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NASA SP-7037 (47)

AERONAUTICAL ENGINEERING

A Special Bibliography

Supplement 47

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in July 1974 in

- *Scientific and Technical Aerospace Reports (STAR)*
- *International Aerospace Abstracts (IAA).*

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INTRODUCTION

Under the terms of an interagency agreement with the Federal Aviation Administration this publication has been prepared by the National Aeronautics and Space Administration for the joint use of both agencies and the scientific and technical community concerned with the field of aeronautical engineering. The first issue of this bibliography was published in September 1970 and the first supplement in January 1971. Since that time, monthly supplements have been issued.

This supplement to *Aeronautical Engineering—A Special Bibliography* (NASA SP-7037) lists 185 reports, journal articles, and other documents originally announced in July 1974 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*.

The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems. It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles.

Each entry in the bibliography consists of a standard bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged in two major sections, *IAA Entries* and *STAR Entries*, in that order. The citations, and abstracts when available, are reproduced exactly as they appeared originally in *IAA* or *STAR*, including the original accession numbers from the respective announcement journals. This procedure, which saves time and money, accounts for the slight variation in citation appearances.

Three indexes—subject, personal author, and contract number—are included.

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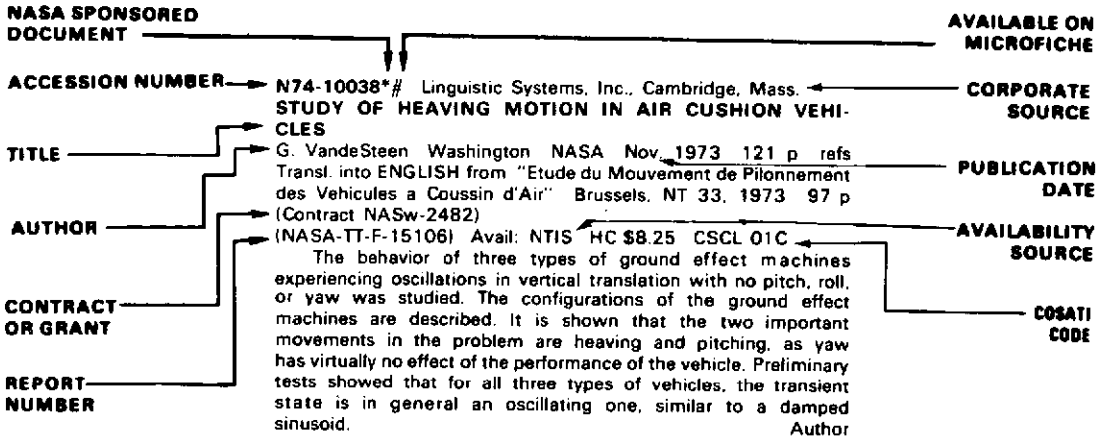

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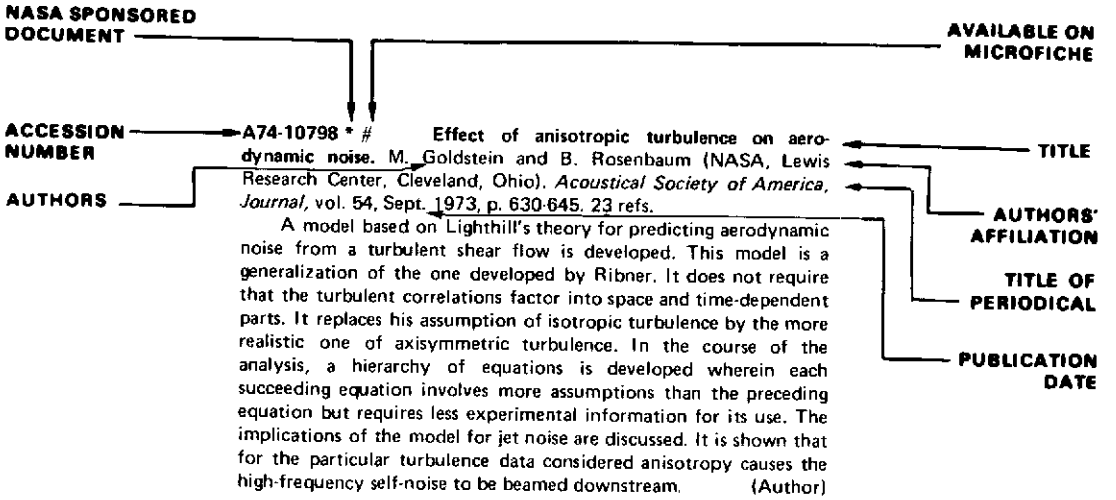

NASA

AERONAUTICAL ENGINEERING

A Special Bibliography (Suppl. 47) AUGUST 1974

IAA ENTRIES

A74-28572 **State versus federal regulation of commercial aeronautics.** R. F. Maris. *Journal of Air Law and Commerce*, vol. 39, Autumn 1973, p. 521-557. 216 refs.

Current federal legislation in the field of air law is dominated by the Federal Aviation Act of 1958. The primary stimulus for its enactment was the undesirable state into which the quality of safety regulation of aeronautics had fallen. Since Congress has the constitutional right to regulate all interstate commerce, and since the aeronautics industry is essentially interstate, it is natural that an area of contention would be whether air safety, and now recently, environmental protection, are so intertwined with the commercial aspect of air transportation as to preclude any state regulation in these areas. In addition, federal domination of the area of airspace control is not matched by control in the economic realm. Rather, it seems that the intent of Congress has been to allow a certain degree of concurrent state authority, which has generated a tremendous amount of uncertainty and litigation since no consistent pattern of federal-state regulation has been articulated. The present work maintains that the distinction between rates and certification, on the one hand, and routes and services on the other, is illogical and should be ended. P.T.H.

A74-28573 **The expanding liability of air traffic controllers.** S. B. Early, W. S. Garner, Jr., M. C. Ruegsegger, and S. S. Schiff. *Journal of Air Law and Commerce*, vol. 39, Autumn 1973, p. 599-624. 121 refs.

In the question of responsibility for aircraft accidents, the trend has been toward expanded air traffic control (ATC) liability. Various cases are reviewed, showing that liability of ATC now exists on what may be called a continuum of dependence. At one end of the scale is the situation where the pilot is almost totally dependent on ATC for guidance, and on the other is the situation in which he is nearly totally independent of any ATC presence. An example of the first situation would be landing under IFR, and an example of the second would be a pilot flying under VFR en route to his destination. Having evolved to the current position of using dependency as the true test of liability, the courts have necessarily had to hold invalid the traditional defenses arising from the exceptions to the Federal Tort Claims Act. As a result, government attempts to absolve ATC of liability presently centered around the common law defenses of 'no duty' and 'primary responsibility'. P.T.H.

A74-28606 # **U.S. Navy Fleet Satellite Communications.** N. L. Wardle (U.S. Navy, Naval Research Laboratory, Washington, D.C.). *American Institute of Aeronautics and Astronautics, Communications Satellite Systems Conference, 5th, Los Angeles, Calif., Apr. 22-24, 1974, Paper 74-458.* 5 p. Members, $1.50; nonmembers, $2.00.

To reduce the impact of the vagaries of HF radio and make Fleet Communications equal to the demands of modern Naval tactics, an extensive Satellite Communications System is being built. Operation is largely in the military UHF band (225-400 MHz) and uses channelized translating repeaters. Key among the reasons for use of UHF are timeliness and terminal cost and size. The channelized repeater was selected to simplify equipment and operation. A constellation of four geosynchronous satellites will accommodate Navy ships, submarines and aircraft and Air Force aircraft. Launch of the satellites is presently scheduled to begin in early 1976. (Author)

A74-28644 # **The problem of supersonic flow past intersecting wings** (K zadache obtekaniia sverkhzvukovym potokom peresekaiushchikhsia kryl'ev). N. F. Vorob'ev. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza*, Jan.-Feb. 1974, p. 173-175. 8 refs. In Russian.

Consideration of the problem of supersonic flow past intersecting, slightly bent wings in the case where the planes to which the boundary conditions on the wings are referred form an arbitrary dihedral angle less than or equal to 180 deg. It is shown that the integrodifferential equations to which the problem of flow past nonplane wings reduces in the case of an arbitrary dihedral angle can be solved by the method of successive approximations. Approximate solutions in quadratures are obtained which differ only slightly from the exact solution in the entire range of interaction of the wings and coincide with the exact solution on characteristic lines such as the boundary of the region of interaction and the edge of the dihedral angle. A.B.K.

A74-28676 # **Foam and aeration characteristics of commercial aircraft lubricants.** F. E. Salb and F. K. Lea (General Motors Corp., Detroit Diesel Allison Div., Indianapolis, Ind.). *American Society of Lubrication Engineers, Annual Meeting, 29th, Cleveland, Ohio, Apr. 28-May 2, 1974, Preprint 74AM-1A-1.* 8 p. 5 refs. Members, $1.50; nonmembers, $2.00.

Laboratory test data on foam and aeration characteristics of various grades of aircraft lubricants as determined by an oil foam and aeration tester are presented. The oil foam and aeration tester was developed when a need existed in screening aviation synthetic lubricants prior to full-scale engine tests. Lubricants discussed, relative to foam and aeration characteristics, cover a period from 1960 to the present day. (Author)

A74-28726 **The national microwave landing system /MLS/.** J. W. Edwards (FAA, Microwave Landing System Div.). *Society of Automotive Engineers, Business Aircraft Meeting, Wichita, Kan., Apr. 2-5, 1974, Paper 740345.* 9 p. Members, $1.25; nonmembers, $2.00.

The microwave landing system (MLS) is being developed as the next generation approach and landing system to replace the present worldwide instrument landing system (ILS). In order to satisfy diverse users such as civil and military aviation and conventional and V/STOL aircraft, the MLS employs compatible modular configura-

tions. The five-year National MLS Development Program, half over, has just completed a hardware feasibility demonstration phase, is about to choose the best technique, either scanning beam or Doppler scan, and in the next phase will select a single national system from among competing contractors. Operational advantages provided by the MLS include far greater flying precision and flexibility, including curved or segmented approaches in three dimensions; and flare guidance for all-weather automatic landing capability, resulting in greater safety while increasing airport capacities. (Author)

A74-28727 * Simulation and flight evaluation of a heads-up display for general aviation. R. L. Harris, Sr. (NASA, Langley Research Center, Hampton, Va.). *Society of Automotive Engineers, Business Aircraft Meeting, Wichita, Kan., Apr. 2-5, 1974, Paper 740347.* 36 p. 8 refs. Members, $1.25; nonmembers, $2.00.

A landing-site indicator (LASI) has been devised as a relatively simple heads-up display to show the pilot the magnitude and direction of the aircraft's velocity vector superimposed on the pilot's view of the landing area. A total of 160 landings were performed in a fixed-base simulation program by four pilots with and without the LASI display. These tests showed the display to be of beneficial use in making the approaches more consistent. Some inferences were also made that the physical workload would also be less with its use. The pilots generally agreed that the LASI, as represented in the simulation was a useful landing aid. Additional pilot comments from preliminary flight tests of a breadboard LASI display unit tend to confirm the simulator results. (Author)

A74-28728 A unique approach to the development of a light helicopter automatic flight control system. D. R. Korte (Bendix Corp., Avionics Div., Fort Lauderdale, Fla.) and R. Bakotich (Enstrom Corp., Menominee, Mich.). *Society of Automotive Engineers, Business Aircraft Meeting, Wichita, Kan., Apr. 2-5, 1974, Paper 740348.* 13 p. 6 refs. Members, $1.25; nonmembers, $2.00.

A74-28729 A simplified criterion to certify light aircraft for flight in icing conditions. D. H. Gollings (Piper Aircraft Corp., Lock Haven, Pa.) and D. W. Newton (Pennsylvania State University, University Park, Pa.). *Society of Automotive Engineers, Business Aircraft Meeting, Wichita, Kan., Apr. 2-5, 1974, Paper 740349.* 13 p. 7 refs. Members, $1.25; nonmembers, $2.00.

A74-28730 * A study of light airplane pilot landing performance. T. C. O'Bryan, M. W. Goode, and R. L. Harris (NASA, Langley Research Center, Hampton, Va.). *Society of Automotive Engineers, Business Aircraft Meeting, Wichita, Kan., Apr. 2-5, 1974, Paper 740350.* 35 p. Members, $1.25; nonmembers, $2.00.

The results of a total of 289 landings performed with a low-wing aircraft by a group of private pilots on long and short runways have been analyzed to determine the landing performance of these pilots. Both the long- and short-runway landings show significant variation from straight or uniformly curved trajectories, denoting considerable 'jockeying' on the part of the pilot during approach. The long-runway approach speeds were variable and higher than recommended. Considerable float followed by touchdown at speeds well above stall were noted. The short-runway landings were quite similar, except that approach speeds were slightly lower as a result of the use of two-thirds to full flaps, and touchdown occurred closer to the threshold. (Author)

A74-28731 * Applications of fluidics to light aircraft instrumentation and control. H. D. Garner (NASA, Langley Research Center, Hampton, Va.). *Society of Automotive Engineers, Business Aircraft Meeting, Wichita, Kan., Apr. 2-5, 1974, Paper 740351.* 7 p. 7 refs. Members, $1.25; nonmembers, $2.00.

Review of a program for the development of advanced fluidic components and the application of these components to general aviation instrumentation and control. The major project in this category has been the development of a simple, reliable, two-axis autopilot for light aircraft, using a fluidic inertial rate sensor for stability and roll attitude control, and a simple magnetometer for azimuth reference. This autopilot has been succesfully flight-tested. Fluidic hardware developed for this autopilot is described, and projected improvements and extensions are discussed. Application of fluidic components to such flight instruments as turn coordinators, artificial horizons, and true airspeed indicators is explored. (Author)

A74-28732 * NASA general aviation research overview. J. W. Stickle (NASA, Langley Research Center, Hampton, Va.), R. L. Winblade, and J. A. Westfall (NASA, Washington, D.C.). *Society of Automotive Engineers, Business Aircraft Meeting, Wichita, Kan., Apr. 2-5, 1974, Paper 740352.* 112 p. 73 refs. Members, $1.25; nonmembers, $2.00.

Review of current NASA research programs directly focused on general aviation. Significant accomplishments are cited in the areas of airfoil research, stall/spin technology, crashworthiness, and propulsion noise and efficiency. Highlights of recent NASA organizational developments affecting general aviation research are outlined. (Author)

A74-28733 * Light aircraft crash safety program. R. G. Thomson and R. J. Hayduk (NASA, Langley Research Center, Hampton, Va.). *Society of Automotive Engineers, Business Aircraft Meeting, Wichita, Kan., Apr. 2-5, 1974, Paper 740353.* 8 p. 6 refs. Members, $1.25; nonmembers, $2.00.

NASA is embarked upon research and development tasks aimed at providing the general aviation industry with a reliable crashworthy airframe design technology. The goals of the NASA program are: reliable analytical techniques for predicting the nonlinear behavior of structures; significant design improvements of airframes; and simulated full-scale crash test data. The analytical tools will include both simplified procedures for estimating energy absorption characteristics and more complex computer programs for analysis of general airframe structures under crash loading conditions. The analytical techniques being developed both in-house and under contract are described, and a comparison of some analytical predictions with experimental results is shown. (Author)

A74-28734 * Stall/spin research status report. J. S. Bowman, Jr. and S. M. Burk, Jr. (NASA, Langley Research Center, Hampton, Va.). *Society of Automotive Engineers, Business Aircraft Meeting, Wichita, Kan., Apr. 2-5, 1974, Paper 740354.* 25 p. Members, $1.25; nonmembers, $2.00.

Description of a program aimed at improving the design and evaluation techniques relative to stall/spin characteristics of general-aviation aircraft. The program encompasses analytical studies, full-scale and model wind-tunnel tests, a radio-control model, and full-scale flight tests. Initial spin-tunnel results of several tail designs on a representative light aircraft are discussed. (Author)

A74-28735 Crash-resistant fuel tanks for helicopters and general aviation aircraft. H. D. Smith (Goodyear Tire and Rubber Co., Akron, Ohio). *Society of Automotive Engineers, Business Aircraft Meeting, Wichita, Kan., Apr. 2-5, 1974, Paper 740358.* 17 p. 19 refs. Members, $1.25; nonmembers, $2.00.

A74-28736 A quiet propeller for commuter and general aviation aircraft. W. B. Harlamert (Hartzell Propeller, Inc., Piqua, Ohio). *Society of Automotive Engineers, Business Aircraft Meeting, Wichita, Kan., Apr. 2-5, 1974, Paper 740359.* 12 p. Members, $1.25; nonmembers, $2.00.

An aircraft propeller with five blades has been developed for application on relatively high horsepower turbine engines. This propeller is capable of absorbing high horsepower at low engine rpm to effect a low propeller noise emission. Propeller performance remains satisfactory, as its design is intended for a commuter-type

aircraft. Structurally, the addition of a blade has not created serious design problems. For its intended application, the five-blade best satisfies the requirement for a 'quiet' propeller. It is doubtful if the addition of more blades would be desirable. (Author)

A74-28737 **Evaluation of aircraft internal noise.** N. Ganesan (Gates Learjet Corp., Wichita, Kan.). *Society of Automotive Engineers, Business Aircraft Meeting, Wichita, Kan., Apr. 2-5, 1974, Paper 740360.* 8 p. 8 refs. Members, $1.25; nonmembers, $2.00.

Methods are outlined for calculating aircraft cabin noise levels due to the three main noise sources - the boundary-layer pressure fluctuations, jet exhaust, and internal equipment. Formulas for quick estimation of overall noise levels due to these sources as well as methods to obtain octave band levels are given. Manufacturing- or service-related noise and methods for identifying their sources are discussed. (Author)

A74-28738 **The background to propeller airplane noise regulations.** E. W. Sellman (FAA, Office of Environmental Quality, Oklahoma City, Okla.). *Society of Automotive Engineers, Business Aircraft Meeting, Wichita, Kan., Apr. 2-5, 1974, Paper 740361.* 8 p. 6 refs. Members, $1.25; nonmembers, $2.00.

Outline of the development of noise standards applicable to light, propeller-driven aircraft. The new noise abatement standards required under the Noise Control Act of 1972 are discussed in regard to their impact on future aircraft designs and their economic effect on the general-aviation industry. Since no type of certification requirements for noise abatement currently existed for propeller-driven aircraft (other than for those in the transport category), it was necessary to set up a testing procedure to determine how the standards could be modified for such aircraft. Discussed in detail are the noise evaluation measures, testing procedures, and maximum noise level standards. (Author)

A74-28739 * **A Fowler flap system for a high-performance general aviation airfoil.** W. H. Wentz, Jr. and H. C. Seetharam (Wichita State University, Wichita, Kan.). *Society of Automotive Engineers, Business Aircraft Meeting, Wichita, Kan., Apr. 2-5, 1974, Paper 740365.* 13 p. Members, $1.25; nonmembers, $2.00. Grant No. NGR-17-002-042.

A74-28740 **Flight test results of a separate surface wing-leveling system.** J. Roskam (Roskam Aviation and Engineering Corp., Lawrence, Kan.). *Society of Automotive Engineers, Business Aircraft Meeting, Wichita, Kan., Apr. 2-5, 1974, Paper 740369.* 10 p. Members, $1.25; nonmembers, $2.00.

A wing-leveler system using a separate-surface aileron driven by a linear electromechanical actuator is being developed for a Cessna 172. The separate-surface aileron is installed in the left wing only. Flight tests indicate that the system performs the bank-angle hold function quite well for a wide range of bank angles. After hardover failures of the system, the pilot still has adequate control over the aircraft. Takeoffs and landings with the system failed hardover have been performed. The system can be retrofitted to existing aircraft. (Author)

A74-28741 **T-tail aerodynamics of the Super King Air.** R. R. Tumlinson and H. L. Walter (Beech Aircraft Co., Wichita, Kan.). *Society of Automotive Engineers, Business Aircraft Meeting, Wichita, Kan., Apr. 2-5, 1974, Paper 740370.* 13 p. 8 refs. Members, $1.25; nonmembers, $2.00.

The Super King Air Model 200 is Beech Aircraft's latest entry into the executive turboprop aircraft market. Principal design features include a T-tail empennage and 850 SHP PT6A-41 powerplants widely spaced on a high-aspect-ratio wing. The results of preliminary studies of the T-tail are cited, as well as the results of preliminary wind tunnel tests. The rationale and design philosophy for satisfactory stall characteristics are discussed, and the development wind tunnel tests, the flight simulator tests, and the development flight-test program are reviewed. (Author)

A74-28742 **A digital simulation technique for crashworthy analysis of aircraft seats.** D. H. Laananen (Ultrasystems, Inc., Phoenix, Ariz.). *Society of Automotive Engineers, Business Aircraft Meeting, Wichita, Kan., Apr. 2-5, 1974, Paper 740371.* 11 p. 9 refs. Members, $1.25; nonmembers, $2.00. U.S. Department of Transportation Contract No. FA72WA-3101.

A74-28743 * **NASA, Langley Impact Dynamics Facility.** V. L. Vaughan, Jr. and E. Alfaro-Bou (NASA, Langley Research Center, Hampton, Va.). *Society of Automotive Engineers, Business Aircraft Meeting, Wichita, Kan., Apr. 2-5, 1974, Paper 740374.* 7 p. Members, $1.25; nonmembers, $2.00.

Description of an impact dynamics facility that will be used to crash test full-scale light aircraft. The aircraft are crashed into the ground as free bodies, using a pendulum swing method to obtain desired flightpath angles and velocities. The aircraft are unrestrained during impact to obtain realistic reactions. Accelerations and strains of the aircraft structure are measured during impact. The crash sequence and structural deformations are obtained by external and internal camera coverage. (Author)

A74-28744 **The design of crashworthy general aviation aircraft.** K. Bergey (Oklahoma, University, Norman, Okla.). *Society of Automotive Engineers, Business Aircraft Meeting, Wichita, Kan., Apr. 2-5, 1974, Paper 740376.* 8 p. 9 refs. Members, $1.25; nonmembers, $2.00.

An analysis of general aviation accident statistics for the years 1964-1967 has been made for the purpose of identifying specific aircraft or aircraft features which have proved in service to be effective in reducing crash fatalities. The results indicate that none of the current general aviation aircraft will serve as a suitable model for the design of future crashworthy aircraft. Furthermore, the value of certain design features recommended in the crash safety literature is not confirmed by the statistics. Recommendations are made for further analysis of accident statistics as well as for programs of research and demonstration in the field of crashworthy design. (Author)

A74-28745 **A control concept combining the best of the current hydromechanical and electronic technologies.** M. F. Keck, J. J. Fredlake, and G. V. Schwent (AiResearch Manufacturing Company of Arizona, Phoenix, Ariz.). *Society of Automotive Engineers, Business Aircraft Meeting, Wichita, Kan., Apr. 2-5, 1974, Paper 740380.* 13 p. Members, $1.25; nonmembers, $2.00.

A74-28746 **Fuel system requirements for small gas turbine engines.** R. G. Moore (Bendix Corp., Energy Controls Div., South Bend, Ind.). *Society of Automotive Engineers, Business Aircraft Meeting, Wichita, Kan., Apr. 2-5, 1974, Paper 740381.* 9 p. Members, $1.25; nonmembers, $2.00.

Fundamental engine configurations and general fuel control functional requirements for 250-1000 hp engines are discussed. A basic fuel control system and functional options developed to meet specific requirements of several engine models are described. Design details of several example options are presented to illustrate the degree of complexity required to obtain desired functions. (Author)

A74-28747 **Fuel system requirements for light aircraft turbocharged reciprocating engines.** J. M. Kirwin and E. A. Hasse (Bendix Corp., Energy Controls Div., South Bend, Ind.). *Society of*

Automotive Engineers, Business Aircraft Meeting, Wichita, Kan., Apr. 2-5, 1974, Paper 740382. 12 p. Members, $1.25; nonmembers, $2.00.

A74-28748 Mathematical simulation of a vibrating light aircraft piston engine and correlation with engine flight test data. R. H. Syson (Teledyne, Inc., Teledyne Continental Motors Div., Warren, Mich.) and R. P. Caron (Arthur D. Little, Inc., Cambridge, Mass.). *Society of Automotive Engineers, Business Aircraft Meeting, Wichita, Kan., Apr. 2-5, 1974, Paper 740383.* 8 p. Members, $1.25; nonmembers, $2.00.

A74-28750 The stress-endurance fatigue severity index concept - A method of SN data development for aluminum aircraft structures. R. Abbott (Cessna Aircraft Co., Arlington, Va.). *Society of Automotive Engineers, Business Aircraft Meeting, Wichita, Kan., Apr. 2-5, 1974, Paper 740386.* 13 p. 6 refs. Members, $1.25; nonmembers, $2.00.

In order to construct the stress-endurance fatigue severity index surface, stress-endurance (SN) curves must be selected which describe the fatigue performance of typical aircraft structures. The definition of the fatigue severity index is considered together with the mean stress relationship, the maximum stress assumption, an interpolation method, and details concerning the applications of the new concept. G.R.

A74-28752 A new method of bulkhead analysis in aircraft structures. M. P. Djuric (Cessna Aircraft Co., Arlington, Va.). *Society of Automotive Engineers, Business Aircraft Meeting, Wichita, Kan., Apr. 2-5, 1974, Paper 740388.* 12 p. 6 refs. Members, $1.50; nonmembers, $2.00.

A new method of bulkhead analysis has been developed using two-dimensional finite element analysis as a tool. The method determines the internal forces, deflections, and stress distribution along the bulkhead, and the shear flow distribution in the adjacent skin. Several bulkheads next to each other can be analyzed simultaneously if the study of interaction becomes necessary. The results of this method compare favorably with the results of a three-dimensional finite element stress analysis and test measurements. The method can be used with any existing two-dimensional finite element computer program containing just a beam element, and it does not require large computer storage. (Author)

A74-28753 Structural finite element analysis aided by computer graphics. J. A. Wallace (Beech Aircraft Corp., Wichita, Kan.). *Society of Automotive Engineers, Business Aircraft Meeting, Wichita, Kan., Apr. 2-5, 1974, Paper 740389.* 12 p. Members, $1.25; nonmembers, $2.00.

Description of a graphically oriented system to aid the stress analyst in his job of synthesizing finite-element data. The analyst is required to decide on a solution procedure and divide the data into two basic parts. The first part is obtained by preprocessing the structural data into four basic sections. These sections are grid coordinates, element grid definitions, element section properties, and external loads. The second part is obtained by postprocessing the program internal loads output into margins of safety for ultimate strength, for fatigue life, and for structural joints. The solution procedure for axial member shear plate idealization is discussed, and some typical graphic displays for the input and output data are presented. (Author)

A74-28754 Finite element airplane cost analysis. H. W. Smith (Kansas, University, Lawrence, Kan.). *Society of Automotive Engineers, Business Aircraft Meeting, Wichita, Kan., Apr. 2-5, 1974, Paper 740390.* 9 p. Members, $1.25; nonmembers, $2.00.

A finite element structural analysis was extended to calculate the dollar cost of the structure and then linked to an 'optimizer' to minimize the cost. This paper describes the initial effort to develop a computer program which will analyze a given structure under a known loading envelope and then optimize the member sizes to give a minimum total cost. The output from a structural analysis program forms the input for a linear optimization program. Since the optimizer was linear, and the problem in this case was nonlinear, the program was written using an iteration loop around the three FORTRAN subroutines, STRUCT, CONVRT, and SMPLEX. Iterations stop when the change in two successive cost calculations is within a limit set by the engineer or when the number of iterations exceeds a preset limit. (Author)

A74-28755 Aerodynamic design approach to the stall/spin problem - The VariViggen. B. Rutan (Bede Aircraft, Inc., Newton, Kan.). *Society of Automotive Engineers, Business Aircraft Meeting, Wichita, Kan., Apr. 2-5, 1974, Paper 740391.* 8 p. Members, $1.25; nonmembers, $2.00.

A74-28756 Amphibian aircraft design. D. B. Thurston (Schweizer Aircraft Corp., Elmira, N.Y.). *Society of Automotive Engineers, Business Aircraft Meeting, Wichita, Kan., Apr. 2-5, 1974, Paper 740395.* 13 p. Members, $1.25; nonmembers, $2.00.

Brief review of service conditions satisfied by amphibian operation, and discussion of basic design parameters and operational problems peculiar to the amphibian, with emphasis placed upon the flying-boat type of hull. Design considerations include wing layout, engine placement and power requirements, hull shape plus beam loading and water trim limits, spray effects, landing gear arrangements, flight stability problems, docking and handling procedures, and brief market specifications for two amphibians. Finally, the possibility of converting existing landplanes into the amphibian configuration is discussed. (Author)

A74-28757 Potential use of work hardening aluminum alloy X5090 sheet in civil aircraft. D. L. Graham, P. R. Sperry, and J. Winter (Cessna Aircraft Co., Arlington, Va.). *Society of Automotive Engineers, Business Aircraft Meeting, Wichita, Kan., Apr. 2-5, 1974, Paper 740398.* 11 p. 7 refs. Members, $1.25; nonmembers, $2.00.

A74-28758 Aircraft applications for electroless nickel plate. D. W. Baudrand (Richardson Co., Des Plaines, Ill.). *Society of Automotive Engineers, Business Aircraft Meeting, Wichita, Kan., Apr. 2-5, 1974, Paper 740399.* 5 p. Members, $1.25; nonmembers, $2.00.

Electroless nickel plating is a process of uniformly depositing a nickel-phosphorus alloy on a suitable basis metal. The source of electrical energy comes from within the plating solution. Aircraft use of electroless nickel plate has increased in recent years. Desirable properties, such as lubricity, high hardness, and good wear resistance, are described. When to select electroless nickel, specific aircraft applications, and undesirable properties of electroless nickel are also discussed. (Author)

A74-28786 The civil supersonic aircraft (L'aeroplano supersonico civile). A. Eula. *(Associazione Italiana di Aeronautica e Astronautica, Conferenza, Rome, Italy, May 14, 1973.) L'Aerotecnica - Missile e Spazio,* vol. 52, Dec. 1973, p. 425-441. 19 refs. In Italian.

Review of the work thus far completed in the field of supersonic commercial aircraft design, and analysis of the economic and political (rather than technical) factors which seem to threaten further developments in this field. An attempt is made to determine whether there is a real need for the supersonic transport. The criteria governing the aerodynamic design of the Concorde are outlined, a description is given of the Olympus engines used in the Concorde, and certain other special features of the aircraft are noted. The

available information concerning the Soviet Tupolev 144 and the abandoned project of the American Boeing 2707-300 supersonic transport is also summarized. A number of factors which have given rise to objections to the use of the supersonic transport are then discussed, including the problem of noise, the sonic boom, and pollution of the stratosphere, with particular attention being paid to the adverse effects of the SST on the ozone concentration in the stratosphere. An attempt is made to determine whether the SST is or can be an economic aircraft to operate, and to summarize the present situation of the Concorde. Finally, the possibility of designing an SST without the above-mentioned shortcomings is discussed. A.B.K.

A74-28791 **Carrier designs for space shuttle orbiter being refined.** D. E. Fink. *Aviation Week and Space Technology*, vol. 100, Apr. 29, 1974, p. 54, 55, 58, 61, 62.

Boeing Co. and Lockheed Aircraft Corp. are refining their respective design studies of the 747 and the C-5A piggyback carrier aircraft for the space shuttle orbiter under contract extensions recently awarded by NASA. Final selection between the 747 and C-5A concepts now is scheduled for mid- to late May. The C-5A and the 747 are equally capable of performing the shuttle program mission, which involves mainly airlifting the Rockwell International orbiter for initial approach and landing tests and later on cross-country ferry flights. G.R.

A74-28847 # **Possibility of investigating the spatial distribution of atmospheric ozone with the aid of an ozonometer installed in the cockpit of an aircraft (O vozmozhnosti issledovaniia prostranstvennogo raspredeleniia atmosfernogo ozona s pomoshch'iu ozonometra, ustanovlennogo v kabine samoleta).** V. V. Osechkin (Leningradskii Gidrometeorologicheskii Institut, Leningrad, USSR). *Meteorologiia i Gidrologiia*, Feb. 1974, p. 103-107. 17 refs. In Russian.

A74-28963 # **Shell instability analysis applied to a radome.** T. L. Janssen and T. G. Swaney (Boeing Co., Wichita, Kan.). *AIAA Journal*, vol. 12, May 1974, p. 714-716.

Description of a finite element technique, and review of its application to the instability analysis of a large-aircraft nose radome, constructed of a uniform sandwich-type arrangement of orthotropic fiberglass material. The finite element technique yielded excellent results for this complicated shell problem. The method is found to be straightforward in use and general in application. M.V.E.

A74-28967 * # **Derivatives of eigenvalues and eigenvectors for a general matrix.** C. S. Rudisill (Clemson University, Clemson, S.C.). *AIAA Journal*, vol. 12, May 1974, p. 721, 722. 7 refs. Grant No. NGR-41-001-027.

Expressions are obtained for the derivatives of the eigenvalues and eigenvectors which are expressions of only one left-hand and one right-hand eigenvector. The approach described makes use of a Choleski decomposition or some other decomposition method. The method may be extended to find any order of derivative of the eigenvalue and eigenvector. The expressions obtained for finding the derivatives of eigenvalues and eigenvectors for nonself-adjoint systems may be applied to self-adjoint systems. G.R.

A74-29035 # **Investigation of new wing shapes for hypersonic flight.** A. L. Gonor, V. I. Lapygin, and N. A. Ostapenko (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR). *International Astronautical Federation, International Astronautical Congress, 24th, Baku, Azerbaidzhan SSR, Oct. 7-13, 1973, Paper.* 21 p. 12 refs. In English and Russian.

Review of some of the problems associated with supersonic gas flow past V-shaped wings. A set of theoretical and experimental studies was performed, and, throughout these studies, special attention was devoted to determining the structure of the flow past the V-shaped wing and the aerodynamic characteristics of the wing. The theoretical studies were performed with the aid of the numerical and analytical methods developed by Lapygin (1971) and Gonor et al. (1971, 1972). Presented comparisons of theoretical and experimental results show satisfactory agreement. The presented variation curve of the lift-to-drag ratio vs transverse V-wing angle shows a definite advantage of the V-shaped wing over delta and other comparable wings. M.V.E.

A74-29105 **Installation for the investigation of the buckling characteristics of thin-walled structural components (Anlage zur Erforschung des Beulverhaltens dünnwandiger Bauteile).** B. Geier (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Flugzeugbau, Braunschweig, West Germany). *DFVLR-Nachrichten*, Apr. 1974, p. 540, 541. In German.

The installation described is designed for the study of buckling in the case of thin shells. The results of the studies are important for the design of aircraft and spacecraft. The device for subjecting the specimen to a load is discussed together with the measurement of the forces, the determination of the form of the specimen, and the recording of the data. G.R.

A74-29251 **The new radar control stations of the French airspace (Les nouvelles stations radar de contrôle de l'espace aérien Français).** J. M. Fraysse (Service Technique de la Navigation Aérienne, Paris, France). *Navigation* (Paris), vol. 23, Apr. 1974, p. 168-177. In French.

A74-29252 **ICAO and the future landing system (L'O.A.C.I. et le système d'atterrissage futur).** P. Fombonne (Thomson-CSF, Paris, France). *Navigation* (Paris), vol. 23, Apr. 1974, p. 179-194. 7 refs. In French.

The propositions put forward to ICAO offer subjects which are reviewed, with comments, as they were presented after the Microwave Landing System (MLS) Symposium of Dec. 1973. The origin, motivations, classification, and technical aspect of the operational specifications are discussed. The operational specifications of the future international system, perfected by the AWOP (all weather operations panel) in 1971 have been approved without much discussion in April 1972 by the seventh air navigation conference of ICAO. The states have been invited to prepare their projects before March 1973. AWOP has received responses from the U.S., Great Britain, France, Germany, and Australia. F.R.L.

A74-29310 **Subsonic blocking in double-flow nozzles (Blocage subsonique dans les tuyères à deux flux).** E. Fage, R. Marchal, and P. Servanty (ASTECH, Meudon-la-Forêt; SNECMA, Suresnes, Hauts-de-Seine, France). *Académie des Sciences (Paris), Comptes Rendus, Série B - Sciences Physiques*, vol. 278, no. 12, Mar. 18, 1974, p. 489-491. In French.

A convergent-divergent nozzle is considered which consists of an exterior body in the interior of which is found a convergent ejector supplied by a gas at a generating pressure p sub a such that the relationship p sub a/p sub 0 is supercritical. The convergent-divergent two-flow nozzles, one of which is supersonic, present the phenomenon of blocking at the geometric collar, even if one of the flows is subsonic. This theoretical study has application in the ejection nozzle of supersonic aircraft engines, notably the Concorde. F.R.L.

A74-29353 **Application of dispersive networks in data-transmission receivers.** D. H. Forgan (Royal Aircraft Establishment, Farnborough, Hants., England) and J. P. Newsome (Nottingham University, Nottingham, England). *Institution of Electrical Engi-*

neers, Proceedings, vol. 121, Apr. 1974, p. 237-244. 5 refs. Research sponsored by the Ministry of Defence.

The practical aspects of the design and the application of the dispersive network are discussed. Problems of network synthesis are considered, taking into account approaches which utilize cascaded bridged-T sections. The significance of network imperfections is investigated, giving attention to component tolerances and the effect of network imperfections on system behavior. Questions of hybrid operation are also explored and the block diagram of a hybrid pulse-compression circuit is examined. G.R.

A74-29371 **A rational basis for determining the EMC capability of a system.** R. B. Schulz (Southwest Research Institute, San Antonio, Tex.). *IEEE Transactions on Electromagnetic Compatibility*, vol. EMC-16, May 1974, p. 109-114.

A logical procedure is presented for determining the electromagnetic compatibility (EMC) of a system, based upon an analytical approach developed earlier. The procedure is illustrated using as a system an aircraft with a manageable number of electrical-electronic subsystems. The result is a single number which can be used in a weapon system effectiveness equation and is generally useful not only to EMC engineers, but also to other electronic engineers and managers. By-products of the procedure are enhanced highlighting of critical parameters for design purposes and a means for economic evaluation of EMC efforts. (Author)

A74-29437 # **Hypersonic flow past a lifting wing (O giperzvukovom obtekanii nesushchego profilia).** O. S. Tyzhov and E. D. Terent'ev. *Prikladnaia Matematika i Mekhanika*, vol. 38, Jan.-Feb. 1974, p. 92-104. 20 refs. In Russian.

A similarity law is formulated for a lifting wing of infinite span in hypersonic flow, using which the velocity field can be determined by solving the problem of 'directional explosion', where both energy and momentum are imparted to the gas. The influence of viscosity and heat conduction in the flow outside the wake is neglected, while the motion in the wake is defined by two terms of an asymptotic expansion of the solution of the Navier-Stokes equations. It is shown that the zero line of flow deviates indefinitely from its initial position with increasing distance from the wing, and that the direction of this deviation coincides with that of the lifting force. V.P.

A74-29452 # **The case for hydrogen-fueled transport aircraft.** G. D. Brewer (Lockheed-California Co., Burbank, Calif.). *Astronautics and Aeronautics*, vol. 12, May 1974, p. 40-51. 15 refs.

Hydrogen is shown to offer significant advantages as an energy medium in a society which can no longer depend on the availability of petroleum and natural gas. For the near term requirements, liquid hydrogen can be manufactured from coal and lignite. In the longer term, power from nuclear power plants or solar collectors can generate large quantities of hydrogen by electrolysis or by thermochemical splitting of water. Introduction of hydrogen into the economy via the air-transportation industry offers many advantages: (1) significant improvements in performance for both subsonic and supersonic aircraft; (2) competitiveness, when needed, with the cost of fuel currently used; and (3) deployment by an aerospace industry experienced in handling liquid hydrogen and capable of quickly developing the necessary technologies. From the aviation example, hydrogen technology will more readily make the transition to wider industrial and domestic uses. M.V.E.

A74-29459 **Some features of the behavior of liquid drops during supersonic flight of a wedge-shaped body through a two-phase medium.** B. E. Gel'fand, S. A. Gubin, and S. M. Kogarko. *(Energetika i Transport*, no. 3, 1973.) *Fluid Mechanics - Soviet Research*, vol. 3, Jan.-Feb. 1974, p. 1-6. 6 refs. Translation.

The motion of liquid drops in the supersonic shock layer around a wedge-shaped body is considered on the basis of proposed empirical relations describing the processes of drop breakup. An equation is derived for the trajectory of the fragmenting drops that suffices for computing the basic parameters of the wall-drop collision - namely, the velocity and angle of incidence of the particles on the surface of the body. The dimensions of the wedge surface subjected to drop action are determined and the parameters bearing on the size of this surface (the wedge opening angle, the altitude and flight speed) are examined. Deductions are made as to the need for taking drop breakup into account in calculations of the supersonic flight of a body in a two-phase medium. (Author)

A74-29467 # **Critical analyses and laboratory research work at the stage of aircraft preliminary design (Analyses critiques et recherches en laboratoire au stade de l'avant-projet d'un avion).** C. Liévens (Service Technique de l'Aéronautique, Paris, France) and P. Poisson-Quinton (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *(NATO, AGARD, Réunion sur l'Intégration et l'Optimisation des Projets d'Avions, Florence, Italy, Oct. 1-5, 1973.) ONERA, TP* no. 1291, 1973. 27 p. In French.

Development of a procedure for performing critical analyses of preliminary designs of military aircraft, and review of the role of the laboratory in the preliminary design stage. It is noted that in the case of a military aircraft such a critical analysis is based on studies of the sensitivity of the aircraft performance to predictable or probable variations of the aerodynamic and power-plant parameters. The need for an analysis of reliability and maintenance aptitude, leading to an estimate of repair and preventive maintenance costs, is stressed, as well as the need for flexibility of the design objectives. A review is made of analysis techniques based on parametric studies, prior experience, sophisticated calculations, test results, and intuition. A detailed account is given of the role of laboratory research in designing vertical-takeoff supersonic fighter, a short-takeoff transport, ramjet propulsion, the Concorde SST, and a variable-sweepback aircraft. A.B.K.

A74-29484 # **Results of measurements of the slight atmospheric pressure increase on the earth surface under an overflying aircraft (Rezul'taty izmereniia slabogo uvelicheniia atmosfernogo davleniia na poverkhnosti zemli pod proletaiushchim samoletom).** N. F. Gorshkov (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR). *Akademiia Nauk SSSR, Izvestiia, Fizika Atmosfery i Okeana*, vol. 10, Feb. 1974, p. 192-195. In Russian.

A74-29493 # **Interference between a delta wing and a cylindrical body with a blunted nose portion at supersonic velocities (Interferentsiia treugol'nogo kryla i tsilindricheskogo korpusa s ozhival'noi nosovoi chast'iu pri sverkhzvukovykh skorostiakh).** L. G. Vasenev and V. S. Dem'ianenko (Akademiia Nauk SSSR, Institut Teoreticheskoi i Prikladnoi Mekhaniki, Novosibirsk, USSR). *Akademiia Nauk SSSR, Sibirskoe Otdelenie, Izvestiia, Seriia Tekhnicheskikh Nauk*, Feb. 1974, p. 73-78. In Russian.

A74-29496 # **Investigation of the effect of supports on the bottom pressure and pitching moment of bodies of revolution at an angle of attack (Issledovanie vliianiia derzhavok na donnoe davlenie i prodol'nyi moment tel vrashcheniia pod uglom ataki).** B. V. Belianin and V. S. Oshchepkov (Akademiia Nauk SSSR, Institut Teoreticheskoi i Prikladnoi Mekhaniki, Novosibirsk, USSR). *Akademiia Nauk SSSR, Sibirskoe Otdelenie, Izvestiia, Seriia Tekhnicheskikh Nauk*, Feb. 1974, p. 87-89. In Russian.

A74-29497 # **Random movement of a wing of finite span in an incompressible liquid (O proizvol'nom dvizhenii kryla ko-**

nechnogo razmakha v neszhimaemoi zhidkosti). V. A. Algazin and D. N. Gorelov (Akademiia Nauk SSSR, Institut Gidrodinamiki, Novosibirsk, USSR). *Akademiia Nauk SSSR, Sibirskoe Otdelenie, Izvestiia, Seriia Tekhnicheskikh Nauk,* Feb. 1974, p. 90-98. 7 refs. In Russian.

A method is presented for the study of the random movement of a thin V-shaped trapezoidal wing in an ideal incompressible liquid. The method is based on an approximation of the intensity of the vortex layer by means of a function whose form takes into account characteristics of the flow near the edges of the wing. The solution algorithm permits the determination of the pressure distribution along the wing and the detailed investigation of the supporting vortex surface. P.T.H.

A74-29572 Future of the light turbine helicopter. T. R. Stuelpnagel (Hughes Helicopters, Culver City, Calif.). *Vertiflite,* vol. 20, Mar.-Apr. 1974, p. 6-9.

It is predicted that in the 1980s the light-turbine helicopter (LTH) will be capable to compete economically with a half-ton truck. The use of the LTH accounts currently for 65% of all helicopter flight hours. This figure is expected to increase to 80% by the middle of the next decade. Trends towards a lowering of operating costs are discussed, giving attention to fuel consumption, maintenance, insurance, and depreciation. G.R.

A74-29609 Solving an aluminum bracket failure. B. K. Young, Jr. (Lockheed-Georgia Co., Marietta, Ga.). *Metals Engineering Quarterly,* vol. 14, May 1974, p. 47-50.

An aircraft engine in which an in-flight fire had occurred was dismantled and examined. A bracket assembly fabricated from 2024 aluminum, one of several failed components, was of prime interest because of apparent heat damage. The scanning electron microscope (SEM) was used to compare laboratory-induced fractures made at room and elevated temperatures with the bracket failure. The service failure exhibited grain separation and loss of delineation of the grain boundaries due to melting. The SEM revealed deep voids between grains and tendrils that connected grains, which resulted from surface tension during melting. Comparisons of the service failure and laboratory-induced failures in conjunction with macroscopic and metallographic observations showed that the bracket assembly failed because an intense, localized flame had melted the material. (Author)

A74-29775 # Jet aircraft ground run-up noise suppressors. *Tech Air,* vol. 30, May 1974, p. 7-11.

One major consideration in the design of ground run-up noise suppressors is the reduction at source of the low frequency sound energy emanating from the jet nozzle. Conventional absorptive exhaust silencers would have to be relatively long to ensure adequate low frequency attenuation. A new exhaust noise suppressor was, therefore, developed. The new device is relatively small, light in weight, and an extremely efficient low frequency attenuator. G.R.

A74-29783 An approach to the development of meaningful design rules for fatigue-loaded CFRP components. A. W. Cardrick and M. A. Smith (Royal Aircraft Establishment, Structures Dept., Farnborough, Hants., England). *(Institute of Physics, Symposium on Fatigue in Composites, Imperial College of Science and Technology, London, England, Nov. 15, 1973.) Composites,* vol. 5, May 1974, p. 96-100. 6 refs.

It is argued that conventional constant amplitude fatigue tests on plain specimens are of limited value for assessing the fatigue performance of carbon fiber reinforced plastics (CFRP) in structural form. Suggestions are made for more meaningful fatigue tests in which specimens containing structural features are tested under an elementary form of variable amplitude loading. Some early fatigue data are presented for CFRP-aluminium alloy scarf joints. These joints appear to develop the full fatigue performance of the aluminium alloy, but there are strong indications that endurance is dependent on loading frequency. (Author)

A74-29785 Transverse compressive behaviour of unidirectional carbon fibre reinforced plastics. T. A. Collings (Royal Aircraft Establishment, Structures Dept., Farnborough, Hants., England). *Composites,* vol. 5, May 1974, p. 108-116. 12 refs.

A74-29787 Specifications for composites - Phenolic and silicone resins. V. Edwards (QMC Industrial Research, Ltd., London, England). *Composites,* vol. 5, May 1974, p. 122, 123.

Two specifications on phenolic resins have been issued by the U.S. Department of Defense. These specifications are MIL-R-3745 and MIL-R-9299C. MIL-R-9299C covers two grades of phenolic or modified phenolic resin used in the fabrication of laminates for structural applications. MIL-R-3745 is a specification for a single grade of phenolic resin for use in the manufacture of laminates. Silicone resins suitable for use in fabricating laminates in aircraft and nonaircraft structural parts are covered by specification MIL-R-25506A(ASG). G.R.

A74-29806 Wing design in the case of the VFW 614 transport aircraft (Tragflügelentwurf am Beispiel des Verkehrsflugzeugs VFW 614). J. Barche (Vereinigte Flugtechnische Werke-Fokker GmbH, Bremen, West Germany). *Zeitschrift für Flugwissenschaften,* vol. 22, Apr. 1974, p. 101-115. 9 refs. In German.

Description of the wing design chosen for a short-haul 40- to 44-passenger jet aircraft operating over low-traffic-density, low-growth routes. In order to satisfy the contradictory requirements for fast and slow flight and to gain certain other advantages, a twin-engine design was chosen in which the engines are mounted on the upper sides of the wings. The various stages involved in the realization of this design are reviewed, including the determination of the wing planform; streamlining for fast flight; minimization of engine and pylon effects; testing and modification of warping, camber, and streamlining for slow flight; and the design of the flap system. A.B.K.

A74-29828 Flight-control systems for automatic landings - Safety by means of redundancy (Flugführungssysteme für automatische Landungen - Sicherheit durch Redundanz). A. Busselt (Vereinigte Flugtechnische Werke-Fokker GmbH, Bremen, West Germany). *Flug Revue/Flugwelt International,* Mar. 1974, p. 31, 32. 9 refs. In German.

It is pointed out that the purely technical-physical problems of automatic landing have been solved. Difficulties preventing a rapid introduction of automatic flight-control methods were connected with the safety requirements of the air-traffic authorities. The required high reliability features of the flight-control systems must be obtained by the employment of redundancies and the use of surveillance, warning, and switching devices. A number of suitable systems developed by various aerospace companies are discussed. G.R.

A74-29829 Dornier/Dassault-Breguet Alpha Jet (Dornier/Dassault-Breguet Alpha Jet). H. Redemann. *Flug Revue/Flugwelt International,* May 1974, p. 60-65. In German.

The development of a new military aircraft was undertaken as a joint project by France and West Germany. The new aircraft is to provide a jet trainer for the French armed services. West Germany wants to use the new jet as a successor of the Fiat G.91/R3. Agreement was reached between the two countries concerning the

development of two different versions of the aircraft and a basic design. Series production of the new aircraft is to begin in January 1975. It is expected that the Alpha Jet will be used in operational service in 1977. Details concerning the progress made so far in the development of the new jet is discussed, giving attention to a number of test flights. A technical description of the aircraft and its weapons system is also provided. G.R.

A74-29830 **New German-Swiss aircraft project - Master-Porter PD-01 (Neues deutsch-schweizerisches Flugzeugprojekt - Master-Porter PD-01).** P. Pletschacher. *Flug Revue/Flugwelt International,* May 1974, p. 66-69. In German.

A two-engine STOL multipurpose aircraft, the Master-Porter PD-01, is being developed by an aerospace firm in Munich, West Germany. Prototypes are to be built by Swiss aerospace companies. The first flights of aircraft prototypes are to take place in 1975. Production of the aircraft is to start in 1976. Features of aircraft design are discussed together with technical details and the sales organization for the aircraft. G.R.

A74-29860 **Balancing of vibration measurements of a continuous mechanical system - Application to the direct measurement of generalized coordinates of an airplane in flight (Pondération des mesures de vibration d'un système mécanique continu - Application à la mesure directe des coordonnées généralisées d'un avion en vol).** G. Coupry (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *Académie des Sciences (Paris), Comptes Rendus, Série B - Sciences Physiques,* vol. 278, no. 14, Apr. 1, 1974, p. 611-613. In French.

The first modes of vibration of a complex mechanical system at rest, i.e., isolated from the environment to which it should be subjected, are in general well known following a qualification vibration test of a calculation on planes. When the structure is subjected to an active environment, its vibrations can be represented by a linear combination of these modes. An attempt is made to measure the generalized coordinates, which are the coefficients of this linear combination, starting from some local measurements of displacement. The method, based on an inertial balancing of measurements, can be used for flight tests of vibration of an aircraft, for the study of dynamically similar models in a wind tunnel, for analysis of vibration of a running internal combustion engine, for suspension bridges, and in general for structures subjected to the wind. F.R.L.

A74-29903 # **Response of a light airplane to ground induced vibration environment.** D. V. Srikantaiah (Defence Research and Development Laboratory, Hyderabad, India) and N. C. Nigam (Indian Institute of Technology, Kanpur, India). *Aeronautical Society of India, Journal,* vol. 25, Aug. 1973, p. 111-118. 10 refs.

Techniques for the measurement and analysis of runway roughness data are described. It is shown that a surveyor's level and a simple profilometer provide a means for measurement of runway roughness over the wavelengths of interest. The power spectral density of the runway profile is obtained by digital processing of data. Analytical techniques for determining the response of a light airplane to a ground induced vibration environment are discussed. A light aircraft is idealized to a five-degree-of-freedom lumped parameter system. The response of the idealized system is obtained during taxiing using the random vibration theory. Response of the aircraft is also obtained for the landing impact. The aircraft is idealized to a single-degree-of-freedom system, and its response during take-off run is computed by numerical integration using the measured runway profile. (Author)

A74-29906 # **Torsion of prismatic shell by finite difference approach.** B. V. A. Rao, V. Ramamurti, and N. Ganesan (Indian Institute of Technology, Madras, India). *Aeronautical Society of India, Journal,* vol. 25, Aug. 1973, p. 134-139. 6 refs.

The paper presents a finite difference approach to the analysis of the prismatic shell with a box-type cross-section. A computational model taking into account the warping and distortion of the cross-section is used. The governing differential equations, which are a set of decoupled ordinary differential equations, are set up by the use of Vlasov's variational method. Finite difference approximations to these differential equations are then solved by means of appropriate matrix technique and use of a digital computer. The procedure is illustrated by means of an example. The results of the analysis are compared with closed form solution. (Author)

A74-30073 **Control of an elastic aircraft.** T. P. Grigor'eva. *(Avtomatika i Telemekhanika,* Nov. 1973, p. 5-10.) *Automation and Remote Control,* vol. 34, no. 11, Apr. 1, 1974, pt. 1, p. 1713-1718. 5 refs. Translation.

Study of large-dimension systems, and development of a method for synthesizing a control law based on the combined measurement of the coordinates of both aircraft motion and elastic airframe oscillations. A numerical example is presented for illustrating the method. M.V.E.

A74-30076 * # **Nozzle geometry and forward velocity effects on noise for CTOL engine-over-the-wing concept.** U. von Glahn, J. Goodykoontz, and J. Wagner (NASA, Lewis Research Center, Cleveland, Ohio). *Acoustical Society of America, Meeting, 86th, Los Angeles, Calif., Oct. 30-Nov. 2, 1973, Paper.* 29 p. 10 refs.

Acoustic shielding benefits for jet noise of engine-over-the-wing for conventional aircraft (CTOL) application were studied with and without forward velocity for various small-scale nozzles. These latter included convergent, bypass and mixer, with and without forward ejector, nozzles. A 13-in. free jet was used to provide forward velocity. Far-field noise data were obtained for subsonic jet velocities from 650 to 980 ft/sec and forward velocities from zero to 260 ft/sec. The studies showed that, although shielding benefits were obtained with all nozzles, the greatest benefits were obtained with mixer nozzles. The absolute magnitude of the jet noise shielding benefits with forward velocity was similar to the variation in nozzle-only noise with forward velocity. (Author)

A74-30077 * # **Forward velocity effects on jet noise with dominant internal noise source.** U. von Glahn and J. Goodykoontz (NASA, Lewis Research Center, Cleveland, Ohio). *Acoustical Society of America, Meeting, 86th, Los Angeles, Calif., Oct. 30-Nov. 2, 1973, Paper.* 16 p.

Acoustic data, with and without forward velocity, were obtained with a circular nozzle using a quiet flow system and one dominated by a low-frequency internal noise source (analogous to combustion noise). Forward velocity effects were obtained by installing the test nozzle in a free jet. Far-field noise data were obtained at jet pressure ratios from 1.3 to 1.7 and forward velocities up to 260 ft/sec. With a quiet flow system, jet noise is reduced by forward velocity. With a dominant low-frequency core noise source, the portion of the noise spectra dominated by this source was not appreciably affected by forward velocity. (Author)

A74-30079 # **Variability in aircraft noise measurements.** D. E. Bishop (Bolt Beranek and Newman, Inc., Los Angeles, Calif.). *Acoustical Society of America, Meeting, 86th, Los Angeles, Calif., Oct. 30-Nov. 2, 1973, Paper.* 18 p.

The results of repeated aircraft noise measurements for two distinct classes of observations are reviewed in a study of the range of variability of such measurements. The first class of observations consists of repeated measurements over a short time period on a single aircraft flown by a skilled flight crew under controlled conditions and moderate weather conditions. A second class involves noise measurements extending over periods of from one to many days at civil airports during routine operations. G.R.

A74-30084 # **Effects of discontinuation of nocturnal aircraft noise.** S. Fidell and G. Jones (Bolt Beranek and Newman, Inc., Canoga Park, Calif.). *Acoustical Society of America, Meeting, 86th, Los Angeles, Calif., Oct. 30-Nov. 2, 1973, Paper.* 9 p.

As a result of a reversal in aircraft approach patterns, the noise exposure to the east of the Los Angeles International Airport was reduced by approximately 50 landings per night. A social survey was conducted to assess the effects of this operational change. Virtually no differences attributable to either sex or subsample membership were found in the response patterns. Almost 56% of the respondents replied that they had not noticed any change in the number of flights. About 20% claimed that they noticed fewer flights, and 20% claimed that they noticed more flights. G.R.

A74-30090 # **Nonlinear acoustic phenomena in the presence of absorptive liners in circular ducts.** O. McDaniel and G. Reethof (Pennsylvania State University, University Park, Pa.). *Acoustical Society of America, Meeting, 86th, Los Angeles, Calif., Oct. 30-Nov. 2, 1973, Paper.* 12 p. NSF Grant No. GK-32584.

The properties of acoustically absorptive liners were studied at high acoustic intensities. The test setup consisted of an anechoically terminated hard-walled duct coupled to four high-intensity electropneumatic sound sources. Frequency response plots are shown for plane and spinning waves with and without a one-foot length liner of one-inch thickness placed at the center of the duct. It was concluded that, if the liner itself does not exhibit strong nonlinear properties, one can expect a moderate to significant increase in liner performance with increasing intensity for the case of plane waves. This is due to energy conversion to higher frequencies, which results from finite amplitude distortion. This effect will not be observed with spinning waves, since they do not distort. P.T.H.

A74-30091 # **The design of sound absorptive materials to meet special requirements.** L. S. Wirt (Lockheed-California Co., Burbank, Calif.). *Acoustical Society of America, Meeting, 86th, Los Angeles, Calif., Oct. 30-Nov. 2, 1973, Paper.* 83 p. 8 refs.

A wide variety of improved sound absorption characteristics may be attained by utilizing more acoustical elements and parallel as well as series connections among the elements. The use of resistance paralleled by inductive resistance provides a facing sheet whose resistance increases with frequency while the positive reactance decreases. Dissimilar air cavities arranged in parallel provides airspace reactance that remains near zero over a broad range of frequency. The cutoff characteristics of miniature acoustic horn arrays may be exploited to provide a dual frequency range of absorption. The upper frequency range resembles that of a laminar absorber, whereas the low frequency absorption occurs in a controllable region of considerable bandwidth. These novel sound absorbing structures may provide practical solutions to such diverse problems as fan jet engine buzzsaw noise, combustion noise, and noise due to cooling towers and car wash installations. (Author)

A74-30092 # **A new anechoic facility for supersonic hot jet noise research at Lockheed-Georgia.** R. H. Burrin, P. D. Dean, and H. K. Tanna (Lockheed-Georgia Co., Marietta, Ga.). *Acoustical Society of America, Meeting, 86th, Los Angeles, Calif., Oct. 30-Nov. 2, 1973, Paper.* 81 p. Contract No. F33615-73-C-2032.

The facility described has been carefully designed with a view toward achieving a capability of testing 2 in. diam model jets up to 2000 F stagnation temperature at pressure ratios as high as eight, in a free-field environment, anechoic at all frequencies above 200 Hz. A comprehensive series of flow visualization and temperature mapping experiments in a one-sixth scale model of the proposed facility, conducted to establish foundations for the unique design features, is described. A test program using a specially designed impedance tube to examine full-scale, four-wedge arrays is discussed, leading to the final selection of an acoustic material and design for the wedges to be used as lining for the new facility to ensure the 200-Hz frequency requirement. Details of construction of the room and exhaust muffler/collector are given together with a description of the design and fabrication of the air supply system. (Author)

A74-30093 # **Model study of the propagation of sound from V/STOL aircraft into urban environs.** P. R. Donavan (MIT, Cambridge, Mass.). *Acoustical Society of America, Meeting, 86th, Los Angeles, Calif., Oct. 30-Nov. 2, 1973, Paper.* 112 p. 26 refs. U.S. Department of Transportation Contract No. TSC-93.

A large number of simulated V/STOL fly-bys of a typical urban region were conducted on 1:64 scale models of urban building geometries while the sound levels in the streets were monitored. Three methods of sound level prediction in urban environs were developed and validated. The first was that of direct acoustic modeling. The second was the use of an average effect on propagation obtained from the simulated fly-bys. The final method was the use of discrete point or incoherent line source imaging which is applicable to arbitrary geometries. The psychoacoustic impact involved in actual V/STOL operations over cities was evaluated quantitatively. The psychoacoustic effects found to be of significance were those of fly-by event duration and onset duration. Two approaches to minimizing the perceived noise intrusion from V/STOL aircraft were determined: (1) increasing flight altitudes and fly-over speeds as much as possible within safe limits; and (2) choosing flight paths so that the surrounding buildings produce the least amount of noise intrusion. (Author)

A74-30095 # **The real and imaginary parts of the complex viscoelastic modulus for boron fiber reinforced plastics /BFRP/.** E. B. Paxson, Jr. *Acoustical Society of America, Meeting, 86th, Los Angeles, Calif., Oct. 30-Nov. 2, 1973, Paper.* 29 p. 5 refs.

Viscoelastic model parameters pertinent to the dynamic material properties of boron fiber reinforced plastics (BFRP) are defined, and quantitative values for these parameters are established by experimental measurement. These quantities for BFRP are compared with the same parameters for glass fiber reinforced plastics and a metallic material such as aluminum 2024-T4 alloy. A general viscoelastic model was chosen to represent the mechanical properties of BFRP, since this should result in a complex viscoelastic modulus upon subjection of the material to a vibratory loading. The experimental configuration selected was that of a thin beam subjected to transverse vibration. The limitations of the results obtained are discussed, and desirable future research is pointed out. M.V.E.

A74-30096 # **Microphone requirements for airport noise monitoring.** E. A. Starr and B. E. Blanchard (Bolt Beranek and Newman, Inc., Cambridge, Mass.). *Acoustical Society of America, Meeting, 86th, Los Angeles, Calif., Oct. 30-Nov. 2, 1973, Paper.* 4 p.

Procurement specifications for airport noise monitoring equipment and, particularly, for microphone systems are considered. It is argued that ANSI S1.4-1971 Type 1 specifications are inappropriate. Recommendations for an appropriate microphone system specification are presented. M.V.E.

A74-30098 * # **Noise tests of a high-aspect-ratio slot nozzle with various V-gutter target thrust reversers.** J. R. Stone and O. A. Gutierrez (NASA, Lewis Research Center, Cleveland, Ohio). *Acoustical Society of America, Meeting, 86th, Los Angeles, Calif., Oct. 30-Nov. 2, 1973, Paper.* 18 p. 10 refs.

The results of experiments on the noise generated by a 1.33 x 91.4 cm slot nozzle with various V-gutter reversers are presented. The experiments were conducted with near-ambient temperature jets at nozzle pressure ratios of 1.25 to 3.0, yielding jet velocities of about 190 to 400 m/sec. At pressure ratios of 2 or less, the reversers, in addition to being noisier than the nozzle alone, also had a more

uniform directional distribution and more high-frequency noise. At pressure ratios above 2, the nozzle alone generated enough shock noise that the levels were about the same as for the reversers. The maximum overall sound pressure level and the effective overall sound power level both varied with the sixth power of jet velocity over the range tested. (Author)

A74-30100 # **Flyover noise prediction from static data.** H. F. Veldman (Boeing Co., Wichita, Kan.). *Acoustical Society of America, 86th, Los Angeles, Calif., Oct. 30-Nov. 2, 1973, Paper.* 17 p. 6 refs.

Comparisons between predicted and measured flyover noise values made from data obtained during a noise research program are reported. The program was aimed at developing a flyover noise prediction method consisting in establishing an acoustic and propulsion data base from engine ground tests and in extrapolating those results to simulate airplane flyovers. The comparisons show that predicted and measured values are in good agreement. M.V.E.

A74-30119 **Transfer of commercial technology.** G. R. White (Xerox Corp., Stamford, Conn.). In: Technology transfer: Successes and failures; Proceedings of the Conference, Seattle, Wash., November 28-30, 1972. San Francisco, San Francisco Press, Inc., 1974, p. 194-207.

Description of prevailing circumstances and utilized techniques in several specific cases of commercial technology transfer between corporations, from government to corporation, from technical institute to corporation, and from university to corporation. Each of these cases is analyzed to draw general guidelines on the responsibilities of commercial enterprises, the government, technical institutes, and universities as efficient components of a technology development and distribution system. T.M.

A74-30142 # **Summary of the air cushion landing system on the de Havilland Buffalo aircraft.** L. H. Hildebrandt and K. H. Digges (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). *(Canadian Aeronautics and Space Institute, Symposium on Air Cushion Technology, Montreal, Canada, June 25-27, 1973.) Canadian Aeronautics and Space Journal,* vol. 20, Mar. 1974, p. 93-100.

The Air Cushion Landing System (ACLS) eliminates the conventional aircraft landing gear and replaces it with a cushion of air maintained in a trunk beneath the fuselage during taxi, takeoff, and landing. The air supply packages are mounted below the wing on each side of the fuselage. A joint U.S./Canadian program was undertaken to install an ACLS on a de Havilland CC-115 Buffalo aircraft. This aircraft has been designated the XC-8A. A special braking system was designed and is described. As a consequence of the constraints imposed by fitting the ACLS to an aircraft that was designed for conventional gear, penalties in weight and drag resulted. It is considered that the concept warrants further detailed investigation. F.R.L.

A74-30313 **Applied research and development of adhesives for bonding filled carboxyl terminated polybutadienes to various substrates.** H. R. Schloss (Sun Chemical Corp., Carlstadt, N.J.). In: Recent advances in adhesion. London and New York, Gordon and Breach, Science Publishers, 1973, p. 485-503.

The results of a one-year applied R&D program, conducted on the bonding of carboxyl-terminated polybutadiene propellant to various substrate materials encountered in solid-propellant rocket motors, are reviewed. The results include the findings that: hydrocarbon liners with low glycerine content show the best all-around adhesion properties on the basis of temperature and aging data; glycerine-containing and Butvar liners give the best shear values; peel values of glycerine-containing liners are superior to those of other liners; the addition of glycerine improves the adhesion of hydrocarbon liners to different substrates; other polyhydroxy compounds also improve the adhesion, but the steric factors of some of the molecules reduce their effectiveness. M.V.E.

A74-30319 **Adaptive arrays.** L. E. Brennan, I. S. Reed, and P. Swerling (Technology Service Corp., Santa Monica, Calif.). *Microwave Journal,* vol. 17, May 1974, p. 43-46, 74. 7 refs.

A fully adaptive array which has been designed and tested through simulation is reported. It is pointed out that antennas with adaptive features will make a major impact on both airborne and ground-based radar, aircraft transponders, and satellite communications, particularly for the resolution of multiple access problems. Aspects of the versatility of adaptive arrays are discussed along with the principles of operation of an adaptive control loop and adaptive-array performance with nonuniform clutter distribution. G.R.

A74-30323 **Improved manufacturing of the F-14A composite horizontal stabilizer.** A. London, S. Dastin (Grumman Aerospace Corp., Bethpage, N.Y.), and G. Lubin. *SAMPE Quarterly,* vol. 5, Apr. 1974, p. 1-9. 5 refs.

A74-30346 **New jet engines (Nouveaux moteurs à réaction).** G. Bruner (Centre de Documentation de l'Armement, Paris, France). *L'Aéronautique et l'Astronautique,* no. 44, 1974, p. 45-59. 7 refs. In French.

The present paper presents the latest information collected - namely during the Air Show 1973 at le Bourget - on the new types or versions of the jet engines ATR 8K50, M.53 (SNECMA), Astafan IV, Astazou XX, Arriel (Turbomeca), Larzac (SNECMA/Turbomeca), M 45 H, M 45 S, Olympus 593 Mk 602 (SNECMA/Rolls-Royce), JT8D15 (SNECMA/Pratt and Whitney), CFM 56 (SNECMA/General Electric), Adour (Turbomeca/Rolls-Royce), RB 211-22B, Pegasus 11 (Rolls-Royce), Pegasus 15 (Rolls-Royce/Pratt and Whitney), XJ.99 (Rolls-Royce/Allison), RB 199 (Rolls-Royce/MTU/FIAT), JT8D-17, JT9D-15, JT10D, JT15D-1, PT6A-50, F100-PW-100 (Pratt and Whitney), CF6-50A, J79-17, F101, YJ.101, T.700 (General Electric), LTS 101 (Lycoming). (Author)

A74-30347 **Reliability and maintainability of jet engines (Fiabilité et maintenabilité sur les réacteurs aéronautiques).** A. Mihail (Bureau Veritas, Paris, France). *L'Aéronautique et l'Astronautique,* no. 44, 1974, p. 60-72. In French.

Improvements in the reliability of jet engines have been one of the main causes for the substantial decrease of the number of accidents recorded during the last decade. New design concepts and new control methods have led to consider, in some cases, the maintenance of the powerplants according to their status. Reliability has thus become only one among the factors conditioning the maintainability of the equipment. This, in turn, determines the availability of the material, which is a major item in its economical usage. (Author)

A74-30356 # **Fully automatic LORAN C for commercial airlines.** J. Hopkins (Teledyne Systems Co., Northridge, Calif.). In: National Radio Navigation Symposium, Washington, D.C., November 13-15, 1973, Proceedings. Washington, D.C., Institute of Navigation, 1974, p. 47-54.

This paper addresses one of the alternatives being considered by U.S. Airlines as a replacement for LORAN A in the event this service is discontinued. LORAN C coverage exists over a large portion of the airline route structure and the current evaluations are aimed at

determining the suitability of LORAN C for airline service. Of special interest is the performance of new low-cost fully automatic cycle matching LORAN C receivers compared with existing envelope matching LORAN A/C receivers. (Author)

A74-30359 # **Current developments in Loran-D.** R. L. Frank (Sperry Rand Corp., Great Neck, N.Y.). In: National Radio Navigation Symposium, Washington, D.C., November 13-15, 1973, Proceedings. Washington, D.C., Institute of Navigation, 1974, p. 85-91. 6 refs.

Loran-D is a highly accurate pulsed hyperbolic navigation system similar to and compatible with Loran-C, but is designed for military tactical use. The helicopter-transportable transmitter stations have quickly erectable antennas using new tower technology. A signal range over half that of Loran-C is achieved by the fortunate propagation characteristics of 100 kHz waves, by a modified compatible signal format, and by improved transmitter solid state technology. Deployments of the stations in the U.S. and Europe are described. The potential uses of Loran-D include: gap filler in Loran-C coverage, a transportable survey system, and long range navigation coverage for many civilian applications. (Author)

A74-30360 # **Analysis of route widths in the domestic airspace.** R. Braff and S. C. Mohleji (Mitre Corp., McLean, Va.). In: National Radio Navigation Symposium, Washington, D.C., November 13-15, 1973, Proceedings. Washington, D.C., Institute of Navigation, 1974, p. 92-102. 10 refs.

The present paper discusses and analyzes error budget component definitions and the effect of error dynamics on the route confinement probability when the route width is the plus or minus two sigma RSS total navigation system error. Fast-time simulation models of VOR radial and VOR/DME area navigation equipped aircraft have been derived containing spatially dependent VOR error sources, random calibration errors, a dynamic wind source, and steering by an autopilot. The simulation experiments presented serve as a vehicle for investigating navigation trade-offs and illustrating experimental concepts for a flight test program. (Author)

A74-30380 **The future of carbon fibres.** M. Langley. In: Carbon fibres in engineering. London, McGraw-Hill Book Co., (UK), Ltd., 1973, p. 243-248.

New developments in the field of carbon fibers can be connected with the employment of fiber diameters which are larger than the diameters in the range from 7.5 to 8.5 micrometers found in currently used carbon fibers. The properties of the fibers may be modified by subsequent treatments. Surface etching has been found to improve the bond with the matrix. Other advances may involve the use of different matrix materials. Actual and prospective applications of carbon fiber composites are discussed, giving attention to aircraft structures, internal combustion engines, the chassis of automobiles, and medical engineering. G.R.

A74-30392 * # **Investigation of acoustic effects of leading-edge serrations on airfoils.** A. S. Hersh (Bolt Beranek and Newman, Inc., Canoga Park, Calif.), P. T. Soderman (U.S. Army, Air Mobility R & D Laboratory, Moffett Field, Calif.), and R. E. Hayden (Bolt Beranek and Newman, Inc., Cambridge, Mass.). *Journal of Aircraft*, vol. 11, Apr. 1974, p. 197-202. 15 refs. Contract No. NAS2-5974.

This paper presents and interprets a series of extensive studies of the application of leading-edge serrations as a device for reducing the vortex noise radiated from stationary and rotating airfoils in low Reynolds number flow. In these studies, a variety of serrations were attached at selected locations near the leading edge of stationary and rotating airfoils. The noise levels of the airfoils were reduced considerably with the serrations attached. An explanation of the aeroacoustic flow mechanisms involved is given. (Author)

A74-30395 # **Study of wind effects on electrostatic autopilots.** E. Sullivan, Jr. (U.S. Navy, Naval Underwater Systems Center, Newport, R.I.). *Journal of Aircraft*, vol. 11, Apr. 1974, p. 221-224.

The electrostatic autopilot is a device which uses the earth's vertical potential gradient as a roll and pitch reference by measuring the potential difference between wing tips and between nose and tail. Small radioactive sources are used to ionize the air at the points between which the measurements are made. This serves to supply charge for a differential amplifier. Wind-tunnel tests on this device have shown that the output is wind-speed dependent. The output is virtually zero for zero wind speed and increases to a stable value at about 25 m/sec. A simplified mathematical model is presented as an explanation of this behavior. The model suggests that, as the wind speed increases, the ionized air is drawn into long streams thus reducing the charge density. This in turn reduces losses due to recombination which results in a greater total charge available. Results of calculations based upon this model are in qualitative agreement with experiment. (Author)

A74-30397 * # **Jet engine soot emission measured at altitude.** J. M. Rosen (Wyoming, University, Laramie, Wyo.) and R. Greegor (Boeing Co., Seattle, Wash.). *Journal of Aircraft*, vol. 11, Apr. 1974, p. 243-245. 5 refs. Grant No. NGR-51-001-028.

The state of knowledge concerning engine design to minimize air pollution is believed to be such that emission products can be reliably predicted while the engine is still on the drawing board. More effort is now being made to measure emission products from engines operating under cruise conditions. The use of an instrumented aircraft to obtain the appropriate data is perhaps a more realistic and less expensive approach. The results of this study taken at face value indicate that the emission index of typical jet engines calculated from the ground level measurements is comparable to the actual in-flight emission index for altitudes up to 30,000 ft. F.R.L.

A74-30398 # **Slender delta wing with conical camber.** R. K. Bera (National Aeronautical Laboratory, Bangalore, India). *Journal of Aircraft*, vol. 11, Apr. 1974, p. 245-247. 7 refs.

The slenderness assumption of Munk (1924) and Jones (1946), made over and above that of linearization, has often been used to get closed form analytical solutions for wings, bodies, and their combinations. Here, simple expressions are obtained for the aerodynamic characteristics of a slender delta wing, exhibiting an even-order polynomial twist distribution in the spanwise coordinate. Carafoli (1956) derived an integral equation which relates the twist distribution to the pressure distribution. Linearized theory predicts two kinds of solution: one in which a leading edge singularity appears, and the other in which the leading edge experiences zero load. F.R.L.

A74-30399 * # **Influence of static aeroelasticity on oblique winged aircraft.** T. A. Weisshaar (Virginia Polytechnic Institute and State University, Blacksburg, Va.). *Journal of Aircraft*, vol. 11, Apr. 1974, p. 247-249. 5 refs. Grant No. NGR-21-002-391.

Interest has recently been expressed about the impact of static aeroelasticity on the lateral control of oblique winged aircraft. An attempt is made to illustrate, by use of a simple example, together with results from published literature, an aeroelastic phenomenon which is believed to be unique to oblique winged aircraft. This phenomenon is the aeroelastic roll moment and occurs because upward bending deflection of the sweptforward wing generates additional lift while the converse is true of sweptback wings. F.R.L.

A74-30401 # **Subsonic flow into a downstream facing inlet.** T. G. Keith, Jr. (Toledo, University, Toledo, Ohio). *Journal of Aircraft*, vol. 11, Apr. 1974, p. 251, 252.

By changing the direction of the internal engine flow, through the use of a variable pitch fan, reverse thrust can be generated in a fan engine. However, in accomplishing a thrust reversal by this method, flow will be taken into the propulsor from its downstream opening and thus the exhaust nozzle will function as an inlet. Since the nozzle was not necessarily intended to be used in this fashion, it is of interest to examine expected performance characteristics. As a first step, a simple extension of an earlier study by Fradenburg and Wyatt (1953), is used to estimate the total pressure recovery of the inlet as a function of the freestream Mach number for parametric values of the inlet or duct Mach number. F.R.L.

A74-30403 * # **Computation of transonic flow about lifting wing-cylinder combinations.** E. B. Klunker and P. A. Newman (NASA, Langley Research Center, High-Speed Aircraft Div., Hampton, Va.). *Journal of Aircraft,* vol. 11, Apr. 1974, p. 254-256. 16 refs.

Some results are described for a lifting rectangular wing centrally located on a circular-cylindrical body. This simple configuration has been utilized in order to assess the merits of a mapping technique for wing-body configurations. The procedure employed makes use of a coordinate transformation to simplify specification of the surface boundary condition in the computation of the flow about the wing. The method can be extended to incorporate wing sweep, finite length body of noncircular cross section, and arbitrary wing placement; however, these extensions involve a considerable increase in complexity of the problem. F.R.L.

A74-30453 Optimization of complex structures to satisfy static, dynamic and aeroelastic requirements. S. S. Rao (Indian Institute of Technology, Kanpur, India). *International Journal for Numerical Methods in Engineering,* vol. 8, no. 2, 1974, p. 249-269. 20 refs.

A structural optimization problem is considered in which the design requirements include restrictions on the strength, stability, frequency, and flutter characteristics of the structure. One of the central concerns of this phase of the work has been to overcome the problems inherent in analyzing the dynamic and aeroelastic behavior of structures with many degrees of freedom. The multiweb delta wing structure under supersonic flight conditions is the model upon which this exploratory study is based. The finite-element idealization, with three different kinds of elements, is used to model the wing structure. The constant-stress triangular plate elements, the rectangular shear panels, and the pin-jointed bar elements are used to represent, respectively, the cover skins, webs, and stringers of the wing structure. The design problem is formulated as a minimum-weight optimization problem and is solved by using nonlinear programming techniques. Computationally efficient schemes are developed for the necessary derivatives of the behavior constraints. (Author)

A74-30513 # **Measurement of hot fatigue crack growth rate of AU2GN aluminium alloy (Mesure de la vitesse de fissuration en fatigue à chaud de l'alliage d'aluminium AU2GN).** G. Vidal (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France) and P. Y. Le Roy. *La Recherche Aérospatiale,* Mar.-Apr. 1974, p. 83-93. 6 refs. In French.

New tests were carried out to check the validity of the Paris law in hot fatigue in the case of AU2GN aluminium alloy. The fatigue tests in undulated tension were performed at 35 Hz on large 1.4 mm thick specimens. The specimen was heated by radiating tubes. Four main series of tests were performed: three on unplated (at 20, 100 and 150 C) and one on aluminium-plated AU2GN (at 100 C). At 100 C, the experimental points for the unplated and plated states of the alloy are almost superposed, which shows that, at that temperature, aluminium plating has no noticeable influence. For unplated alloy, experimental points at 20, 100 and 150 C are practically the same, which indicates that, in this range, temperature influence on crack growth rate is negligible. (Author)

A74-30592 General avionics progress. H. Field. *Shell Aviation News,* no. 422, 1974, p. 10-14.

The equipment that can be installed in the modern light aircraft to make it compatible with the air traffic system is comprehensive, extremely light in weight and remarkably reliable. The techniques and the technologies of present-day general aviation differ but little from those of the airlines. The majority of general aviation radios have had 360-channel capability for a decade. New aircraft types are considered, giving attention to a light weight executive jet. G.R.

A74-30593 Prelude to airworthiness - An outline of quality assurance in aircraft construction. J. Corlett. *Shell Aviation News,* no. 422, 1974, p. 26-31.

The authorities who issue a certificate of airworthiness for a new aircraft stipulate an unbroken chain of surveillance from raw material to finished part. The inspection system established to provide this inspection is considered. Radiography and ultrasonics may be employed to determine the quality of important structural items before they are built into an aircraft. The inspection of subassemblies is discussed together with the checking of bonded joints, approaches for system verification, and inspections before and between test flights. G.R.

A74-30596 # **Potential uses for the Kiebitz tethered rotor platform.** W. Göller. *Dornier-Post* (English Edition), no. 2, 1974, p. 14-17.

The Kiebitz tethered rotor platform was designed as an unmanned vehicle to carry sensors of various kinds. The objective is continuous operation of a payload weighing up to 140 kg at an altitude of 300 m. Continuous operation is made possible by the permanent supply of fuel via the tethering cable. The primary mission of Kiebitz would be battlefield reconnaissance by means of radar. When long-range radar is used, the rotor platform can be operated so far behind the forward edge of the battle area that there is no danger to the system from enemy ground-based weapons. This kind of platform can also be used in maritime surveillance and fire control for ship-to-ship missiles. P.T.H.

A74-30597 # **Continuing the Aerodyne experimental study.** W. Melzer. *Dornier-Post* (English Edition), no. 2, 1974, p. 18-21.

Though operational Aerodyne vehicles will be based on the present experimental model, they will be further developed in many points. For example, they will have a bigger speed envelope and greater jet deflection in the hover. This will result in a considerably smaller nose-down angle in the hover and shorter, and retractable, landing gear. Theoretical and experimental work is creating the technological conditions for such advanced Aerodyne vehicles. A particularly important place is occupied here by the improvement in jet deflection. In addition, questions of fan design and general shape are being considered. F.R.L.

A74-30598 # **Experimental system for future remotely piloted vehicles.** J. Spintzyk. *Dornier-Post* (English Edition), no. 2, 1974, p. 22-25.

Unmanned remote-controlled combat aircraft, known as remotely piloted vehicles or RPVs, may well acquire great importance, alongside the conventional manned aircraft. The German armed forces could save upkeep costs in peacetime with the aid of RPVs. Defence capability would not suffer thereby, since RPVs promise greater efficiency in operation. An especially interesting aspect is the use of RPVs against attacking armored units and other strongly defended ground targets in the combat area. The RPV system envisaged by Dornier consists of one or more vehicles, a flying relay station, and a mobile ground control station. F.R.L.

A74-30599 # **The Alpha Jet wind tunnel model for aeroelastic investigations.** P. Esch and T. Windeck. *Dornier-Post* (English Edition), no. 2, 1974, p. 26-29.

The high-speed flutter model of the Alpha Jet is the joint work of Dassault-Breguet, Institut de Mécanique des Fluides de Lille (IMFL), and Dornier. IMFL is responsible for the design and construction of two fuselages with their wing and tail unit attachments, while Dornier is designing and constructing three pairs of wings with ailerons, three horizontal tail units, two vertical tail units with rudders and, for future tests, pylons and external loads, all with dynamic similarity. The tail units are much more complex than the wing, as their load-bearing structure cannot be idealized by a beam. The design of the model tail units, together with spars, ribs, attachment fittings, and stressed skin covering must correspond to the full-scale design. F.R.L.

A74-30600 # **Light hoverable combat aircraft - Wind tunnel tests.** J. van der Decken and R. Joos. *Dornier-Post* (English Edition), no. 2, 1974, p. 30, 31.

In order to examine the concept proposal for a new light multirole aircraft with hover capability and good maneuverability, whose main feature is a fan propulsion system with subsequent jet deflection at both sides of the fuselage, a wind tunnel model was built with realistic propulsion simulation. The wind tunnel model corresponds approximately to a 1:6 scale single seater. The wind tunnel tests on this model supplied the necessary initial working data to get an idea of its suitability with respect to flight mechanics, because such an unconventional model is accessible to purely theoretical consideration to a certain degree only. The main objective of the wind tunnel tests was to determine jet interferences, jet deflection, and ground effects. This results in special requirements for model design and experimental technique. F.R.L.

A74-30601 # **The MUDAS-F crash recorder for the Alpha Jet.** B. Müller and K. Rosenblatt. *Dornier-Post* (English Edition), no. 2, 1974, p. 32-35.

In view of the Alpha Jet's operational profile, a deployable crash recorder was chosen. The deployment criteria are actuation by the ejector seat, or impact of the aircraft, or sinking of the aircraft below 2 m of water. The MUDAS-F crash recorder comprises the following subsystems: data recording, with signal adaption unit (SAU), recorder, switch and check-out equipment, data recovery, with deployment sensors (ejector seat relay, crash switch in nose, pressure switch), and a ground station to play back and evaluate the recorded signals. F.R.L.

A74-30625 **L-1011 Iron Bird uncovers potential hydraulic troubles.** S. Bangs. *Hydraulics and Pneumatics*, vol. 27, May 1974, p. 113-115.

In connection with the design of the Tri-Star L-1011 wide-body jet transport, a Tri-Star Vehicle Systems Simulator, a land-bound combined 'Iron Bird' facility, and a 3-year test program were developed. The Iron Bird revealed 404 significant faults, failures, and effects from wear and load. Only one third of the hydraulic welded joints were found acceptable by Lockheed's quality analysis standards. G.R.

A74-30690 **25 years after, why the Astafan (25 ans après, pourquoi l'Astafan).** J. Szydlowski (Turboméca, S.A., Bordes, Pyrénées-Atlantiques, France). *Air et Cosmos*, vol. 12, Apr. 27, 1974, p. 17-21, 23. In French.

The Astafan family constantly follows the evolution of the basic Astazou turbine. The Astafan formula permits a great flexibility of adaptation, without altering the essential elements. In effect, by a variation of the exterior diameter of the fan, which is limited to a change of the fan blades and the cold flux chamber, and by the appropriate choice of reduction ratio (changing of pinions), it is possible to cover a wide range of thrusts with the same basic turbine. All the accessories are lodged in the interior diameter of the cold flux chamber, which does not change, the modifications being limited, except for the blades and the pinions, to static parts fabricated of sheet metal. F.R.L.

A74-30748 **Tilt-rotor aircraft nears final design.** R. G. O'Lone. *Aviation Week and Space Technology*, vol. 100, May 20, 1974, p. 51-53.

Effort to build two U.S. tilt-rotor research aircraft is proceeding in a program marked by extensive reliance on advanced simulation techniques throughout all phases. The NASA/Army/Bell XV-15 tilt-rotor model is a 42-ft-long H-tail aircraft with a 32-ft slightly forward-swept wing that has an engine powering a 25-ft-diameter rotor at each tip. Lycoming 1,500 shp LTC1K-4K free turbine engines are mounted in the nacelles, which can rotate between 0 and 95 degrees to provide a range of V/STOL capability. The computer simulation program includes more that 25 sets of nonlinear differential equations, which can be coupled together to simulate the entire aircraft. Some of these modules, for example, represent the high and low speed rotor program; high and low speed control system; the wing, pylon, and fuselage aerodynamics; and the engine. Flight safety characteristics include autorotation capability in case of complete power loss, and cross-shafting of engines, allowing either powerplant to power both rotors. P.T.H.

A74-30749 **USAF evaluating helicopter IFR aids.** B. M. Elson. *Aviation Week and Space Technology*, vol. 100, May 20, 1974, p. 59-63.

Recent advances in helicopter control, display, and stability augmentation systems are being evaluated by USAF to determine whether they can materially improve pilots' instrument flight capabilities at reasonable cost. One of these systems is a flight director system that includes a three-cue attitude director indicator; another is an automatic flight control system that allows for pilot input without changing the system's control dynamics or control laws. This is accomplished by placing force-sensing devices in the aircraft's controls, thereby coupling the pilot electronically to the flight control system. Also, the main features of a yaw axis augmentation system are described. P.T.H.

A74-30750 # **On scaling transonic wind tunnel data.** R. J. Vidal (Calspan Corp., Buffalo, N.Y.). *Naval Research Reviews*, vol. 27, Feb. 1974, p. 1-17. 16 refs.

The historical development of scaling procedures is considered and attention is given to the C-141 problem. The design of the aircraft was based partly on the testing of small-scale models in a wind tunnel in which the flight Mach number was duplicated. The flight Reynolds number could not be duplicated, but suitable techniques were employed to simulate the Reynolds number. However, a flight test with the aircraft showed subsequently that the tail loads were much greater than expected from the wind tunnel tests. The reasons for these discrepancies are discussed along with some potential solutions. One approach is to develop high Reynolds number test facilities. Another solution is to seek scaling laws which could provide a basis for a simulation of the high Reynolds number shock wave-boundary layer interaction. G.R.

A74-30818 **Anti-icing tests on Concorde.** P. Baker (British Aircraft Corp., Commercial Aircraft Div., Weybridge, Surrey, England). *Society of Experimental Test Pilots, Technical Review*, vol. 12, no. 1, 1974, p. 5-7.

Before flight tests were attempted, tests were carried out both in wind tunnels and on a flying engine test bed to investigate the likely anti-icing equipment needed to meet the relevant requirements. The preliminary testing led to the provision of anti-icing of the airframe, intake, and engine. For the airframe and intake, an electrical system

was chosen, using heater mats and mineral insulated cables, a combination of continuous and cyclic heating being used to the various areas. The nose bullet and entry guides were treated separately, being provided with engine tapped hot air. This is the system currently fitted to the prototype, and upon which all tests to date have been done. F.R.L.

A74-30819 **Low speed handling with prototype-Concorde.** G. Defer (Société Nationale Industrielle Aérospatiale, Paris, France). *Society of Experimental Test Pilots, Technical Review,* vol. 12, no. 1, 1974, p. 8, 9.

There is no natural warning (buffet) within the explored envelope and of course no lift discontinuity which is characteristic of the stall on conventional aircraft. Up to alpha max equals 23.5 deg, maneuverability remains excellent on all three axes and most particularly in pitch. The dynamic stability decreases slowly as incidence increases, but remains satisfactory at 23.5 deg. The unaugmented static stability is frankly negative, more especially as the C.G. is further aft, but the incidence trim restores an apparent positive stability (in forces). To succeed in finding a slight aerodynamic abnormality the vicinity of alpha max must be reached with a steady sideslip of at least 8 deg. F.R.L.

A74-30820 **Pilot workload-efficiency of military aircraft systems with one or two man crew.** E. Dahlstrom (Saab-Scania AB, Linkoping, Sweden). *Society of Experimental Test Pilots, Technical Review,* vol. 12, no. 1, 1974, p. 10-19.

It is possible to design a one-man aircraft for high efficiency missions. The two-man aircraft gives even higher efficiency. The question of cost effectiveness is investigated, as well as the question of whether the avionics in a two seater are in fact cheaper than in a single seater with the same efficiency. If the same avionics are used in both versions the question of how much better the two-place aircraft is requires attention. The airframe cost must be higher for a two-place aircraft. Consideration must also be given to variation in maintenance, salaries, training, etc., costs when adding a second crew member. F.R.L.

A74-30821 **A data reduction method for landing performance tests.** M. T. Cobb (Grumman American Aviation Corp., Cleveland, Ohio). *Society of Experimental Test Pilots, Technical Review,* vol. 12, no. 1, 1974, p. 20, 21.

Landing performance flight tests required by FAR Part 25 define measurement of the landing distance from an altitude of 50 ft at an airspeed of 1.3 V sub S and at maximum landing gross weight. From the flight test pilot's standpoint it is difficult to achieve precisely 1.3 V sub S, unaccelerated, at exactly 50 ft altitude. It is also impractical to perform the required six consecutive landings at exactly maximum gross landing weight. The data can be corrected for airspeed and weight deviations from test specifications if approached from an energy basis. F.R.L.

A74-30822 **XFV-12A V/STOL fighter/attack aircraft.** E. A. Gillespie (Rockwell International Corp., Columbus, Ohio). *Society of Experimental Test Pilots, Technical Review,* vol. 12, no. 1, 1974, p. 26-33.

The two prototypes presently being designed and constructed are to prove or disprove the technology concept of an augmenter wing. The airplane will VTOL with an engine only two-thirds the size of conventional direct lift jets. The airplane will STOL in very short distances with a large payload capability. The airplane should be extremely maneuverable with low wing loading, high thrust-to-weight, good visibility, high sustained G with low loss of Ps, with good stability throughout the conventional fighter envelope, and have excellent deceleration devices. F.R.L.

A74-30823 **Shipboard operations of Harrier.** J. F. Farley (Hawker Siddeley Aviation, Ltd., Kingston-on-Thames, Surrey, England). *Society of Experimental Test Pilots, Technical Review,* vol. 12, no. 1, 1974, p. 34-49.

The question of adapting ships to optimize them for the Harrier often crops up. With any aircraft the more room there is the better they can be operated, and this still holds for the Harrier; however, because the landings are always vertical the space that needs to be allocated to landing is less than the takeoff case. This is the reverse of normal shipboard fixed wing and leads to any deck extensions only having to be stressed to accept Harrier taxiing loads. The nature of a Harrier efflux on vertical takeoff is such that a heavier weight can be hovered in free air than can be lifted through its own efflux environment. F.R.L.

A74-30824 **Escape system concepts need reexamining.** J. F. Heye (USAF, Washington, D.C.). *Society of Experimental Test Pilots, Technical Review,* vol. 12, no. 1, 1974, p. 53-56.

This article reexamines the crew escape problem in order to make the reader aware that design of modern day aircraft does not necessarily require an airborne escape system. The traditional approach has been to provide as much coverage of the operational envelope as technology will support. However, in light of the ever increasing acquisition costs of today's weapon systems, the Department of Defense continues to stress that the services must design for only what is necessary. In light of this statement, the author evaluates the real need for an escape system for new aircraft. The so-called escape system requirements fall into the category of absolutely necessary and just nice to have. (Author)

A74-30825 * **V/STOL flying qualities research using the X-22A.** R. E. Smith (Calspan Corp., Buffalo, N.Y.). *Society of Experimental Test Pilots, Technical Review,* vol. 12, no. 1, 1974, p. 57-70. Navy-USAF-NASA-FAA-sponsored research.

The X-22A has four ducted propellers and four engines. The engines are connected to a common system of rotating shafts which distribute propulsive power to the four propellers. Changes in the direction of the thrust vector are accomplished by rotating the ducts, which are interconnected so that all rotate through the same angle. Thrust magnitude is determined by a collective pitch lever, very similar to a helicopter. There are four variable stability system (VSS) controllers: thrust, pitch, roll, and yaw, and three artificial feel servos for the evaluation pilot cockpit controls, each employing electrohydraulic servos. Longitudinal flying qualities for STOL landing approach, and lateral-directional flying qualities and control power requirements for STOL landing approach are discussed. Attention is given to the data acquisition and processing system. F.R.L.

A74-31097 # **Wing profile with rotating flap in shear flow (Profil' kryla s vrashchaiushchimsia zakrylkom v sdvigovom potoke).** T. S. Patel' (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR). *Moskovskii Universitet, Vestnik, Seriia I - Matematika, Mekhanika,* vol. 29, Mar.-Apr. 1974, p. 97-105. In Russian.

Solution of the problem of the unbounded linear shear flow around a circular cylinder and a thin wing profile with a rotating flap. On the basis of the results for a thin profile, the particular cases of a flat plate and a nonsymmetric profile are considered, calculating the aerodynamic lift and pitch moment coefficients. Results are presented in graphical form. P.T.H.

A74-31219 **Aircraft dynamics and automatic control.** D. McRuer, I. Ashkenas (Systems Technology, Inc., Hawthorne, Calif.), and D. Graham (Princeton University, Princeton, N.J.; Systems Technology, Inc., Hawthorne, Calif.). Princeton, N.J., Princeton University Press, 1973. 805 p. 479 refs. $27.50.

The subject of feedback control of flight is studied in depth. Necessary mathematical techniques for approaching the synthesis of aircraft flight control systems are reviewed, including Laplace transform, transfer function, root locus, and open-loop/closed-loop logarithmic frequency response methods. The equations of motion

for aeronautical vehicles are developed, and from these are evolved the transfer functions of an aircraft's response to control. The analysis covers longitudinal and lateral dynamics and elementary longitudinal and lateral feedback control. Finally, the system design process, inputs and system performance assessment, and multiloop flight control systems are extensively covered. P.T.H.

A74-31245 **Looking ahead with hindsight /The Sixty-Second Wilbur and Orville Wright Memorial Lecture/.** G. Edwards (British Aircraft Corp., Ltd., London, England). *Aeronautical Journal*, vol. 78, Apr. 1974, p. 134-146.

Developements in British aviation before and during the Second World War are briefly reviewed. The history of the civil airliner business after the war is considered, giving attention to the Viking, the Viscount, and the Vanguard Aircraft developed in cooperation between British and French aerospace firms are discussed, giving attention to the Concorde and the Jaguar military supersonic tactical fighter. The strength and composition of aircraft design engineering manpower over the past four decades are considered along with economic developments in air traffic, UK aerospace exports, and the significance of speed and time in air travel. G.R.

A74-31247 **Some experimental results of the effect of a streamwise vortex on a two-dimensional wing.** M. H. Patel and G. J. Hancock (Queen Mary College, London, England). *Aeronautical Journal*, vol. 78, Apr. 1974, p. 151-155. 6 refs.

An experimental investigation was conducted of the phenomena of low speed streamwise vortex-wing interference. Flow visualization tests were carried out in addition to pressure plotting. Surface flow patterns were obtained on a downstream aerofoil. Further tests were conducted in a smoke tunnel. A fore wing generated a tip vortex into which smoke was introduced, photographs were taken as the vortex passed over a downstream aerofoil. G.R.

A74-31275 **GE ships final engine for flight-test B-1.** M. L. Yaffee. *Aviation Week and Space Technology*, vol. 100, May 27, 1974, p. 45-47, 50.

The fourth F101-GE-100 flight test engine for the supersonic B-1 strategic bomber has been shipped for installation and testing. The augmented turbofan 30,000-lb.-thrust engine passed an extensive preliminary flight rating test in March. A schematic drawing presented shows details of the turbofan powerplant. Variable inlet guide vanes are in front of the two-stage fan and also in front of the nine-stage high-pressure compressor. The F101 is the first engine to use an infrared pyrometer as the basis of its control system. G.R.

A74-31474 **Hydraulic muscle with electrical controls.** L. L. Boulden. *Machine Design*, vol. 46, May 30, 1974, p. 57-61.

Fly-by-wire (FBW) methods have been developed by the Air Force as a way to boost reliability, cut energy losses, and tighten servo response. In FBW or control-by-wire (CBW), the entire hydraulic system is located at the point of actuation. The valves are controlled electrically from a distance, so that the entire hydraulic system can be placed deep inside a machine, or in other remote, inaccessible locations. One of the biggest problems with applying FBW/CBW is overheating of the actuator package. Approaches for dealing with this problem are discussed. G.R.

A74-31611 **A low cost p-i-n diode phase shifter for airborne phased-array antennas.** F. G. Terrio, R. J. Stockton (Hughes Aircraft Co., Culver City, Calif.), and W. D. Sato. *IEEE Transactions on Microwave Theory and Techniques*, vol. MTT-22, June 1974, p. 688-692. Research supported by the Hughes Aircraft Co.; Contract No. F33615-73-C-5160.

This paper presents a description of a p-i-n diode phase shifter that was designed for low cost production for use in X-band phased-array systems. The phase shifter is designed to make maximum use of photoetched circuit components and low cost materials, and is well suited for assembly on a fully automated assembly line. The salient features of this phase shifter are a printed-circuit transmission structure and inexpensive RF connectors that are integrated into the circuit package. The microwave performance characteristics are generally superior to those of equivalent devices; a useful band width of 40% with an average insertion loss of 1.6 dB has been demonstrated with 3-bit units. (Author)

A74-31643 **Reachable sets for tracking.** P. J. Wong and A. J. Korsak (Stanford Research Institute, Menlo Park, Calif.). *Operations Research*, vol. 22, May-June 1974, p. 497-509. Navy-supported research.

The Pontryagin maximum principle is used to derive a set of equations which describe the reachable set. The reachable set is the set of all possible aircraft positions at a certain time, taking into account the aircraft position and velocity at a previous time along with limits concerning the ability of the aircraft to maneuver and change speed. The theory developed in the analysis can be applied to the search and tracking of vehicles other than aircraft, as long as the searching system and vehicle satisfy the modeling assumptions. The method can also be extended to three-dimensional applications. G.R.

A74-31705 # **Random vibration of aircraft undercarriages with nonlinear characteristics.** O. Kropac and J. Sprinc (Vyzkumny a Zkusebni Letecky Ustav, Prague, Czechoslovakia). *(International Conference on Nonlinear Oscillations, 6th, Poznan, Poland, Aug. 29-Sept. 4, 1972.) Zagadnienia Drgan Nieliniowych*, no. 14, 1973, p. 393-416. 11 refs.

Attention is given to the estimation of vertical motions and loading forces acting on an aircraft landing gear under all important ground operation regimes including taxiing and transient regimes during take-off and landing runs. The system input function is given by the roughness of the runway and the forward aircraft speed. This input is of random nature so that methods of statistical dynamics are to be used. For estimates of power spectral densities, models with parametrically linearized elastic terms of the shock absorber are adequate. For detailed studies requiring the knowledge of distribution functions, the Markov process approach is recommended making it possible for all types of nonlinearities to be fully included. The transient regimes are solved as quasi-stationary ones, i.e., with mean values of the processes changing very slowly as compared with the changes of their random components. The advantages of multiple-mass models enabling a closer explanation of some complex dynamical phenomena are outlined. F.R.L.

A74-31745 # **Observable changes of load sample function due to structural elasticity.** L. Laudanski (Warszawa, Politechnika, Warsaw, Poland). *(International Conference on Nonlinear Oscillations, 6th, Poznan, Poland, Aug. 29-Sept. 4, 1972.) Zagadnienia Drgan Nieliniowych*, no. 15, 1974, p. 337-351. 22 refs.

The present work describes a new method for analyzing the dynamic loads of a flexible construction subjected to stochastic disturbances. New numerical characteristics of the stationary and Gaussian processes describing the load history of the construction are determined and used in the example taken from aeronautical applications (a response of a flexible glider to continuous turbulence). (Author)

A74-31795 **The new Douglas 'Minipac' ejection seat.** O. E. Howland (Douglas Aircraft Co., Long Beach, Calif.). *SAFE Journal*, vol. 4, Spring 1974, p. 18-20.

It is pointed out that the fatality rate for rotary-wing aircraft is almost three times that of fixed-wing aircraft. Forty to sixty per cent of helicopter fatalities can be prevented by an adequate in-flight escape system. The new Minipac ejection seat is to provide this escape system. Minipac is an ultra-light weight, low impulse, fast-reaction seat system. Details of Minipac design and its principles of operation are discussed. G.R.

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STAR ENTRIES

N74-21631*# Kanner (Leo) Associates, Redwood City, Calif.
PROCESS AND DEVICE FOR ADAPTATION OF SHARP LEADING EDGE AIRFOILS TO ANY SPEED, SUBSONIC OR SUPERSONIC
Washington NASA Apr. 1974 27 p Transl. into ENGLISH from French Patent no. 1071234 (19 Nov. 1952)
(Contract NASw-2481)
(NASA-TT-F-15569) Avail: NTIS HC $4.50 CSCL 01A

The invention of a method for changing the configuration of sharp leading edge airfoils during flight to maximize their efficiency in any speed range is described. The primary mechanism used is a deflecting or slotted flap with sharp leading edge which can be used in aircraft wings, stabilizers, or air intakes. Deflection of the flap brings the airflow into a position tangential to the edge and the shock wave strikes the edge itself or the area of its immediate vicinity. Pressure measurement devices enable the pilot or an automatic control system to make the proper change in the deflection of the flap as a function of the speed of the aircraft. Author

N74-21633*# Kansas Univ Center for Research, Inc., Lawrence. Flight Research Lab.
AN ANALYTICAL INVESTIGATION OF WING-JET INTERACTION
Edward C. Lan Apr. 1914 136 p refs
(Grant NGR-17-002-107)
(NASA-CR-138140; CRINC-FRL-74-001) Avail: NTIS HC $10.00 CSCL 01A

The aerodynamic interaction between the wing and an inviscid jet with Mach number nonuniformity is formulated by using a two-vortex-sheet model for the jet. One of the vortex sheets accounts for the induced jet flow and the other the induced outer flow. No additional source distribution is needed for the jet at an angle of attack. The above problem is solved by satisfying the jet and wing tangency and the jet pressure-continuity conditions and using a quasi vortex lattice method for computing the induced flow field. The latter method is derived through theoretical consideration by properly accounting for singularities present in the equations and possesses the same simplicity and generality as the conventional vortex lattice method but has a better rate of numerical convergence. The resulting system of algebraic equations is solved by Purcell's vector method. The numerical formulation is first applied to the wing-slipstream interaction problem. Results for one centered-jet configuration are compared with those predicted by some existing theories. Author

N74-21634*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
LOW SPEED AERODYNAMIC CHARACTERISTICS OF NACA 6716 AND NACA 4416 AIRFOILS WITH 35 PERCENT-CHORD SINGLE-SLOTTED FLAPS
Gene J. Bingham and Kevin W. Noonan Washington May 1974 52 p refs Prepared in cooperation with Army Air Mobility R and D Lab., Hampton, Va.
(NASA-TM-X-2623; L-8410) Avail: NTIS HC $3.75 CSCL 01A

An investigation was conducted in a low-turbulence pressure tunnel to determine the two-dimensional lift and pitching-moment characteristics of an NACA 6716 and an NACA 4416 airfoil with 35-percent-chord single-slotted flaps. Both models were tested with flaps deflected from 0 deg to 45 deg, at angles of attack from minus 6 deg to several degrees past stall, at Reynolds numbers from 3.0 million to 13.8 million, and primarily at a Mach number of 0.23. Tests were also made to determine the effect of several slot entry shapes on performance. Author

N74-21635*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ON THE USE OF THICK-AIRFOIL THEORY TO DESIGN AIRFOIL FAMILIES IN WHICH THICKNESS AND LIFT ARE VARIED INDEPENDENTLY
Raymond L. Barger Washington May 1974 15 p refs
(NASA-TN-D-7579; L-9350) Avail: NTIS HC $3.00 CSCL 01A

A method has been developed for designing families of airfoils in which the members of a family have the same basic type of pressure distribution but vary in thickness ratio or lift, or both. Thickness ratio and lift may be prescribed independently. The method which is based on the Theodorsen thick-airfoil theory permits moderate variations from the basic shape on which the family is based. Author

N74-21636# Aeronautical Research Labs., Melbourne (Australia).
A PRELIMINARY TOWING TANK STUDY OF THE TRAILING VORTEX GENERATED BY A RECTANGULAR WING, INCLUDING THE EFFECTS OF SEVERAL TIP MODIFICATIONS
D. H. Thompson Sep. 1973 42 p refs
(ARL/A-Note-342) Avail: NTIS HC $5.25 CSCL 01A

The structure of the trailing vortex generated by a rectangular wing in a small towing tank has been studied using the hydrogen bubble flow visualization technique. The effects on the vortex of starting and stopping the towing carriage and of passing a body through the vortex core have been examined. A total of fourteen modifications to the basic wing have been tested for the effect of each on the trailing vortex. Those modifications which most altered the vortex structure were a spoiler on the wing upper surface at the tip; a circular end plate and a perforated tip extension. Author

N74-21637# Technion - Israel Inst. of Tech., Haifa. Dept. of Aeronautical Engineering.
DETERMINATION OF THE ALLOWABLE TOLERANCES FOR THE ASYMMETRIES OF A FREE ROLLING VEHICLE
A. Kirszenblat Aug. 1973 31 p refs
(TAE-185) Avail: NTIS HC $4.75

A method for determining tolerances on free rolling missile asymmetries is presented. Practical flight limitations, such as a specified maximum lateral aerodynamic load, are taken into account. The proposed method can deal with missile dynamics described by differential equations of motion. It is demonstrated for the case of a vehicle having a lateral center-of-gravity and aerodynamic asymmetries. The vehicle tolerance contour with the mass asymmetry as an independent variable is calculated by an optimal parameter search combining the gradient projection technique and the continuation method. For this search, the maximum value of the lateral load and its partial derivatives with respect to the asymmetry parameters must be known. They are obtained by integrating numerically the differential equations of motion and the related sensitivity equations. The method is applied to a numerical example. Author.

N74-21639*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FLIGHT REYNOLDS NUMBER EFFECTS ON A CONTOURED BOATTAIL NOZZLE AT SUBSONIC SPEEDS
Roger Chamberlin Washington May 1974 24 p refs
(NASA-TM-X-3053; E-7818) Avail: NTIS HC $3.00 CSCL 01A

A contoured boattail nozzle typical of those used on a twin-engine fighter was tested on an underwing nacelle mounted on an F-106B aircraft. The gas generator was a J85-GE-13 turbojet engine. The effects of Reynolds number, Mach number, and angle of attack on boattail drag and boattail pressure profiles were investigated. Increasing Reynolds number caused a slight reduction in boattail drag at both Mach 0.7 and 0.9. The nozzle had relatively low boattail drag even though the flow was separated over a large portion of the boattail. Author

N74-21641# Lockheed-Georgia Co., Marietta.
VALIDATION OF NEW GUST DESIGN PROCEDURES FOR MILITARY TRANSPORTS Final Report, 1 Mar. - 9 Nov. 1973
James J. Spitler Nov. 1973 115 p refs
(Contract F33615-73-C-3047; AF Proj. 1367)
(AD-775385; LG73ER0153; AFFDL-TR-73-118) Avail: NTIS CSCL 01/1

AFFDL-TR-70-106, Design Manual for Vertical Gust Based on Power Spectral Techniques, outlines four procedures for design of aircraft for vertical gusts. Validation of these new gust design procedures for military aircraft is provided by application of these procedures to four military transports. Lockheed models C-130, C-141A, C-140, C-130, and C-5A provide the means to evaluate design gust response for a range of gross weights from 20,000 to 750,000 pounds and encompass design features such as straight and swept wings, prop jets, fan jets, and turbo jets. The four design procedures, each successively more detailed, are applied for each aircraft evaluation even though they may not be required. In practice, the design manual allows analysis conclusion upon successful completion of the less detailed procedures. (Modified author abstract) GRA

N74-21644# RAND Corp., Santa Monica, Calif.
THE FLOW OVER A POROUS BODY: A SINGULAR PERTURBATION PROBLEM WITH TWO PARAMETERS
K. Gersten and J. F. Gross May 1973 47 p refs
(AD-775072; R-980-PR) Avail: NTIS CSCL 01/1

The proper design of high-speed aircraft depends to a large extent on the ability to predict the skin-friction and heat-transfer characteristics resulting from the interaction of the surface of the aircraft with the surrounding medium. At high speeds, viscous heating in the laminar boundary layer on the surface of the vehicle can cause elevated temperatures that result in loss of structural integrity or ablation of the surface. To alleviate this problem, a coolant can be injected through pores in the surface. Surface heating is reduced both by the action of the coolant and by the diminished heat transfer resulting from an increase in boundary-layer thickness. The report discusses the effects of injection or suction of material near the stagnation point of a porous body--the extreme forward point where the oncoming air is brought to rest and the boundary layer essentially begins. Emphasis is given to strong injection and suction problems. GRA

N74-21645# McDonnell-Douglas Corp., Long Beach, Calif.
ANALYTICAL STUDIES OF TWO-ELEMENT AIRFOIL SYSTEMS Interim Report, Feb. 1971 - Dec. 1973
Richard M. James Feb. 1974 277 p refs
(Contract N00014-72-C-0218)
(AD-775538; MDC-J5831) Avail: NTIS CSCL 01/1

The report represents an interim stage of a research program sponsored by ONR to try and put the basic mathematics of design and flow analysis methods for two-element airfoil systems on an equivalent footing to that of single element configurations with the ultimate end in view of producing optimum designs. Techniques of conformal mapping and multiple image reflection are used to solve problems connected with two disjoint circles and then to develop the integral equations describing problems of real interest posed in a canonical domain -- the annular space between two concentric circles. Using this point of view, the essential character of a promising general technique is deduced. (Modified author abstract) GRA

N74-21646*# Scientific Translation Service, Santa Barbara, Calif.
A METHOD FOR AVOIDING INSECT ROUGHNESS ON AIRCRAFT
F. X. Wortmann Washington NASA Apr. 1974 13 p refs Transl. into ENGLISH from Luftahrttechnik, Raumfahrttechnik (West Germany), v. 9, no. 9, Sep. 1963 p 272-274
(Contract NASw-2483)
(NASA-TT-F-15454) Avail: NTIS HC $4.00 CSCL 01C

Insect-induced roughness on aircraft can be avoided by highly elastic rubber coverings on wing and control surface leading edges. Film photographs have shown that such elastic surfaces can elastically reflect impacting insects or viscous liquid drops. This prevents the formation of insect roughness and the endangered fuselage and wing leading edges remain smooth. Author

N74-21647*# Kansas Univ. Center for Research, Inc., Lawrence. Flight Research Lab.
AN INVESTIGATION OF SEPARATE SURFACE STABILITY AUGMENTATION SYSTEMS FOR GENERAL AVIATION AIRCRAFT Progress Report
Apr. 1974 100 p ref
(Grant NGR-17-002-095)
(NASA-CR-138120; PR-9) Avail: NTIS HC $8.00 CSCL 01C

The status of a project to develop and evaluate separate surface stability augmentation systems for general aviation aircraft is discussed. The electrical design, roll heading hold is described and schematic diagrams and an operational description are provided. The flight tests program is explained. Various failure conditions are proposed and the effects on the stability of the aircraft are analyzed. Author

N74-21648*# Oklahoma State Univ., Stillwater. School of Electrical Engineering.
OPTIMAL CONTROLLER DESIGN FOR HIGH PERFORMANCE AIRCRAFT UNDERGOING LARGE DISTURBANCE ANGLES Final Report
Ronald P. Rhoten 28 Feb. 1974 124 p
(Grant NGR-37-002-096)
(NASA-CR-138130) Avail: NTIS HC $9.25 CSCL 01C

An examination of two aircraft controller structures applicable to on-line implementation was conducted. The two controllers, a linear regulator model follower and an inner-product model follower, were applied to the lateral dynamics of the F8-C aircraft. For the purposes of this research effort, the lateral dynamics of the F8-C aircraft were considered. The controller designs were evaluated for four flight conditions. Additionally, effects of pilot input, rapid variation of flight condition and control surface rate and magnitude deflection limits were considered. Author

N74-21649*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FREE-FLIGHT INVESTIGATION OF THE STABILITY AND CONTROL CHARACTERISTICS OF A STOL MODEL WITH AN EXTERNALLY BLOWN JET FLAP
Lysle P. Parlett, Sandy J. Emerling, and Arthur E. Phelps, III (Army Air Mobility R and D Lab., Hampton, Va.) Washington Apr. 1974 84 p refs
(NASA-TN-D-7411; L-9148) Avail: NTIS HC $4.00 CSCL 01B

The stability and control characteristics of a four-engine turbofan STOL transport model having an externally blown jet flap have been investigated by means of the flying-model technique in the Langley full-scale tunnel. The flight characteristics of the model were investigated under conditions of symmetric and asymmetric (one engine inoperative) thrust at lift coefficients up to 9.5 and 5.5, respectively. Static characteristics were studied by conventional power-on force tests over the flight-test angle-of-attack range including the stall. In addition to these tests, dynamic longitudinal and lateral stability calculations were performed for comparison with the flight-test results and for use in correlating the model results with STOL handling-qualities criteria. Author

N74-21650*# Kanner (Leo) Associates, Redwood City, Calif.
NEAR FIELD AND FAR FIELD SOUND RADIATION FROM Do 31 V/STOL JET TRANSPORT AND POSSIBILITIES FOR NOISE ABATEMENT IN FUTURE V/STOL DEVELOPMENT
Peter Bartels Washington NASA Apr. 1974 126 p refs Transl. into ENGLISH of "Schallabstrahlung im Nah- und Fernfeld des V/STOL Strahltransporters Do 31 und Laermminderumgsmoeglichkeiten bei Zukuenftigen VSTOL-Entwicklungen", Dornier-Werke G.m.b.H., Friedrichshafen, West Germany, BMVG-FBWT-72-23, 1972 167 p
(Contract NASw-2481)
(NASA-TT-F-15534; BMVg-FBWT-72-23) Avail: NTIS HC $9.50 CSCL 01C

Theoretical and experimental near and far field noise studies on the Do 31 V/STOL jet transport aircraft are presented in updated form. Particular significance is also attached to the reduction in noise which the Do 31 has already made possible at existent airports and the problems of noise and noise abatement associated with present and future V/STOL designs. The V/STOL aircraft's flexibility in the selection of flight procedures allows it to adapt well to local conditions. This is important not only militarily but also in terms of optimum economy and noise abatement. Author

N74-21651*# Scientific Translation Service, Santa Barbara, Calif.
VSTOL AIRCRAFT STABILITY AND CONTROL EXPERIENCE FROM METHODS AND RESULTS OF Do 31 FLIGHT TESTS
H. Wuennenberg Washington NASA Apr. 1974 84 p refs Transl. into ENGLISH of "Stabilitaet und Steuerbarkwit von VSTOL-Flugzuegen nach Verfahren und Ergebnissen aus der Do 31-Flugerprobung", Dornier-Werke G.m.b.H., Friedrichshafen, West Germany, BMVG-FBWT-72-25, 1972 90 p
(Contract NASw-2483)
(NASA-TT-F-15531; BMVg-FBWT-72-25) Avail: NTIS HC $7.25 CSCL 01C

Stability and control of V/STOL aircraft are discussed. Though the V/STOL handling qualities criteria in AGARD-Rep 577 and US-MIL-F-83300 correspond to a certain extent to the flight test results of the Do 31, the MIL Spec. in particular is not applicable to jet lift V/STOL aircraft with attitude stabilization systems. The principles of control and stabilization used for the Do 31 have proved its validity and have even enabled the pilots to perform simulated IFR transitions up to hovering flight. However, for an operational aircraft, improvements to simplify handling and further automation of the landing approach are essentially necessary for all-weather operations. Author

N74-21652*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
COMPARISON OF ACOUSTIC PERFORMANCE OF FIVE MUFFLER CONFIGURATIONS ON A SMALL HELICOPTER
Robert J. Pegg and David A. Hilton Washington May 1974 37 p refs
(NASA-TN-D-7495; L-8990) Avail: NTIS HC $3.25 CSCL 01C

A field noise measurement program has been conducted on a standard Bell 47 series helicopter and on one that had been modified with specially designed, airframe-mounted mufflers to reduce the engine exhaust noise. The purpose of the study was to evaluate the acoustic performance of five experimental exhaust muffler configurations for a helicopter reciprocating engine in an operational environment. All muffler configurations produced beneficial engine exhaust noise reductions but some configurations were markedly better than others. Flyover noise results indicated that maximum overall noise reductions of approximately 8 db were obtained with the various mufflers. The rotor noise was judged to be the dominant noise component for the muffler-equipped helicopters whereas the engine noise was the dominant component for the basic configuration. Author

N74-21653*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EXTRACTION FROM FLIGHT DATA OF LONGITUDINAL AERODYNAMIC COEFFICIENTS FOR F-8 AIRCRAFT WITH SUPERCRITICAL WING
James L. Williams and William T. Suit Washington May 1974 26 p refs
(NASA-TN-D-7470; L-9203) Avail: NTIS HC $3.25 CSCL 01C

The longitudinal aerodynamic derivatives of the F-8 aircraft with supercritical wing were obtained from flight data by a parameter-extraction algorithm at Mach numbers of 0.8, 0.9, and 0.98. A set of derivatives were obtained from which calculated aircraft responses were correlated almost identically with actual flight responses. In general, the trends of the extracted derivatives obtained by the algorithm agreed with those obtained by a Newton-Raphson method and with preliminary data from the Langley 8-foot transonic pressure tunnel. The wind-tunnel damping derivatives were, however, substantially higher than the converged damping derivatives possibly because of Reynolds number differences between flight and model tests. Author

N74-21654*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SENSITIVITY OF TRANSPORT AIRCRAFT PERFORMANCE AND ECONOMICS TO ADVANCED TECHNOLOGY AND CRUISE MACH NUMBER
Mark D. Ardema Feb. 1974 55 p
(NASA-TM-X-62336) Avail: NTIS HC $5.75 CSCL 01C

Sensitivity data for advanced technology transports has been systematically collected. This data has been generated in two separate studies. In the first of these, three nominal, or base point, vehicles designed to cruise at Mach numbers .85, .93, and .98, respectively, were defined. The effects on performance and economics of perturbations to basic parameters in the areas of structures, aerodynamics, and propulsion were then determined. In all cases, aircraft were sized to meet the same payload and range as the nominals. This sensitivity data may be used to assess the relative effects of technology changes. The second study was an assessment of the effect of cruise Mach number. Three families of aircraft were investigated in the Mach number range 0.70 to 0.98: straight wing aircraft from 0.70 to 0.80; sweptwing, non-area ruled aircraft from 0.80 to 0.95; and area ruled aircraft from 0.90 to 0.98. At each Mach number, the values of wing loading, aspect ratio, and bypass ratio which resulted in minimum gross takeoff weight were used. As part of the Mach number study, an assessment of the effect of increased fuel costs was made. Author

N74-21655*# Boeing Commercial Airplane Co., Seattle, Wash.
REDUNDANT ACTUATOR DEVELOPMENT STUDY Final Report
D. R. Ryder Dec. 1973 73 p refs
(Contract NAS2-7653)
(NASA-CR-114730; D6-41511) Avail: NTIS HC $6.75 CSCL 01C

Current and past supersonic transport configurations are reviewed to assess redundancy requirements for future airplane control systems. Secondary actuators used in stability augmentation systems will probably be the most critical actuator application and require the highest level of redundancy. Two methods of actuator redundancy mechanization have been recommended for further study. Math models of the recommended systems have been developed for use in future computer simulations. A long range plan has been formulated for actuator hardware development and testing in conjunction with the NASA Flight Simulator for Advanced Aircraft. Author

N74-21657# National Transportation Safety Board, Washington, D.C.
SPECIAL STUDY: US GENERAL AVIATION ACCIDENTS INVOLVING FUEL STARVATION, 1970 - 1972
11 Apr. 1974 29 p
(NTSB-AAS-74-1) Avail: NTIS HC $4.50

Fuel starvation accidents are analyzed involving 29 selected makes and models of fixed-wing aircraft, which occurred in all operations of U. S. General Aviation from 1970 through 1972.

Of the selected group, 12 aircraft were found to be more, or less, susceptible to fuel starvation than the others. Accidents involving these 12 aircraft were reviewed in detail to define the primary causes of fuel starvation and other associated causal factors. Chronic difficulties and influential factors, found in the accident file review and technical research were discussed with representatives of the Federal Aviation Administration and three manufacturers of general aviation aircraft. From these discussions, remedial measures to reduce the number of fuel starvation accidents were formulated. Author

N74-21658*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SIMULATION OF DECELERATING LANDING APPROACHES ON AN EXTERNALLY BLOWN FLAP STOL TRANSPORT AIRPLANE
William D. Grantham, Luat T. Nguyen, and Perry L. Deal Washington May 1974 50 p refs
(NASA-TN-D-7463; L-9242) Avail: NTIS HC $3.25 CSCL 01C

A fixed-base simulator program was conducted to define the problems and methods for solution associated with performing decelerating landing approaches on a representative STOL transport having a high wing and equipped with an external-flow jet flap in combination with four high-bypass-ratio fan-jet engines. Real-time digital simulation techniques were used. The computer was programed with equations of motion for six degrees of freedom and the aerodynamic inputs were based on measured wind-tunnel data. The pilot's task was to capture the localizer and the glide slope and to maintain them as closely as possible while decelerating from an initial airspeed of 140 knots to a final airspeed of 75 knots, while under IFR conditions. Author

N74-21659*# Developmental Sciences, Inc., City of Industry, Calif. Aerospace Technology Div.
OBLIQUE WING REMOTELY PILOTED RESEARCH AIRCRAFT. VOLUME 1: DEVELOPMENT Final Report
Apr. 1974 144 p Original Contains Color Illustrations
(Contract NAS2-7211)
(NASA-CR-114723) Avail: NTIS HC $10.25 CSCL 01C

The NASA Ames/DSI oblique wing remotely piloted research aircraft is a highly unusual, variable remotely piloted vehicle whose configuration and capabilities are the result of certain initial design guidelines that, in terms of conventional aircraft structures and configurations, would be considered to be contradictory and unachievable. Accordingly, the novel design of the yawed wing RPV is at odds in many respects with conventional aircraft practice. Novelty, then, forms the first, unwritten, design guideline. This design is intended to move away from convention in geometry, structure, and materials. The specific guidelines followed in the design of the yawed wing RPV and a short discussion of the impact of each on the configuration of the vehicle are presented. Author

N74-21660*# Battelle Columbus Labs., Ohio.
EFFECTIVENESS EVALUATION OF STOL TRANSPORT OPERATIONS (PHASE 2) Final Report
David W. Welp, Ronald A. Brown, David G. Ullman, and Mark B. Kuhner 8 Feb. 1974 204 p refs
(Contract NAS2-6889)
(NASA-CR-137481) Avail: NTIS HC $13.25 CSCL 01C

A computer simulation program which models a commercial short-haul aircraft operating in the civil air system was developed. The purpose of the program is to evaluate the effect of a given aircraft avionics capability on the ability of the aircraft to perform on-time carrier operations. The program outputs consist primarily of those quantities which can be used to determine direct operating costs. These include: (1) schedule reliability or delays, (2) repairs/replacements, (3) fuel consumption, and (4) cancellations. More comprehensive models of the terminal area environment were added and a simulation of an existing airline operation was conducted to obtain a form of model verification. The capability of the program to provide comparative results (sensitivity analysis) was then demonstrated by modifying the aircraft avionics capability for additional computer simulations. Author

N74-21661*# California Univ., Davis. Dept. of Mechanical Engineering.
STUDY OF DYNAMICS OF X-14B VTOL AIRCRAFT Final Report, Oct. 1970 - Sep. 1973
W. V. Loscutoff, J. L. Mitchiner, R. A. Roesener, and J. A. Seevers Nov. 1973 253 p refs
(Grant NGR-05-004-051)
(NASA-CR-138185) Avail: NTIS HC $15.75 CSCL 01C

Research was initiated to investigate certain facets of modern control theory and their integration with a digital computer to provide a tractable flight control system for a VTOL aircraft. Since the hover mode is the most demanding phase in the operation of a VTOL aircraft, the research efforts were concentrated in this mode of aircraft operation. Research work on three different aspects of the operation of the X-14B VTOL aircraft is discussed. A general theory for optimal, prespecified, closed-loop control is developed. The ultimate goal was optimal decoupling of the modes of the VTOL aircraft to simplify the pilot's task of handling the aircraft. Modern control theory is used to design deterministic state estimators which provide state variables not measured directly, but which are needed for state variable feedback control. The effect of atmospheric turbulence on the X-14B is investigated. A maximum magnitude gust envelope within which the aircraft could operate stably with the available control power is determined. Author

N74-21663# Technische Univ., Berlin (West Germany). Inst. fuer Luft- und Raumfahrt.
PROBLEMS OF PILOT-AUTOMATIC CONTROL INTERACTIONS IN FLIGHT CONTROL [DAS PROBLEM DES ZUSAMMENWIRKENS VON FLUGZEUGFUEHRER UND REGLER IN DER FLUGFUEHRUNG]
D. Dey and U. Kirchhoff May 1973 134 p refs In GERMAN
(ILR-4-1973) Avail: NTIS HC $9.75

The problems in pilot-controller interaction are discussed from the viewpoints of blind landing automation for CTOL aircraft and stabilization of VTOL aircraft. For the optimization of the task division between pilot and automation, the properties and capabilities of the human being were compared with those of the technical controller. Optimization criteria for the design of a flight control system are requirements of safety, performance, and economy. Based on the complementary properties of the pilot and the automatic system, a strong man-machine integration is proposed, and the model representations of a hierarchical systems structure for systematic design of flight control systems is described. The hierarchy model is applied to the guidance simulation study of a hovering VTOL aircraft. ESRO

N74-21664# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
A NUMERICAL STUDY OF THE EFFECTS OF AIRCRAFT MANOEUVERS ON THE FOCUSING OF SONIC BOOMS
Ronald O. Onyeonwu Jul. 1973 120 p refs
(Grant AF-AFOSR-1885-70; AF Proj. 9783)
(AD-775095; UTIAS-192; AFOSR-74-0181TR) Avail: NTIS CSCL 01/2

The effects of aircraft maneuvers on the focusing of sonic booms are investigated for a model atmosphere which is piecewise linear in wind and sound speeds, and piecewise constant in wind direction. Ray-tube areas and trajectories are obtained in closed form for a real atmosphere with winds and aircraft in arbitrary maneuvers. A mathematical formalism is developed for identifying the focusing ray in general maneuvers, leading to a direct and accurate determination of the caustic surface ground intercept. The algorithms derived in the analysis complement those of Hayes to form the basis for a computer program for predicting sonic boom properties. There appears to be a ten-fold reduction in computing time as compared with the Hayes-Haefeli program. (Modified author abstract) GRA

N74-21665# Honeywell, Inc., Minneapolis, Minn. Systems and Research Center.
F-14 OPTIMUM FLIGHT MODES, VOLUME 1 Final Report, 1 Jul. 1972 - 30 Sep. 1973

D. C. Sederstrom and K. L. Curtner Oct. 1973 121 p refs
(Contract N00014-72-C-0405; NR Proj. 213-098)
(AD-775246) Avail: NTIS CSCL 01/3

An F-14 optimum flight modes study is described. The overall objective of the project was to define an energy management demonstration system which could use the F-14A with its existing computer systems as a flight test vehicle. The work included development of a computer program to determine performance and generate trajectories for various energy management modes. An energy management demonstration system is presented, the computational algorithm is described, and potential performance benefits resulting from the use of an energy management system are discussed. Author (GRA)

N74-21666# Naval Ship Research and Development Center, Bethesda, Md. Aviation and Surface Effects Dept.
CIRCULATION CONTROL: A BIBLIOGRAPHY OF NSRDC RESEARCH AND SELECTED OUTSIDE REFERENCES
Michael B. Stone and Robert J. Englar Jan. 1974 18 p refs
(AD-775284; NSRDC-4108; Aero-1191) Avail: NTIS CSCL 01/1

The report presents a bibliography of technical notes, formal reports, and technical papers by personnel of the Rotary Wing Division of the Aviation and Surface Effects Department, Naval Ship Research and Development Center (NSRDC) from the beginning of calendar year 1969 until the end of fiscal year 1973. The citations are arranged chronologically and represent the technology of circulation control as it has developed at NSRDC. The report also contains appendixes of selected outside references which are pertinent to circulation control. Author (GRA)

N74-21667# Borst (Henry V.) and Associates, Rosemont, Pa.
SUMMARY OF PROPELLER DESIGN PROCEDURES AND DATA. VOLUME 1: AERODYNAMIC DESIGN AND INSTALLATION
Henry V. Borst Nov. 1972 323 p refs
(Contract DAAJ02-72-C-0033; DA Proj. 1G1-62207-AA-72)
(AD-774831; USAAMRDL-TR-73-34A-Vol-1) Avail: NTIS CSCL 01/3

The technology needed for the design and installation of propellers is presented and summarized in three volumes. Volume I (Aerodynamic Design and Installation) contains the basic theory and necessary design procedures for establishing the external geometry and performance of any propeller. The procedures and data which apply for both single and dual rotation propellers are established for the entire range of flight conditions. The performance of propellers operating at off design condition, high values of shaft angle of attack and negative thrust condition is given Author (GRA)

N74-21668# Borst (Henry V.) and Associates, Rosemont, Pa.
SUMMARY OF PROPELLER DESIGN PROCEDURES AND DATA. VOLUME 2: STRUCTURAL ANALYSIS AND BLADE DESIGN Final Technical Report
William Amatt, William E. Bates, and Henry V. Borst Nov. 1973 381 p refs
(Contract DAAJ02-72-C-0033; DA Proj. 1G1-62207-AA-72)
(AD-774836; USAAMRDL-TR-73-34B-Vol-2) Avail: NTIS CSCL 01/3

The technology needed for the design and installation of propellers is presented and summarized in three volumes. Volume 2 (Structural Analysis and Blade Design) contains the theory and data for the detailed structural and vibration analysis of propellers. Included are estimating procedures for initial design purposes; the details for designing solid, hollow, and composite blades; and manufacturing techniques used. Author (GRA)

N74-21669# Naval Coastal Systems Lab., Panama City, Fla.
HELICOPTER TOW TESTS OF THE US COAST GUARD'S AIR DELIVERY CONTAINER FOR OIL SPILL CONTAINMENT BARRIER
John R. Kennedy Dec. 1973 23 p refs
(AD-774898; NCSL-198-73) Avail: NTIS CSCL 13/2

An oil spill barrier with its air delivery packing container was successfully towed by a Navy H-53 tow-equipped helicopter. Flight tow tests were conducted to demonstrate feasibility, develop any required special equipment, and provide data for similar Coast Guard tests. Author (GRA)

N74-21670# Speas (R. Dixon) Associates, Manhasset, N.Y.
AIRLINE INDUSTRY FINANCIAL ANALYSIS WITH RESPECT TO AIRCRAFT NOISE RETROFIT PROGRAMS 1972-1978 Final Report, Aug. - Dec. 1972
Leroy Simpson, Robert C. Knowles, and Jack B. Feir Jan. 1973 69 p refs
(Contract DOT-OS-20088)
(PB-226586/6GA; POT-OST-ONA-73-1) Avail: NTIS HC $3.50 CSCL 01C

An examination was made of the factors related to the financing of capital investments that would be required by the principal U.S. airlines to purchase and to install proposed noise reducing retrofit hardware on their JT-3D and/or JT-8D engined aircraft. The study indentified the number of such turbofan aircraft expected to be retrofit, the range of capital costs for three alternative retrofit programs, the relationship of such costs to total future airline financing requirements, and the variation of retrofit cost impact among carriers in the U.S. airline industry. The cost impact of retrofit was analyzed in relation to a forecast of the principal U.S. carriers' total future financing requirements for flight and ground equipment. Total future financing requirements were analyzed in detail for four selected airlines.
Author (GRA)

N74-21671# Boeing Vertol Co., Philadelphia, Pa.
TAIL ROTOR DESIGN GUIDE Final Report, Nov. 1972 - Aug. 1973
Wayne Wiesner and Gary Kohler Jan. 1974 254 p refs
(Contract DAAJ02-73-C-0010; DA Proj. 1F1-62204-AA-43)
(AD-775391; D210-10687-1; USAAMRDL-TR-73-99) Avail: NTIS CSCL 01/3

The report presents general guidelines for the preliminary design of tail rotors for single-rotor helicopters in low-speed and hover flight. Application of these guidelines should alleviate the directional control problems of single-rotor helicopters under certain conditions of wind speed and direction, height above the ground, gross weight, and altitude. The main data base used to develop the guidelines is the results of a wind tunnel test of a tail rotor helicopter model conducted by Boeing. These tests were conducted in and out of ground effect, in various wind speeds to 35 knots, and with varying wind azimuths. (Modified author abstract) GRA

N74-21672# Army Aviation Systems Command, St. Louis, Mo.
MAJOR ITEM SPECIAL STUDY (MISS), CH-47A HYDRAULIC SERVOCYLINDER Interim Report, 1 Jan. 1964 - 1 Jul. 1973
Feb. 1974 22 p refs
(AD-775449; USAAVSCOM-TR-74-10) Avail: NTIS CSCL 01/3

Major Item Special Study (MISS) reports are performed on DA Form 2410 reportable components. These are time change in items and certain condition change items selected because of high cost or need for intensive management. Basically, the MISS reports are concerned with analyzing reported removal data presented in the Major Item Removal Frequency report. The failure modes reported for each removal are examined and grouped into categories which are intended to clarify the intent of the data reporting. From the data, removal distributions can be plotted and an MTR (mean time to removal) can be calculated. The MISS reports then investigate possible cost savings based on total elimination of selected failure modes. These modes are chosen because of the percentage of failures they represent and/or because they appear to be feasible Product Improvement Program areas. Author (GRA)

N74-21673# McDonnell Aircraft Co., St. Louis, Mo.
AIR-TO-AIR FIRE CONTROL EXPOSITION, PHASE 3 (EXPO 3) Final Report, May 1972 - Jan. 1973
Robert L. Berg and Michael M. Sears Sep. 1973 117 p refs
(Contract F33615-72-C-2046; AF Proj. 69DF)

(AD-775360; AFAL-TR-73-287) Avail: NTIS CSCL 19/5

The Air-to-Air Fire Control Exposition (EXPO) Program, which has as its goal investigate fire control system concepts for use in advanced fighter aircraft, was continued as a Phase 3 effort. The objectives of this follow-on phase were to model and program combined fire control system approaches (which included that of an associated participant) to the air-to-air gunnery problem, model and implement degraded sensor inputs to the fire control system models, provide capability for investigation of high velocity ammunition, and to define a test plan for a flight simulator optimization and evaluation of the fire control systems in a subsequent program phase. (Modified author abstract) GRA

N74-21847# Battelle Columbus Labs., Ohio.
APPLICATION OF INTERACTIVE GRAPHICS TO THE AVIONICS EVALUATION PROGRAM Technical Report, 15 Jan. - 29 Jun. 1973
David W. Welp, Ronald A. Brown, Jerry L. Pittenger, and David A. Nippert Nov. 1973 62 p
(Contract F33615-72-C-2081; AF Proj. 6091)
(AD-775372; AFAL-TR-73-270) Avail: NTIS CSCL 09/2

A computer program for simulation and effectiveness evaluation of avionics for military aircraft has been developed and expanded for the purpose of providing the Avionics Laboratory with the capability of executing the Avionics Evaluation Program (AEP) via interactive graphics and to adapt the program for use on the Avionics Laboratory computer. The AEP is a very large computer program with extensive multidiscipline input data. There was a very clear need to provide an easier means of executing the program, storing potential input data, and graphically presenting results. During the contract extension Battelle's Columbus Laboratories have (1) procured interactive graphics equipment, (2) developed interactive software, (3) procured additional equipment for the Air Force Avionics Laboratory PDP 11 computer to support the interactive capability, and (4) made additional modifications to the AEP to enhance its capability and to make it compatible with the PDP 11 computer. This report presents a description of the resultant effort. GRA

N74-21902# Naval Air Development Center, Warminster, Pa. Air Vehicle Technology Dept.
HOOK BOUNCE TEST OF THE C-2A AIRPLANE ARRESTING GEAR A FRAME Final Report
R. B. Cadman 1 May 1973 15 p refs Revised
(AD-774085; NADC-72217-VT-Rev-A) Avail: NTIS CSCL 01/2

A laboratory hook bounce test was performed on a C-2A arresting gear A frame to determine whether the A frame could sustain the effects of 3000 arrested landings. A total of 6000 simulated hook bounce cycles were applied to the A frame during the test with no structural failures. With a test scatter factor of two, the 6000 test cycles are equivalent to 3000 service arrested landings. Author (GRA)

N74-21903# Naval Air Development Center, Warminster, Pa. Air Vehicle Technology Dept.
HOOK BOUNCE TEST OF THE E-2A AIRPLANE ARRESTING GEAR A FRAME Final Report
Robert B. Cadman 15 Dec. 1973 16 p refs Revised
(AD-774086; NADC-72218-VT-Rev-A) Avail: NTIS CSCL 01/5

A laboratory hook bounce test was performed on an E-2A arresting gear A frame to determine whether the A frame could sustain the effects of 3,000 arrested landings. A total of 6,000 simulated hook bounce cycles were applied to the A frame during the test with no structural failures. With a test scatter factor of 2, the 6,000 test cycles are equivalent to 3,000 service arrested landings. Author (GRA)

N74-21904# Air Force Weapons Lab., Kirtland AFB, N.Mex.
EVALUATION OF RUNWAY SKID-RESISTANCE CHARACTERISTICS AT MINOT AIR FORCE BASE, NORTH DAKOTA Final Report, 1 Nov. 1972 - 30 Jun. 1973
George D. Ballentine and Phil V. Compton Jan. 1974 35 p
(AF Proj. 683M)
(AD-773403; AFWL-TR-73-241) Avail: NTIS CSCL 01/5

Data gathered during the Air Force Weapons Laboratory (AFWL) standard skid-resistance test conducted at Minot AFB, North Dakota, on 18 and 19 October 1972, are analyzed. The test results indicate the runway surface had good to fair skid-resistance properties and no corrective action was indicated at the time of the test. Author (GRA)

N74-21910# Air Force Weapons Lab., Kirtland AFB, N.Mex.
C-130 LANDING ON XM-18B LANDING MAT, OAK GROVE AUXILIARY AIR FIELD, NORTH CAROLINA Final Report, Feb. - May 1973
H. R. Marien Feb. 1974 70 p refs
(AF Proj. 683M)
(AD-775365; AFWL-TR-73-254) Avail: NTIS CSCL 01/5

During March and April 1973, a large number of C-130 aircraft operations were conducted on an XM-18B landing-mat runway at Oak Grove Auxiliary Air Field, North Carolina. Detailed measurements were made to determine the lateral and longitudinal movement of the mat at the conclusion of each day's operations. The methods used to make these measurements, the data collected, an analysis of the data and recommendations for future efforts to measure landing-mat movement are presented. Although there were no landing-mat failures at Oak Grove AAF, the 60-by-3500-foot runway did move as much as 13 inches. Transverse bowing, vertical movement, and random lateral shifting were observed and documented. Author (GRA)

N74-22138*# Kanner (Leo) Associates, Redwood City, Calif.
DIFFUSION WELDING IN AVIATION TECHNOLOGY
Klodbimierz Karlinski Washington NASA Apr. 1974 14 p refs Transl. into ENGLISH from Tech. Lotnicza Astronaut. (Warsaw), v. 27, Jul. 1973 p 25-28
(Contract NASw-2481)
(NASA-TT-F-15568) Avail: NTIS HC $4.00 CSCL 13H

Diffusion welding of special heat-resistant alloys for aerospace applications is described in terms of the main process parameters, the required equipment, and the properties of bonds made between various materials. Attention is given to surface cleaning requirements, vacuum and temperature levels used in the process, and the compression of the welded surfaces. Tabulated mechanical properties characterize bonds obtained between steels, heat-resistant alloys, and titanium alloys. Author

N74-22558# Army Missile Command, Redstone Arsenal, Ala.
VIBRATION ABSORBERS FOR ROCKET LAUNCHERS MOUNTED ON HELICOPTERS: ANALYTICAL ANALYSIS AND IMPLEMENTATION TECHNIQUES
C. D. Johnson 2 Jan. 1974 87 p refs
(DA Proj. 1M3-62303-A-214)
(AD-774845; RL-TR-74-1) Avail: NTIS CSCL 19/7

An analytical analysis of the dynamical behavior of the tuned-mass vibration absorber is presented, and the notion of optimum damping is introduced. Computational techniques for calculating optimum damping coefficients are developed and three representative numerical examples are solved. A nonlinear servo-control system is designed to achieve inflight automatic tuning of the tuned-mass absorber in the face of varying helicopter rotor speeds. The practical aspects of implementing active vibration absorbers are studied and some specific circuits and hardware schemes are proposed. A spring-linkage (parallelogram) mount, a cantilever-wing tuned-mass absorber, and an active absorber are designed for implementation and testing on a full scale mock-up of a Cobra helicopter wing. (Modified author abstract) GRA

N74-22597# RAND Corp., Santa Monica, Calif.
PROBLEMS IN AVIONICS LIFE-CYCLE ANALYSIS
Marco R. Fiorello Dec. 1973 19 p refs Presented at 320 Mil. Operations Symp., 14-16 Nov. 1973
(P-5136) Avail: NTIS HC $4.00

The life-cycle costs of new generation avionics subsystems in contemporary weapon systems are discussed. These new avionics have high procurement costs, higher support costs and even appear to dominate the weapon system maintenance costs. This report is concerned with the difficulties that characterize contemporary avionics life-cycle analysis. The uncertainty

associated with estimating avionics life-cycle costs is related to the life-cycle stages of weapon systems. Specifically, the following areas are reviewed: (1) current avionics industry costing methods, (2) uncertainty in life-cycle cost modeling and estimating, (3) military cost data availability versus requirements, and (4) military institutional disincentives. Various recommendations are made to improve avionics life-cycle analysis. Author

N74-22631*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXTERNALLY BLOWN FLAP NOISE RESEARCH
Robert G. Dorsch 1974 44 p refs Presented at the Natl. Air Transportation Meeting, Dallas, 30 Apr. - 2 May 1974; sponsored by SAE
(NASA-TM-X-71541; E-7948) Avail: NTIS HC $5.25 CSCL 01C

The Lewis Research Center cold-flow model externally blown flap (EBF) noise research test program is summarized. Both engine under-the-wing and over-the-wing EBF wing section configurations were studied. Ten large scale and nineteen small scale EBF models were tested. A limited number of forward airspeed effect and flap noise suppression tests were also run. The key results and conclusions drawn from the flap noise tests are summarized and discussed. Author

N74-22632# Comptroller General of the United States, Washington, D.C.
PROBLEMS IN MANAGING THE DEVELOPMENT OF AIRCRAFT ENGINES, DEPARTMENT OF DEFENSE
[1973] 37 p refs
(B-179166) Avail: NTIS MF $1.45; US General Accounting Office, Room 4522, 441 G Street, N. W., Washington, D. C. 20548 HC $1.00

A study was made of the contractural and procurement procedures followed by the Department of Defense in obtaining aircraft engines. The management of the development and modification activities is analyzed. Deficiencies in the present system are reported and recomendations are made for an improved procedure. Author

N74-22637*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A FLIGHT INVESTIGATION OF THE STOL CHARACTERISTICS OF AN AUGMENTED JET FLAP STOL RESEARCH AIRCRAFT
Hervey C. Quigley, Robert C. Innis, and Seth Grossmith (Min. of Transport, Canada) May 1974 143 p refs
(NASA-TM-X-62334; A-5418) Avail: NTIS HC $10.25 CSCL 01C

The flight test program objectives are: (1) To determine the in-flight aerodynamic, performance, and handling qualities of a jet STOL aircraft incorporating the augmented jet flap concept; (2) to compare the results obtained in flight with characteristics predicted from wind tunnel and simulator test results; (3) to contribute to the development of criteria for design and operation of jet STOL transport aircraft; and (4) to provide a jet STOL transport aircraft for STOL systems research and development. Results obtained during the first 8 months of proof-of-concept flight testing of the aircraft in STOL configurations are reported. Included are a brief description of the aircraft, fan-jet engines, and systems; a discussion of the aerodynamic, stability and control, and STOL performance; and pilot opinion of the handling qualities and operational characteristics. Author

N74-22640# Advisory Group for Aerospace Research and Development, Paris (France).
NOISE MECHANISMS
Mar. 1974 345 p refs Mostly in ENGLISH; partly in FRENCH Presented at Fluid Dyn. Panel Specialists Meeting, Brussels, Belgium, 19-21 Sep. 1973
(AGARD-CP-131) Avail: NTIS HC $20.25

Emphasis of the conference was on the fundamental problems of noise generation and attenuation. Main aspects considered were noise generation and damping, combustion and jet noise, sonic boom theory, and noise due to boundary and shear layer effects.

N74-22643 Cambridge Univ. (England). Engineering Lab.
IMPULSIVE SOURCES OF AERODYNAMIC SOUND: ORAL SCRIPT OF THE INTRODUCTORY REVIEW LECTURE
John E. Efowcs Williams *In* AGARD Noise Mech. Mar. 1974 24 p (For availability see N74-22640 14-02)

The sources of aircraft noise due to rapid acceleration of large bodies is discussed. Work by Lighthill and other investigators is reviewed and a discussion is given to explain the origin of occassional violent pressure transients observed in the noise field of high velocity jets. A.L.

N74-22650* California Univ., Los Angeles. School of Engineering and Applied Science.
USE OF CROSS-CORRELATION MEASUREMENTS TO INVESTIGATE NOISE GENERATING REGIONS OF A REAL JET ENGINE AND A MODEL JET
W. C. Meecham and P. M. Hurdle *In* AGARD Noise Mech. Mar. 1974 13 p refs Sponsored by NASA

CSCL 20A

Cross-correlations are reported of the jet static pressure fluctuations (as measured with a B and K microphone fitted with a nose cone), with the far-field radiated sound pressure. These measurements were made for various probe positions and a large number of far-field positions (at various angles). In addition, the tests were run for a number of different jet exit velocities. The measured, normalized cross-correlation functions vary between 0.004 and 0.155. These values depend upon the angular position of the far-field microphone, the jet exit Mach number, and the position of the probe. In addition, the cross-correlation technique was employed to study the symmetry of the far-field radiated sound about the jet axis. Third-octave analyses of both the probe signal and the far-field radiated sound were made. This is the first time correlation measurements have been made on a jet engine. In addition, a report is given on an extensive noise survey of a model jet. The correlations are related to sound source functions and jet source regions are discussed. Author

N74-22655 Southampton Univ. (England). Dept. of Aeronautics and Astronautics.
ON THE NOISE FROM JETS
G. M. Lilley *In* AGARD Noise Mech. Mar. 1974 12 p refs

A modification of Lighthill's theory is discussed in which pressure disturbances in the jet are treated as an inner flow problem which is matched to the outer flow radiation problem. In this treatment the source function involves quadratic and higher order small disturbance terms. This approach, although more complicated mathematically than the exact theory of Lighthill, has the advantage that it draws attention directly to the role played by the mean velocity and temperature distributions on the generation and propagation of the emitted sound. The model in its simplest form can be reduced to a vortex sheet model and thus draws attention to the stability characteristics of the vortex sheet. In the more general treatment the stability characteristics of the mixing region are considered and its least stable modes are regarded as dominating the large-scale eddy motion. The linear stability theory is extended to deal with non linearities and, as a result, the amplitude of the larger-scale motion is determined. This is compared with the measured large-scale structure of the jet. From this model the main characteristics of the source function are found. The paper concludes with some results from this new formulation and a comparison is made with experimental findings. Author

N74-22663 University of Southern Calif., Los Angeles. Dept. of Aerospace Engineering.
ON THE GENERATION OF JET NOISE
J. Laufer, R. E. Kaplan, and W. T. Chu *In* AGARD Noise Mech. Mar. 1974 8 p refs

(Grant DOT-OS-00002)

It is proposed that the rate of subharmonic production, that is, the rate at which large scale vortex-ring like structures interact with each other, is the primary mechanism responsible for most

of the noise generation of a subsonic jet. The interaction consists of simultaneous acceleration and deceleration of vorticity containing coherently moving regions followed by a pairing process. This picture is consistent with Lighthill's quadrupole like sources, as well as with the formulation of Powell's vortex sound theory. It is suggested that more direct experiments are necessary to examine the validity of the above proposition.
Author

N74-22668* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
CURRENT STRUCTURAL VIBRATION PROBLEMS ASSOCIATED WITH NOISE
John S. Mixson *In* AGARD Noise Mech. Mar. 1974 16 p refs

As the performance of aerospace vehicles has increased, the noise generated by the propulsion system and by the passage of the vehicle through the air has also increased. Further increases in performance are now underway for space vehicles such as the space shuttle vehicle and for short distance takeoff and landing (STOL) aircraft, and are being planned for supersonic aircraft. The flight profiles and design features of these high-performance vehicles are reviewed and an estimate made of selected noise-induced structural vibration problems. Considerations for the prevention of acoustic fatigue, noise transmission, and electronic instrument malfunction are discussed. Author

N74-22671*# Systems Technology, Inc., Hawthorne, Calif.
ANALYSIS AND MOVING BASE SIMULATION OF TRANSITION CONFIGURATION MANAGEMENT ASPECTS OF A POWERED LIFT AIRCRAFT
Walter A. Johnson, Samuel J. Craig, and Irving L. Ashkenas Dec. 1973 59 p refs
(Contract NAS2-6441)
(NASA-CR-114698; STI-TR-1015-2) Avail: NTIS HC $6.00 CSCL 01C

A study aimed at the implementation of a configuration management flight control system is reported. The system is designed to take the guesswork out of, and improve the operational safety of, transition flight in the region from cruise to STOL. Potential improvements in the trim configuration management aspects of the transition process are described. D.L.G.

N74-22672# Cranfield Inst. of Technology (England). Coll. of Aeronautics.
THE WEIGHT, ECONOMIC AND NOISE PENALTIES OF SHORT HAUL TRANSPORT AIRCRAFT RESULTING FROM THE REDUCTION OF BALANCED FIELD LENGTH
D. Howe Jan. 1974 39 p refs
(Cranfield-Aero-24) Avail: NTIS HC $5.00

Design studies of short haul transport aircraft in reduced takeoff and landing, short takeoff and landing, and vertical takeoff and landing categories are analyzed to establish their respective performance penalties relative to the conventional landing and takeoff types of aircraft. The main criteria used for comparison are weight, direct operating costs, and 80 PNdb noise footprint areas. Some consideration is also given to low speed control characteristics. The basis of all the designs was a requirement to carry 108 passengers over a range of 600 nautical miles plus reserves.
Author

N74-22673# National Aerospace Lab., Tokyo (Japan).
DYNAMIC RESPONSES OF THE STRUCTURAL MODEL WITH BUILT-UP WINGS AND A FUSELAGE (1)
Taketoshi Hanawa and Keiji Komatsu Dec. 1973 46 p refs In JAPANESE; ENGLISH summary
(NAL-TR-350) Avail: NTIS HC $5.50

The application of an analytical method to the analysis of the dynamic responses of a structural model which consists of the built-up wings and fuselage which is unrestrained or cantilevered at the rear end of the fuselage, and has been subjected to an external force with the form of a half-sine wave in time variation. The approximate natural vibration modes are calculated by the analysis of Rayleigh-Ritz procedure and have the characteristic of mathematical orthogonality between these modes. It is concluded that this method can be used to obtain the approximate responses at the beginning of the structural design when it is subjected to gust loads in flight or in the wind tunnel.
Author

N74-22676*# Systems Technology, Inc., Hawthorne, Calif.
ANALYTICAL DESIGN AND SIMULATION EVALUATION OF AN APPROACH FLIGHT DIRECTOR SYSTEM FOR A JET STOL AIRCRAFT
Richard H. Klein, Lee Gregor Hofmann, and Duane T. McRuer Jan. 1974 100 p refs
(Contract NAS2-6441)
(NASA-CR-114697; STI-TR-1015-1) Avail: NTIS HC $8.00 CSCL 01C

A program was undertaken to develop design criteria and operational procedures for STOL transport aircraft. As part of that program, a series of flight tests shall be performed in an Augmentor Wing Jet,STOL Aircraft. In preparation for the flight test programs, an analytical study was conducted to gain an understanding of the characteristics of the vehicle for manual control, to assess the relative merits of the variety of manual control techniques available with attitude and thrust vector controllers, and to determine what improvements can be made over manual control of the bare airframe by providing the pilot with suitable command guidance information and by augmentation of the bare airframe dynamics. The objective of the study is to apply closed-loop pilot/vehicle analysis techniques to the analysis of manual flight control of powered-lift STOL aircraft in the landing approach and to the design and experimental verification of an advanced flight director display. Author

N74-22684# Ecole Nationale d'Ingenieurs de Constructions Aeronautiques, Toulouse (France). Div. Automatique 2.
STUDY AND STABILIZATION OF LATERAL MOTION OF MODERN TRANSPORT AIRCRAFT [ETUDE ET STABILISATION DES MOUVEMENTS LATERAUX D'UN AVION DE TRANSPORT MODERNE]
Gerard Guillot and Jean Pierre Passani 1973 119 p refs In FRENCH
Avail: NTIS HC $9.00

A study for the stabilization of lateral motion in heavy passenger transport aircraft is presented. The stabilization can be achieved by the use of a yaw damping device. The natural lateral movements of the aircraft are discussed theoretically. Flight mechanics differential equations were established and linearized. Theoretical determination of the yaw damper was performed. A numerical study of the differential equation system is detailed while the case of jet engine power loss is treated on an analog computer. The yaw damper electronic circuit is presented. Its properties were checked with the help of an analog computer in six cases of typical flight conditions. The problems of matching the damper to the aircraft are discussed in terms of input signal demodulation, input/output impedance matching, and system reliability.
ESRO

N74-22688# Army Aviation Systems Test Activity, Edwards AFB, Calif.
HELICOPTER ICING SPRAY SYSTEM QUALIFICATION Final Report, 13 Apr. - 5 Jul. 1973
James S. Hayden, Edward E. Bailes, Joseph C. Watts, and Larry K. Brewer Oct. 1973 90 p refs
(AD-775803) Avail: NTIS CSCL 01/2

The United States Army Aviation Systems Test Activity conducted an engineering evaluation of the CH-47C helicopter incorporating the icing spray system designed and built by a contractor. The evaluation was conducted during the period 13 April through 5 July 1973 at Edwards Air Force Base, California. The evaluation consisted of handling qualities and water droplet size and distribution calibrations, and involved 38 test flights totaling 27.5 productive flight hours. The CH-47C icing spray system handling qualities were evaluated in the long boom configuration and an attempt was made at evaluation in the short boom configuration. (Modified author abstract) GRA

N74-22689# Army Engineer Waterways Experiment Station, Vicksburg, Miss.
PREDICTION OF AIRCRAFT GROUND PERFORMANCE BY

EVALUATION OF GROUND VEHICLE RUT DEPTHS Final Report, Jan. - Jul. 1973
G. W. Turnage and D. N. Brown Feb. 1974 125 p refs
(AF Proj. 683M)
(AD-775744; AFWL-TR-73-213) Avail: NTIS CSCL 01/3

Two single aircraft tires (20-20, 22-PR and 49-17, 26-PR) and three standard military trucks were tested under towed (nonpowered, nonbraked) and self-powered conditions, respectively, in buckshot clay test beds whose strengths ranged from about 110 to 600 cone index. Tests included multiple passes over the prepared test beds (usually 100 passes for the aircraft tires, 10 for the trucks) at low speeds. Only single-wheel configurations were examined (i.e., outer second- and third-axle wheels of the M35A2 and M51 were removed). Curves were developed to allow soil strength (airfield index) to be estimated directly from the rut produced by single or multiple passes of any of the three trucks. These curves were developed through use of a dimensionless prediction term (tire-clay numeric Nc) that allows pneumatic tire performance to be scaled over a wide range of soil strengths, wheel loads, and tire size, shape, and deflection conditions. (Modified author abstract) GRA

N74-22690# Summa Corp., Culver City, Calif. Hughes Helicopters Div.
OH-6A DESIGN AND OPERATIONAL FLIGHT LOADS STUDY Final Report
R. Boocock, L. L. Erle, J. F. Needham, G. D. Roeck, and H. G. Smith Jan. 1974 103 p refs
(Contract DAAJ02-72-C-0061; DA Proj. 1F1-62204-AA-82)
(AD-775832; HH-73-14; USAAMRDL-TR-73-21) Avail: NTIS CSCL 01/1

An analysis and correlation of OH-6A helicopter engineering design values and actual operational values recorded in Southeast Asia is presented. The operational data are based on USAAMRDL Technical Report 71-60, Flight Loads Investigation of OH-6A Helicopters Operating in Southeast Asia. The parameters involved include mission profiles, rotor drive system, and main and tail rotor fatigue load spectra, damage rates, and service lives. Recommendations are made for additions and changes to improve the structural design criteria for future Army observation helicopters. Author (GRA)

N74-22697# Technology, Inc., Dayton, Ohio.
HELICOPTER DRIVE SYSTEM LOAD ANALYSIS Final Report
Raymond B. Johnson, Jr. and Terry L. Cox Jan. 1974 68 p refs
(Contract DAAJ02-73-C-0012; DA Proj. 1G1-62204-AA-72)
(AD-775858; USAAMRDL-TR-73-105) Avail: NTIS CSCL 01/3

To study the overtorque conditions of three Army helicopter types - the AH-1G, UH-1H, and OH-6A - and the potential effect of such conditions on the maintenance procedures and design criteria for these helicopters was the prime objective of the reported research. To this end, approximately 755 hours of previously documented multichannel oscillogram data, recorded under combat conditions in the Vietnam theater, were reprocessed and reanalyzed to investigate the extent and significance of engine and transmission operations that exceeded specific torque pressure limits for each helicopter type. (Modified author abstract) GRA

N74-22700# Bell Helicopter Co., Fort Worth, Tex.
AH-1G DESIGN AND OPERATIONAL FLIGHT LOADS STUDY Final Report
Max E. Glass, David L. Kidd, and John P. Norvell Jan. 1974 100 p refs
(Contract DAAJ02-72-C-0099; DA Proj. 1F1-62204-A-170)
(AD-775838; BHC-209-099-371; USAAMRDL-TR-73-41) Avail: NTIS CSCL 01/1

The report compares AH-1G helicopter Southeast Asian mission profiles with the original engineering frequency-of-occurrence spectrum and the Navy AR-56 spectrum for attack helicopters. Fatigue lives calculated using the Southeast Asian profile are compared with those determined using the original frequency-of-occurrence spectrum. The development cycle of the Bell Helicopter Company Model 540 rotor system is reviewed, and the fatigue design methods used are presented. Maximum one-time occurrences measured in the Southeast Asian operational survey are compared with those specified in the AH-1G structural design criteria and those measured in structural demonstration flight tests. Recommendations are made regarding future mission surveys, the structural surveys, the structural design criteria for attack helicopters, and the upgrading of rotor loads prediction capability. Author (GRA)

N74-22701# Army Air Mobility Research and Development Lab., Fort Eustis, Va.
DEVELOPMENT OF MANUFACTURING METHODS FOR BALLISTICALLY TOLERANT FIBERGLASS TUBULAR BELLCRANKS
I. E. Figge, Sr. Jan. 1974 35 p refs
(AD-775818; USAAMRDL-TM-73-105) Avail: NTIS CSCL 01/3

The purpose of this investigation was to develop manufacturing methods for the ballistically tolerant tubular/sandwich CH-47 forward bellcrank with the goals of optimizing production costs and weight, while achieving structural repeatability. Complete fabrication details are presented. Ballistic, fatigue, and static tests, conducted at -65F, 75F, and 180F, showed that the bellcrank met the design requirements. The manufacturing techniques developed resulted in both substantial weight savings (1.65 pounds compared to 3.4 pounds for a metal bellcrank) and cost savings ($68.60 compared to $135.00). A slotting technique that localized the ballistic damage on the exit face sheet and prevented gross delaminations was developed. Author (GRA)

N74-22837# Army Aviation Systems Test Activity, Edwards AFB, Calif.
EVALUATION OF THE TELEDYNE RYAN MODEL 622 TERRAIN-FOLLOWING RADAR SYSTEM INSTALLED ON OH-58A HELICOPTER Final Report, 6 Apr. - 15 Aug. 1973
Carl F. Mittag Nov. 1973 55 p refs
(AD-775806; USAASTA-73-02) Avail: NTIS CSCL 17/9

The objectives of the evaluation were to generate data to substantiate a terrain following radar (TFR) safety-of-flight release for further operational testing and to determine to what extent the TFR system aids the pilot during low-level flying. GRA

N74-23342*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
REDUCTION OF JT8D POWERED AIRCRAFT NOISE BY ENGINE REFANNING
L. E. Stitt and A. A. Medeiros 1974 26 p refs Presented at the Air Transport Meeting, Dallas, 30 Apr. - 2 May 1974, sponsored by SAE
(NASA-TM-X-71536; E-7942) Avail: NTIS HC $4.50 CSCL 21E

The technical feasibility is described of substantially reducing the noise levels of existing JT8D powered aircraft by retrofitting the existing fleet with quieter refan engines and new acoustically treated nacelles. No major technical problems exist that preclude the development and installation of refanned engines on aircraft currently powered by the JT8D engine. The refan concept is technically feasible and provides calculated noise reductions of from 7 to 8 EPNdb for the B727-200 aircraft and from 10 to 12 EPNdb for the DC-9-32 aircraft at the FAR Part 36 measuring stations. These noise levels are lower than both the FAR Part 36 noise standards and the noise levels of the wide-body DC-10-10. Corresponding reductions in the 90 EPNdb footprint area are estimated to vary from about 70 percent for the DC-9 to about 80 percent for the B727. Author

N74-23413# Advisory Group for Aerospace Research and Development, Paris (France).
FRACTURE MECHANICS OF AIRCRAFT STRUCTURES
Harold Liebowitz, ed. (George Washington Univ.) Jan. 1974 624 p refs
(AGARD-AG-176; AGARDograph-176) Avail: NTIS HC $34.25

The proceedings of a conference on the structural analysis

of airframes and aircraft components are presented. The subjects discussed include the following: (1) history of aircraft loading and examples of aircraft failure, (2) application of fracture mechanics principles in the design and analysis of damage tolerant aircraft structures, (3) fail safe design procedures, (4) experimental techniques for determining fracture toughness, and (5) flaw detection methods.

N74-23414 Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
SPECTRUM OF LOADING OF AIRCRAFT
Howard A. Wood *In* AGARD Fracture Mechanics of Aircraft Structures Jan. 1974 p 3-7 refs

A summary of airframe service loadings and experience is presented. The areas of concern are: (1) the structural environment, (2) the operational environment, (3) the internal airframe environment, and (4) frequency of occurrence and significance of airframe loadings. Diagrams are presented for typical load profile for tactical aircraft on a conventional delivery mission and the flight-profile for a transport aircraft wing root. Author

N74-23415 Royal Aircraft Establishment, Farnborough (England).
EXAMPLES OF AIRCRAFT FAILURE
W. T. Kirkby *In* AGARD Fracture Mechanics of Aircraft Structures Jan. 1974 p 8-13

Examples of structural failure of aircraft components are presented to show the importance of structural design and reliability engineering. Photographs of typical aircraft components are provided to show the type of failure and the degree of impairment. The examples include the following: (1) pressure cabin skin cracking, (2) landing gear door uplock failure, (3) rotor blade extrusion cracking, (4) wheel casting failure, and (5) typical defects in spar booms. Author

N74-23428 Douglas Aircraft Co., Inc., Long Beach, Calif.
THE APPLICATION OF FRACTURE MECHANICS IN THE DEVELOPMENT OF THE DC-10 FUSELAGE
T. Swift *In* AGARD Fracture Mechanics of Aircraft Structures Jan. 1974 p 226-287 refs

The degree of damage tolerance used in the design of the DC-10 fuselage pressure shell is discussed with reasons for its selection. Analysis methods are presented for the prediction of the residual strength of damaged, stiffened panels, based on the Matrix Force solution of an idealized structure combined with fracture mechanics equations. The effects of attachment flexibility, which play an important part in the residual strength of damaged structure, are accounted for. Crack growth retardation due to the plastic zone formed on high load cycles and its effect on propagation under spectrum loading is discussed. It is shown that the stress intensity at the threshold of slow stable growth is not only a material property but depends almost entirely on past load history. A description of the development test program to verify the analytical techniques and to substantiate the fail-safe strength of the fuselage shell is given together with the results of many of the tests. Author

N74-23443 Army Materials and Mechanics Research Center, Watertown, Mass.
TYPICAL PLANE STRAIN FRACTURE TOUGHNESS OF AIRCRAFT MATERIALS
W. T. Matthews *In* AGARD Fracture Mechanics of Aircraft Structure Jan. 1974 p 509-579 refs

The fracture toughness values of aircraft metals are expressed in terms of linear elastic fracture mechanics. The general tabulation includes only values measured under plane strain conditions. These plane strain K sub IC values have been obtained by the ASTM E399-72 Standard Method of Test for Plane Strain Fracture Toughness Testing of Metallic Material or a similar method. This data compilation includes materials manufactured in the U.S.A. and Europe. Factors involved in the selection and interpretation of the K sub IC values will be discussed in the latter sections of this introduction. Author

N74-23483# National Research Council of Canada, Ottawa (Ontario).
QUARTERLY BULLETIN OF THE DIVISION OF MECHANICAL ENGINEERING AND THE NATIONAL AERONAUTICAL ESTABLISHMENT, 1 JANUARY - 31 MARCH 1974
31 Mar. 1974 96 p refs
(DME/NAE-1974(1)) Avail: NTIS HC $8.00

Mechanical engineering projects on hydrodynamic code approximation, programming flying spot scanner/analyzer, and modifying Bell helicopters to serve as airborne simulators for STOL and V/STOL aircraft are sumarized.

N74-23491# Laboratorium fuer Betriebsfestigkeit, Darmstadt (West Germany).
RESEARCH REPORTS FROM THE INSTITUTE FOR SERVICE RELIABILITY, ISSUE 6 [INSTITUTS VEROEFFENTLICHUNGEN HEFT 6]
Oct. 1973 218 p refs In GEORGIAN
Avail: NTIS HC $14.00

Activities at the laboratory centered on stress testing of welded joints, life estimates for fatigued structures, flight load analysis, acceleration loads on airplane tails, mission profiles for transport aircraft, environmental stress simulation for materials, vehicle wheel evaluation, statistical stress-strain-time analysis, fatigue life tests on construction components, and measurement methods for wheel spokes and rims. G.G.

N74-23500# Advisory Group for Aerospace Research and Development, Paris (France).
HIGHLIGHTS, SPRING 1973
1973 32 p
Avail: NTIS HC $4.75

Short articles on the progress and activities of AGARD panels are presented. Panels are included in the areas of avionics, electromagnetic wave propagation, flight mechanics, and structures and materials. A summary of the work completed on the new AGARD multilingual aeronautical dictionary is included, along with a description of the plans for the publication of the collected works of Theodore Von Karman. K.M.M.

N74-23509*# Techtran Corp., Glen Burnie, Md.
THE CREATIVE LIFE OF S. V. IL'YUSHIN
G. V. Novozhilov Washington NASA May 1974 11 p Transl. into ENGLISH from Grazhdanskaya Aviatsiya (Moscow), no. 3, Mar. 1973 p 14-15
(Contract NASw-2485)
(NASA-TT-F-15622) Avail: NTIS HC $4.00 CSCL 05D

The professional carreer of aircraft designer S.V. Il'yushin is outlined. A brief history is given of the design office headed by Il'yushin and a brief description is given of some of the planes developed by this office for military and civilian purposes. Author

N74-23519 European Space Research Organization, Paris (France).
OPTIMIZATION OF A VIBRATION GENERATOR IN CONDITIONS OF EXTERNAL EXCITATION
Jean Francois Boisseau (ONERA, Paris) *In its* Aerospace Res., Bi-monthly Bull. No. 1973-2 (ESRO-TT-6) Jan. 1974 p 142-145 ref Transl. into ENGLISH from La Rech. Aerospatiale, Bull. Bimestriel No. 1973-2, 1973, p 119-120

An arrangement is proposed, which generalizes the results of the model of the Atwood machine in vibration conditions. Additional stiffness and damping is included for reducing the relative displacement between the mass and the structure in a given ratio whatever the value of the disturbance. ESRO

N74-23520 European Space Research Organization, Paris (France).
APPARATUS FOR THE QUALIFICATION OF VERY LOW

FREQUENCY VIBRATION EXCITERS

Jean Francois Boisseau (ONERA, Paris) *In its* Aerospace Res., Bi-monthly Bull. No. 1973-2 (ESRO-TT-6) Jan. 1974 p 146-155 refs Transl. into ENGLISH from La Rech. Aerospatiale, Bull. Bimestriel No. 1973-2, 1973, p 120-122

Exciters are not only used in ground tests, during which the exciter is active and the structure passive, but also an aircraft in flight. In this case, the structure may be excited independently of the exciter, e.g. by atmospheric turbulence. The test device is a vibration generator which replaces the flight structure excited by turbulence. ESRO

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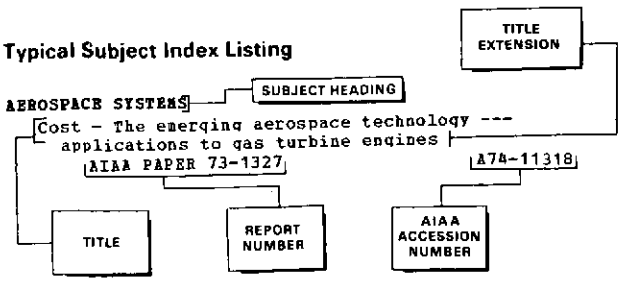

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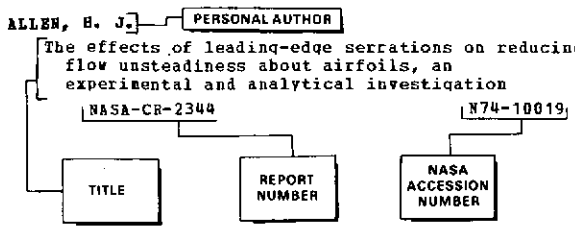

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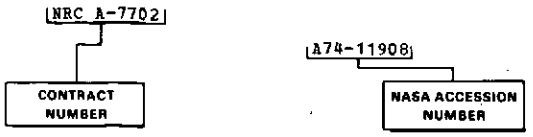

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