airworthiness design and standards for auxiliary fuel system installations applicable to transport category airplanes. This technical basis will then be used by the FAA to develop a draft advisory circular following normal procedures at a later date. This technical forum was open to all parties, both foreign and domestic, who have an interest in this subject. The forum was held at the Bahia Hotel in San Diego, California, from November 15 through November 18.

A few examples of technical subjects which were discussed during the forum were:

1. Fuel system installation integrity and crashworthiness.

2. Auxiliary fuel system arrangement.

3. Component materials.

4. Auxiliary fuel system performance.

5. Impact of system on aircraft operation and performance.

6. User instructional requirements.

There were FAA representatives from all the regions participating in the forum. In addition, industry was well represented.

All comments received during the forum will be considered for the advisory circular which is targeted for completion in draft form by February 1984.††

General News Continued...

Certification of Vertical Descent Flight Modes in Transport Category Aircraft.

There have been recent reports to our office that systems which incorporate vertical descent flight path modes are being installed in executive jet type transport category aircraft. These systems can readily induce the aircraft speed to rapidly exceed V_{mo}/M_{mo} after the transition from cruise to the descent mode. These systems were approved through the STC and field approval process. The systems include features which allow the air crew to pre-program vertical descent flight modes to the flight guidance system at relatively high descent path angles. With the airplane in a cruise configuration and at a normal power setting, the non-annunciated event can result in airplane overspeed unless the air crew anticipates the event with some degree of precision. In some cases, a descent flight path angle can be preselected that exceeds the ability of the flight crew to manage with maximum airplane high drag re-configuration and power reduction. We are presenting the following approval guidance for your information.

"Stand Alone" or Performance/Flight Management Systems incorporating features that allow the air crew to pre-program a vertical descent flight mode automatically to the flight guidance system which can subsequently result in speeds which exceed V_{mo}/M_{mo} with no further action required by the air crew should not be approved in accordance with FAR 21.21(b)(2). This may include vertical descent flight modes which command flight path angle, vertical speed, or a combination of the two.

Systems that provide proper annunciation prior to reaching the top of descent point and require a positive air crew action to enable the transition to the vertical descent mode are acceptable, providing the resulting speeds are within the airplane certificated operating envelope. Proper annunciation should take into account the time required for the air crew to reconfigure the airplane and provide/verify the appropriate thrust settings. Autothrottle mechanized systems are acceptable. Systems should be evaluated to the above criteria at the critical combination of altitude and descent angle.

Watch the Federal Register.
As of August 22, the Office of the Federal Register ended its two-day-a-week publication schedule because of increased costs and limited participation in the volunteer program. So, please be sure to monitor each issue of the Federal Register for FAA publications. (ASF-400)††

FAR 25.1309 Meeting. On September 13 and 14, 1983, the Transport Airplane Certification Directorate sponsored an FAA/Industry meeting on the application of FAR 25. 1309. Approximately 80 people from both the FAA and industry attended the meeting.

The meeting was quite successful and stimulated much discussion about 25.1309. Some of the areas which industry indicated 25.1309 had been, or could be misapplied included:

1. Assigning a "catastrophic" ("critical" in AC 25.1309-1) result to a failure condition that does not necessarily result in an accident. This is due primarily to the fact that credit is not given to mitigating factors.

2. Overemphasis of statistical methods when engineering judgment and/or service experience is more appropriate.

3. Using 25.1309 to make "new" requirements or interpretations outside of proper regulatory procedures, in addition to applying 25.1309 to new equipment being installed in pre-Amendment 25-23 airplanes.

4. Dictating maintenance requirements by assumptions on inspection/maintenance intervals made in probability analyses.

While there were others, those four items constituted industry's main areas of complaint.

General News Continued...

Following the industry portion of the meeting, the FAA participants held a critique of the meeting and spent several hours brainstorming future activity. It was agreed that an FAA "Steering Committee," with participants from each of the Directorates, should be formed to develop and implement an action plan to address the issues raised at the meeting.

Some of the possible areas/subjects for future action concerning standardizing application of FAR 25.1309 identified by the FAA team were:

1. Revision of AC 25.1309-1. At the 25.1309 meeting, Aerospace Industries Association (AIA) agreed to form an industry team to develop proposed changes to the AC. We have already sent a letter to AIA accepting their offer of assistance.

2. Develop an internal FAA document containing case histories (real or fictional) on applying 25.1309.

3. Develop a method of disseminating information on how 25.1309 was applied in precedent setting cases.

4. Define "sound engineering judgment."

5. Workshop/Training on AC 25.1309-1.

6. A step-by-step method of finding compliance to 25.1309.

7. Develop hazard assessment methodology.

8. Maintenance relationships, particularly structural vs. 25.1309 systems.††

<u>Establishing Design Values for Composite Assemblies</u>

Structures fabricated from composite materials receive special attention within the FAA. The FAR requirements state that design values for materials, panels, and joints must be based on sufficient number of tests to establish strength properties on a statistical basis. The FAA has been presented with allowables to be used in analysis based on manufacturers' data, which in some instances were unacceptable. The FAA will not accept allowables data which has not followed an FAA approved process. A proper procedure begins with approved drawings, materials, and process specifications; next, a test plan is developed, submitted to and approved by the FAA; conformity inspections are conducted by the FAA; the data is reduced in accordance with the referenced handbooks and the final results submitted to the FAA for approval.

The application of Mil-HDBK-5 or -17 reduction techniques to the manufacturers' published data based on a low number of samples can result in a relatively low design value. Since the difference between the design values and the sample mean is a function of the number of samples tested, it is to the manufacturer's advantage to have a large number of samples. Strength data for composites does not follow the normal distribution and is best represented by a Weibull distribution. Mil-HDBK-17 is being revised to provide the latest criteria. It is advantageous to the manufacturer to obtain early FAA concurrence regarding distributions, number of different layups used and how the effects of temperature and humidity are accounted for during testing. Interim guidance materials on establishing allowables should be available from the FAA in the near future.††

<u>Flutter Failsafe Requirements - FAR 25.629</u>

In this article we intend to clarify the criteria for the relief granted in FAR 25.629(d)(3) to the single element failure conditions specified in FAR 25.629(d)(4) (i) and (ii). This problem was addressed previously in a letter to the other Directorates in May 1982. That letter recommended that single element

General News Continued...

failures be considered on engine mounts since we were unable to determine any adequate criteria for the relief.

This interim technical guidance emphasizes that engine structures as well as engine mounts are included in the assessment, and provides an alternative to single element failures that may be applicable in some cases.

FAR 25.629(d)(4) specifies several specific single element failure conditions that are required to be investigated for freedom from flutter and whirlmode instabilities. Section 25.629(d)(4)(i) applies to supports such as engine mounts that attach engines and other bodies to the basic airframe while FAR 25.629(d)(e)(ii) applies to single element failures of engine structure that supports the propeller shaft or otherwise affect the pitch and yaw rigidity of the propeller plane. The engine structure referred to by 25.629(d)(4)(ii) is structure that may be certified under FAR 33 and therefore not necessarily required to comply with other provisions of FAR Part 25.

This rule was promulgated as a result of several inflight accidents and was intended to require single element failures where linkages, fittings, and other discrete attachments were used as supports. In order to give some flexibility in the application of the rule to other kinds of supports that might be essentially immune to discrete element failures, FAR 25.629(d)(3) was also promulgated. FAR 25.629(d)(3) provides the following ways of showing that these single element failures are extremely improbable:

1. by showing that the element is designed with conservative static strength margins for the flight and ground load conditions;

2. by showing that the element is designed with sufficient fatigue strength for the expected loading spectrum.

This relief was not intended for discrete linkages and fittings which were the type of structure for which the failsafe rule was written. There is no level of static margin or fatigue strength that will assure that failure of this type structure is extremely improbable. This type of structure is subject to damage, corrosion, wear, misassembly, and manufacturing anomalies that cannot be accounted for by static margin or fatigue strength. In addition, flutter failures on these types of structural attachments may take the form of reduced stiffness or the development of free play, neither of which are directly related to strength margins.

In recent months a few manufacturers have attempted to use the relief provided by 25.629(d)(3) for discrete linkages and fittings. As a result, there have been requests for the development of criteria and that would define "sufficient" fatigue strength or "conservative" static strength margins. We have not established any criteria since we believe, based on service experience, there is no level of static margin or of fatigue strength that would be sufficient to show failure to be extremely improbable on those types of structures. Therefore, single element failures should be strongly encouraged.

As an alternative, the structural attachments referred to by 25.629(d)(4)(i) and (d)(4)(ii) may be subjected to damage tolerance assessment as described by FAR 25.571, provided they are structural elements that lend themselves to such analysis. In addition, investigations of partial failure reduced stiffness effects and maximum free play should be investigated. It should be emphasized that some of the structural elements in question are engine structures that are not otherwise required to meet FAR 25.571.

Use of Plastic Oxygen Lines

The Regulations and Policy Office recently evaluated the use of plastic and nylon tubing for oxygen lines. Generally, oxygen system tubing located in the fuselage walls is made of stainless steel for high pressure lines and aluminum alloy

General News Continued...

for low pressure lines. The evaluation indicated that plastic (polyethelene) and nylon tubing are unacceptable for use as oxygen lines which are subject to continuous pressure. This finding is based on their higher susceptibility to combustion than stainless steel and aluminum and their loss of strength with an increase of temperature. However, synthetic materials are acceptable when there is not a continous pressure, such as the lines between distribution system and the mask.††

News From The Flight Standards Division

THE AIRCRAFT EVALUATION GROUP (AEG) PROGRAMS.

Aircraft Evaluation Groups (AEG) have evolved within the FAA to bridge the gap between the certification efforts prior to the type certification and operational activities which take place at and after the time an aircraft is placed into service. AEG's continue to support technical aspects of safe operation of aircraft during an aircraft's full operational life by assessing information from and by providing information to FAA field offices. In the Northwest Mountain Region, this service is provided by two AEG's which are co-located with the Aircraft Certification Offices (ACO) in Seattle and Long Beach. The Seattle AEG is basically assigned Boeing and foreign manufactured Part 25 or equivalent aircraft, and the Long Beach AEG is assigned McDonnell Douglas, Lockheed, and other transport category aircraft manufactured in the U.S.

The AEG's have a variety of responsibilities, including:

1. During the type certification process, providing consultation concerning FAA operating and airworthiness rules and policies to the FAA ACO's, Flight Standards Field Offices, the manufacturers, and airlines.

2. New/common/same aircraft type rating determinations.

3. Developing specific aircraft training and checking criteria through Flight Standardization Boards (FSB).

4. Developing Master Minimum Equipment Lists (MMEL) which become the basis for the airline's Minimum Equipment List (MEL) and operating rule reviews through Flight Operations Evaluation Boards (FOEB).

5. Developing maintenance program standards and guidelines through Maintenance Review Boards (MRB).

6. Providing follow-up for operational consideration for airworthiness directives (AD), service difficulties (SD), accidents and incidents.

Some examples of significant work accomplished by our AEG's during this past year are:

1. B-757/B-767 initial MMEL approval.

2. B-757/B-767 common type rating determination.

3. Numerous annual MMEL reviews (B-727, B-737, B-747, DC-9, etc.).

4. Lear Jet special FSB training report.

5. DC-9-80 interim training program.

6. SD-3-30/3-60 same type rating determination.

7. Heads Up Display (HUD), Flight Dynamics, Inc., B-727 Category I authorization.

8. Twin engine extended overwater operations studies which are currently in progress.

9. B-757 and B-767 MRB documents.††

REDESIGNATION OF AIRCRAFT CERTIFICATION FIELD OFFICES (ACFO) AS AIRCRAFT CERTIFICATION OFFICES (ACO).

In October, the Denver, Anchorage, Honolulu, and Hawthorne offices of the Transport Airplane Certification

General News Continued...

Directorate were redesignated as Aircraft Certification Offices (ACO). These offices were previously called "field offices" to differentiate them from the Seattle ACO and the Los Angeles ACO to which they reported. However, the "field office" designation was confusing to many people because it implied that these were not full service offices. In order to ensure that there is no confusion concerning the responsibilities of these offices, they were retitled as ACO's. There is no change in reporting authority, however, the Denver, Anchorage, and Honolulu offices will continue to report to the Seattle ACO and the Hawthorne office will report to the Los Angeles ACO.††

Office Profiles

Office Profile: THE REGULATIONS AND POLICY OFFICE.

(EDITOR's NOTE: This section "OFFICE PROFILE" will be a regular feature of our Newsletter. In each issue we will highlight one of the offices or branches within the Directorate in an effort to help you understand who we are and what we do.)

The Regulations and Policy Office is the principal staff element of the Aircraft Certification Division for carrying out the regulations and policy responsibilities delegated by the FAA Administrator to the Transport Airplane Certification Directorate. These delegated responsibilities include:

1. Granting or denying exemptions from FAR Part 25.

2. Issuing, amending, extending or withdrawing notices of proposed rulemaking, including appendices, to FAR Part 25.

3. Issuing special conditions for transport category airplanes pursuant to paragraphs 11.28, 21.16, and 21.101 of the FAR.

4. Issuing, amending, or cancelling advisory circulars which establish acceptable means of compliance.

At present, there are eighteen employees in the Regulations and Policy Office: an office manager, two branch managers--one heading the Regulations Branch and one responsible for the Policy and Procedures Branch--two secretaries, two technical writer/editors, and twelve aerospace engineers. The engineers on the Regulations and Policy Office staff have a wide variety of work experience. Many of them previously worked for Boeing, Lockheed, the Air Force, or the Navy prior to coming to the FAA. In addition, they represent a diversity of aerospace engineering specialties, e.g., crash-worthiness, flight test, propulsion, airframe, systems, and noise.

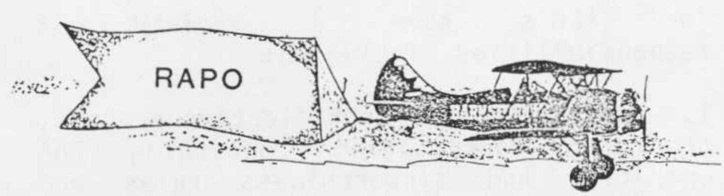
A few of the projects currently under development in the Regulations and Policy Office include:

1. A long-range project to systematically develop Advisory Circulars (AC's) for each section of FAR Part 25 as needed.

2. Crashworthiness rulemaking activities.

3. An overall review of FAR Part 25 which will be published shortly as a Notice of Proposed Rulemaking.

4. The development of certification criteria for extended overwater operation of twin engine airplanes.††



REGULATIONS & POLICY OFFICE (RAPO)

AIRCRAFT CERTIFICATION DIVISION

REGULATIONS & POLICY OFFICE

ANM-110

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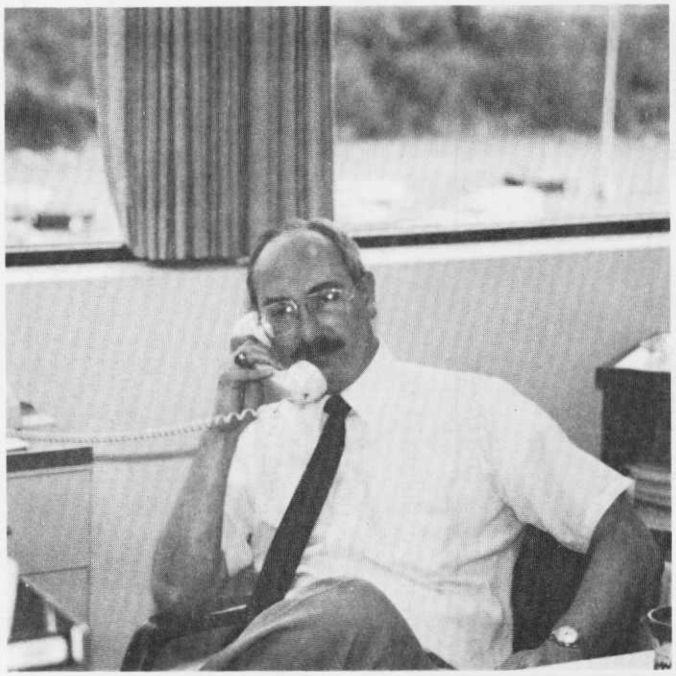

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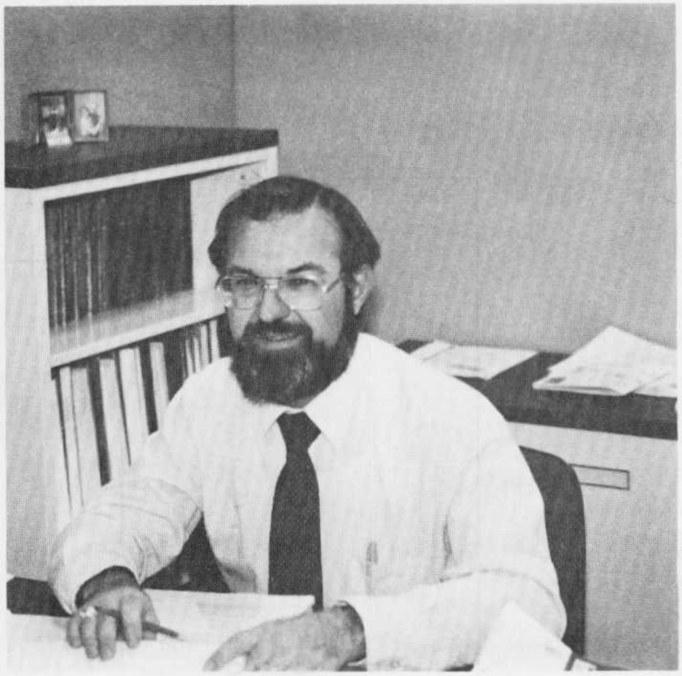

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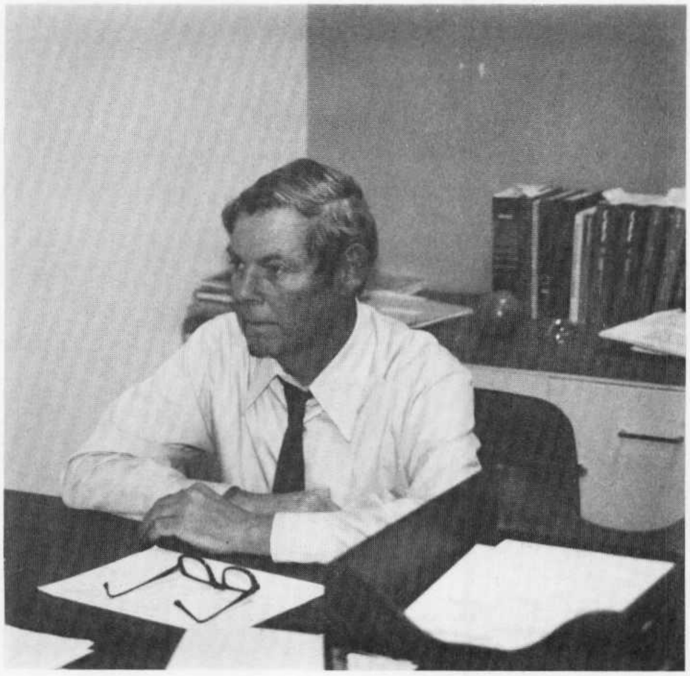

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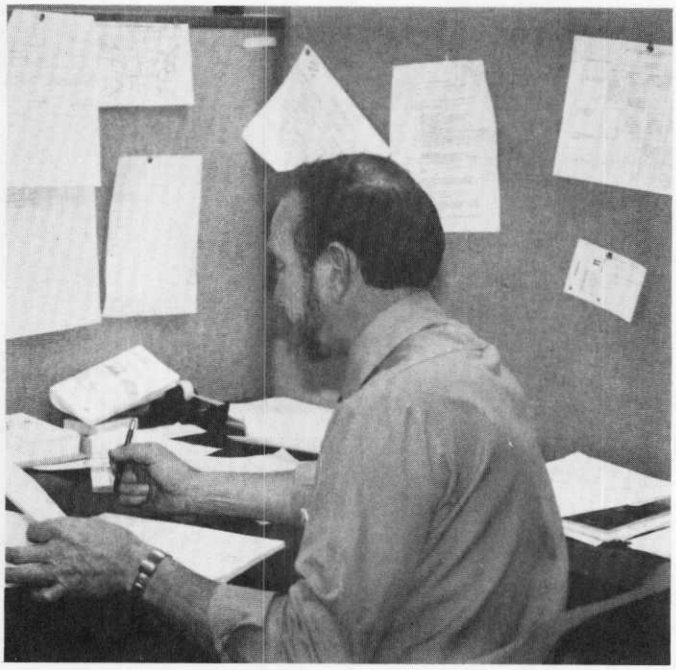

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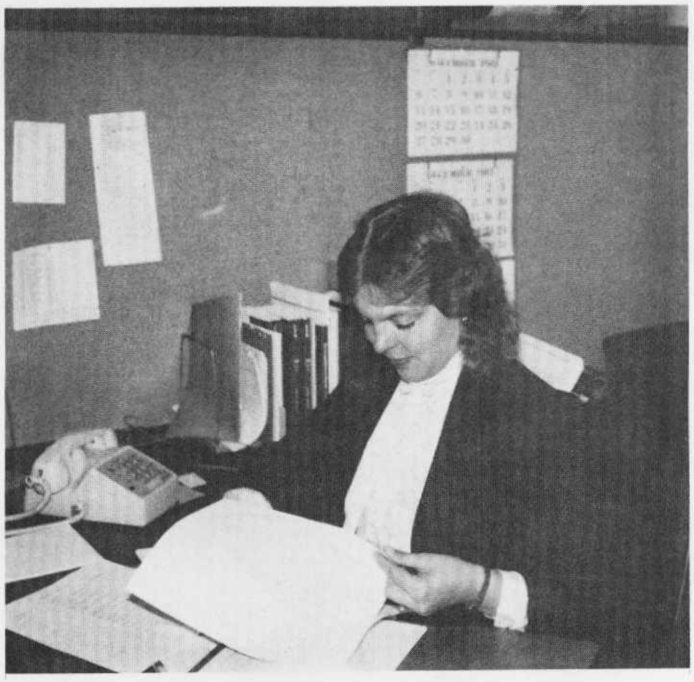

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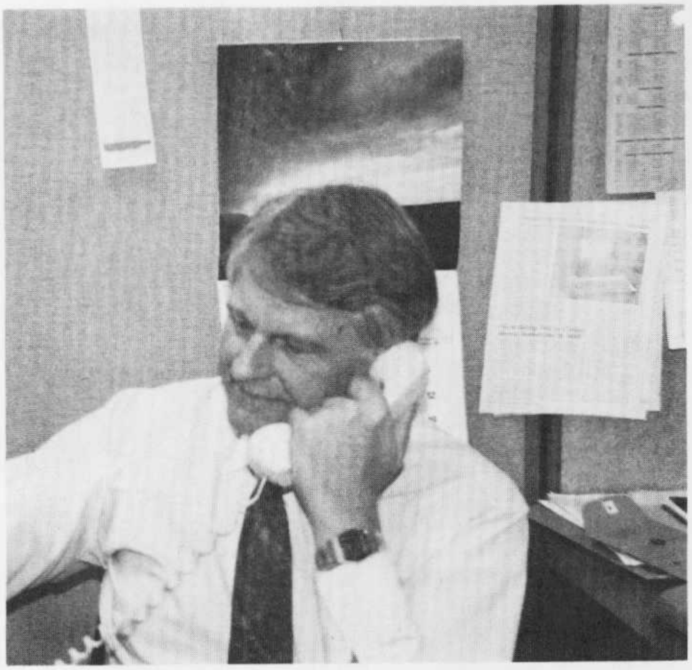

MAX PEACOCK,
Aerospace Engineer

BILL BOXWELL,
Aerospace Engineer

Special Topic

In light of the recent FAR 25.1309 conference which was sponsored by the Directorate, we thought it might be worthwhile to run the following "discussion paper." The paper was prepared several years ago by S. B. Poritzky and S. M. Horowitz of the now defunct FAA Office of Systems Engineering Management. The paper was brought to our attention when it was run in the July 1983 issue of the Aviation Standards Newsletter, an internal newsletter circulated in the FAA Aviation Standards complex. We are reprinting the paper here in the hope that it will provoke some thought and discussion on the issues raised by the authors. Following the article is a brief comment provided by Donald L. Riggin, Manager of the Regulations and Policy Office.††

The Uses and Limitations of Probability Estimates in Establishing Standards for Aviation Safety.

Attempts to quantify levels of safety for the purpose of certification and approval of aviation standards, procedures, and hardware are almost as old as the certification and approval process itself. FAA, and its predecessor agencies, and the aviation industry itself, have been highly safety-conscious from the beginning, and have sought rational and reasoned numerical methods for certification which would be thoroughly grounded in experience, and representative of FAA's goals. FAA has invoked strict safety regulations for many years, and the industry enjoys an enviable safety record, but quantification of safety standards prior to accumulation of a vast array of operational experience has proved elusive.

Over the years, as aircraft and their related systems have become more complex, the idea of using numerical/analytical/statistical methods of assessing probable failures and probable risks in new systems has become ever more attractive. Elaborate models intended to represent the aircraft and its component systems have been created to support such analyses, and similar efforts have been made for procedural processes, such as air route separation. Attempts have been made to establish levels of "acceptable risk" in numerical terms and component and element failure probabilities have been set based on assumptions of "acceptable risk."

Two problems arise immediately from the attempt to establish a standard: the problem of setting an acceptable risk level, by some rational reckoning, by any means other than the goal of making the system safer than it was previously; and the even more difficult problems of rationally correlating a probability of failure of a given element or elements of multi-element systems with a consequential accident probability.

Elaborate models have been constructed, some of which look elegant and attractive (especially if the resulting failure probabilities are very low). The difficulty is that neither the industry nor FAA has found a way to validate such models, because they are derived from abstract representations with multiple assumptions about dependence or independence of the elements, and only shaky knowledge of co-probabilities.

As a result, the application of failure probability estimating models should be viewed with skepticism for any problem other than comparing alternatives in relative terms. As systems become more complex in both hardware and computer software, and engineering judgments more difficult, requiring skills in many areas, the idea of using numerical probabilities of failure becomes more and more enticing. Yet, such models are subject to abuse by manipulation of the assumptions, as well as the more serious problem of model validation even if the assumptions are all valid, as discussed below.

Present Practices Have Proved Sound. It is fact, however, that the procedures used by the FAA in the past for regulating and certificating aircraft safety, for

Special Topic Continued...

establishing obstacle clearance and missed approach criteria, for setting air route separation standards and operating minimums, have been validated through a wealth of history and experience. FAA's safety record for aircraft certification and for the establishment of safe procedures remains exemplary, and it seems doubtful that a better record could be achieved by the use of analytical probability estimates as "standards" of safety.

Mathematical analyses of various kinds have been used over the years as an aid first to the designer, and then to the FAA inspector or analyst. Such work is essential both to designers and FAA in analyzing complex systems for failure modes fault detection and survival, and for assessing design alternatives in comparative--not absolute--terms. The paradox is that excessive enthusiasm for numerical estimates predicting future performance for the purpose of certification of setting standards may impact safety in the wrong direction. If the critical expert judgments which have been traditionally used to achieve safety are allowed to play second fiddle to computer model-derived probability estimates, there is a risk that safety could be compromised. If either the supplier of devices and systems in aircraft or procedures, or the inspector, is tempted to substitute mathematical processes, which have not or cannot be validated, for critical judgment based on history and experience, aviation safety is likely to suffer.

The FAA has been grappling for some time, as has the industry, with the task of putting into balance the desirable and essential processes of analysis, computer modeling of complex systems, fault-tree analysis, and mathematical comparison of alternatives--with the critical human judgments that must still be used to make a final approval of a system or a procedure as "safe enough" for use in aviation.

The FAA accepts the use of numerical probability estimates of failures or accidents as one method for evaluating designs as explained in FAA Advisory Circular, "System Design Analysis." Advisory circulars provide guidelines concerning how existing safety regulations are to be interpreted by both the aircraft industry and FAA engineers and inspectors. The advisory circular considers setting an allowable standard of risk for an aircraft accident related to the consequence of an accident. The relationship is intuitive and derives from the notion that accidents having increasingly severe consequences must be likely to occur with increasingly reduced probability. The requirements are stated in such a way as to assure that the probability guidelines are not interpreted precisely, but provide for a range of allowable estimates based on judgment. However, the final decision is still based on sound operational and engineering judgments considering all available data including the risk analysis.

The FAA's attempt to establish advisory guidelines which use objective numerical standards of safety has not been easy. The drafting of the advisory circular went through numerous revisions since its original proposal some years ago and has generated considerable discussion. There are two separate problems: (1) problems associated with establishing the numerical value for a safety standard, and (2) problems associated with demonstrating compliance with the standard that has been established. The latter problem may, for the reason noted above, be insurmountable.

Establishing an "Objective" Standard of Safety. On the face of it, the establishment of a standard should not be difficult. The number should be no lower than the present risk of an aircraft accident as evidenced by available statistics. A comparison of these accident statistics with those of other modes of transportation and with the customary risks associated with maintaining the quality of life demanded by society, suggests that it is possible to define an "acceptable" level of risk; with, perhaps, an improvement factor added

Special Topic Continued...

to account for the factors which cannot be modeled with high confidence. There is a problem, however, in attempting to assign an "acceptable" level of risk since the public's perception of risk is highly subjective. It seems easy to conclude rationally that the risk of an aviation accident fatality need not be lower than the other risks taken routinely in maintaining a given quality of life, i.e., risks from disease, automobile, coal mining or nuclear accidents, etc. It is not clear that the public, if some appropriate method could be found for actually polling their view, would choose to correlate the risks generated from many sources in an attempt to find a level of equivalence between them. Thus, it is extremely difficult to determine an objective level of risk for aviation; yet any use of probability computations for standard-setting demands that it be done.

Since the target level that is established is defined as representing the public's estimate of a "safe" standard, it necessarily includes the aircraft's contribution to safety as a portion of this standard, but only a portion: An aircraft in operational use interacts with such non-aircraft variables as pilot intervention, the effect of the air traffic control system, other aircraft in the system, the myriad influences of weather and environment, etc., in order to complete its operation safely.

Thus, the probability estimate for the mechanical safety of an aircraft is different from the probability estimate of the operational safety in use. There is a problem, therefore, in using an estimate for an acceptable objective standard of safety for certificating aircraft, because the standard will be compromised by other, non-aircraft, failures. We have not been successful in assigning probability estimates to these other factors. In addition, we do not know how to assign individual component probabilities convincingly to subsystems which interact, are conditionally dependent on one another, and must perform without failure in order for the aircraft to perform safely.

It is, of course, possible to establish some high exponential value (10^8, 10^9, etc.) as the standard of safety and then hold all aircraft components to this same value. However, this guideline for interpreting the regulation may both understate or overstate the actual risk of an accident simultaneously, and may spawn design complexities which do not really contribute to safety.

A tremendously large number of components combine to make an aircraft system. Even if each were held to a one-failure-in 10x design standard, there are countless possibilities for estimating that at least one component will fail. To the degree that these possibilities are mutually exclusive, we can estimate the probability that for "n" numbers of cooperating components, the probability that at least one will fail is (n) x (10x); and the belief that a strict standard of safety was being imposed could be decimated by the factor "n" (a very large number). A standard which appears at first blush to be strict, may in reality be quite lax.

On the other hand, a decision to assume that any, or many, element failures will result in a catastrophe, because the actual correlation cannot be established, may result in unnecessary complexity and overdesign. To the extent that airplanes and other components of the aviation system are designed to have back-up, parallel or redundant systems, the assumption that all component failures must be held to the same strict standard does not recognize that some back-up components may need to be used only if the primary system has failed; their use being conditional upon this prior failure. Hence, the probability of a compound failure event which includes the prior event may actually cause the FAA to set an unrealistically high and, perhaps, needlessly expensive standard of safety for a large number of aviation components, without necessarily achieving commensurate operational safety improvements. As an illustration of the problems involved, consider that most accidents are traceable to human error, and major air carrier accidents occur about once in a few hundred thousand flights. The risk of

Special Topic Continued...

such an accident is, therefore, in the 10^5 to 10^6 range. We are faced with a dilemma, then, if we require an autoland system to have a 10^9 risk of fatal accident as a minimum. We are, implicitly, requiring the mechanical systems to be analyzed as roughly 1,000 times safer than people before we will aprove it, and rejecting those which are only estimated to be, say, 10 times safer.

The fact that failures are compound and conditional makes it difficult to interpret any guidelines which provide objective standards of safety, when these standards are applied to major subsystems of the aircraft.

"Demonstrating" Compliance with a Numerical Safety Standard. The result of a model "demonstration" is a numerical estimate of a probability of an accident that conforms to the guidelines. The "demonstration" usually means that a model or simulation of an aircraft can be constructed which will yield this estimate.

The use of such a model assumes that an aircraft (or a procedure) can be represented by an abstract scheme in which the relationships between all components are identified, and for which estimates of failures for all individual components are available. "Fault trees" or paths of compound failure events can then be postulated, and probability estimates made for these events. Unfortunately, the compelling counter-argument against the use of such models is that they cannot be validated, i.e., the models have not demonstrated an ability to predict estimates of failure, which can be subsequently verified by an reasonable amount of experience. Accidents fortunately are rare events, and systems are designed to be reliable, and it takes a very long time to accumulate 10^8 or 10^9 events. The largest selling airliner, the Boeing 727, has only accumulated 5×10^7 hours of flight.

An impression persists that in the absence of hard experience or flight test data, especially for complex systems which are hard to analyze judgmentally, a model or abstract representation may provide the best information available for judging the safety and reliability of a new system. It is precisely in situations where experience is lacking that a mathemetical model cannot be used for predicting safety levels, since there has not been a demonstration of the model's validity. However, as before, good mathematical models can and should be used for comparative analysis of alternative designs.

The question remains, then, of how best to certify and regulate new, complex systems for which operational or experience data are not yet available. The answer must be by using experience, skepticism, and prudent operational and engineering judgments.

Implications on New Design Innovation. There is another problem in attempts to set numerical safety standards which involve predictions of future events in probabilistic safety terms. It applies to the development of new design and design innovations which, by rational engineering judgment, can be determined to improve safety. Since no experience exists for a new design or a new innovation, it is almost surely not possible to "demonstrate" compliance with a numerical safety "standard" in a believable manner.

For this kind of application, the use of mathematical analysis to evaluate alternative concepts is essential, but attempts to apply "standards" in numerical probability terms may simply prevent introduction of valuable new ideas. If designers of a new innovation or a system improvement are forced to try to "prove" compliance with an unprovable probability model, the initiatives to create real improvements can easily be stifled, with serious consequences on the basic motive of setting standards--that of achieving better and safer systems. In evaluating improvements and innovative changes, sound comparative analysis and operational/engineering judgment are the only acceptable guides.

Non-Issues. The use of numerical analyses, computer analysis of complex systems should be encouraged and is not the issue. The issue is concerned only with the use of these analyses for the purpose of establishing a numerical probability estimate of risk, as a standard for the purpose of regulating safety. Analyses of failure paths using estimates of component probabilities in order to estimate the probability of a compound failure event for the entire design network of components (so-called "Fault Tree Analyses") are, likewise, not controversial. The use of such statistical analyses, including their application in such techniques as Failure Mode and Effects Analysis are essential tools to be used in evaluating alternative concepts of aviation system designs, but their use alone does not result in a reliable and valid standard that can be used for the purpose of safety regulation.

FAA's ability to regulate aircraft safety is not the issue. The achieved record of aircraft safety is excellent and is not being challenged. However, this record was achieved by using a regulatory procedure based on conservative technical judgments derived from operational experience. Several examples of mechanical systems for which probability estimates have been claimed to have been calculated are available as case studies. From the published reports of these cases, the demonstrated ability to calculate meaningful probabilities has not been verified to be valid.

The Issue. The issue therefore is whether the use of numerical analyses which purport to give probability estimates of failure should be relied upon more heavily than in the past as a primary means of certification of aircraft or development of procedures, when proof of validity has not been demonstrated, and may not be achievable. The task is to find the best balance between numerical/probability analysis and expert judgment based on operational experience.††

COMMENTS FROM THE DIRECTORATE

The above article has some interesting "food for thought." Although never mentioned, the article is about FAR 25.1309, which the authors seem to view as an attempt by FAA to quantify acceptable risk levels for airplane design. This, of course, was never the intent of FAR 25.1309. FAR 25.1309 (specifically paragraph (b)) was originally intended to provide industry and FAA with a means of designing and evaluating complex systems. The numerical analysis is only one tool to be used in that process and was never intended to replace engineering judgment.††

At left, Richard Davenport, Manager, Seattle Aircraft Evaluation Group (AEG), with James Loesch, Boeing Commercial Airplane Company test pilot, on the right, in the cockpit of the Boeing 767. (See related article on the AEG in this issue).

FAA Administrator J. Lynn Helms in Boeing Simulator.