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SEPTEMBER 1973

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AERONAUTICAL ENGINEERING

A Special Bibliography

Supplement 35

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 August 1973 in

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

Scientific and Technical Information Office
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SEPTEMBER 1973
Washington, D.C.

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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 614 reports, journal articles, and other documents originally announced in August 1973 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.

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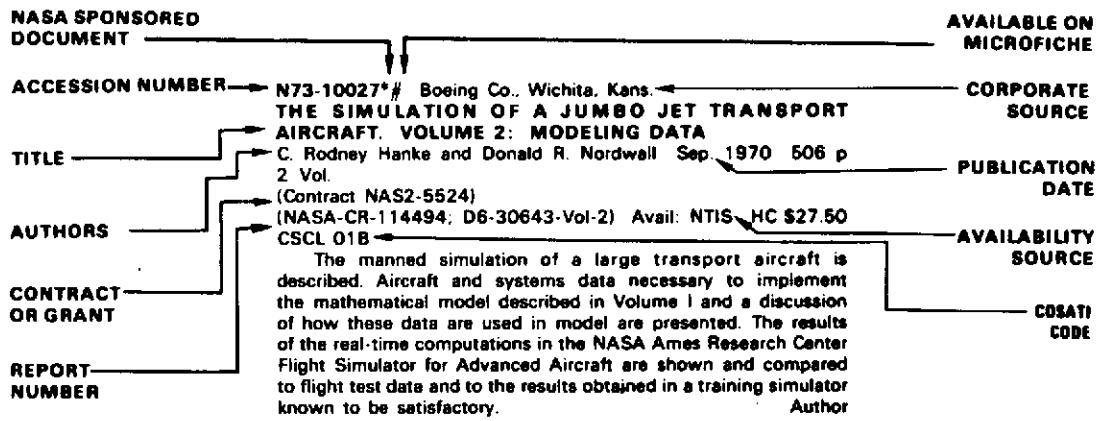

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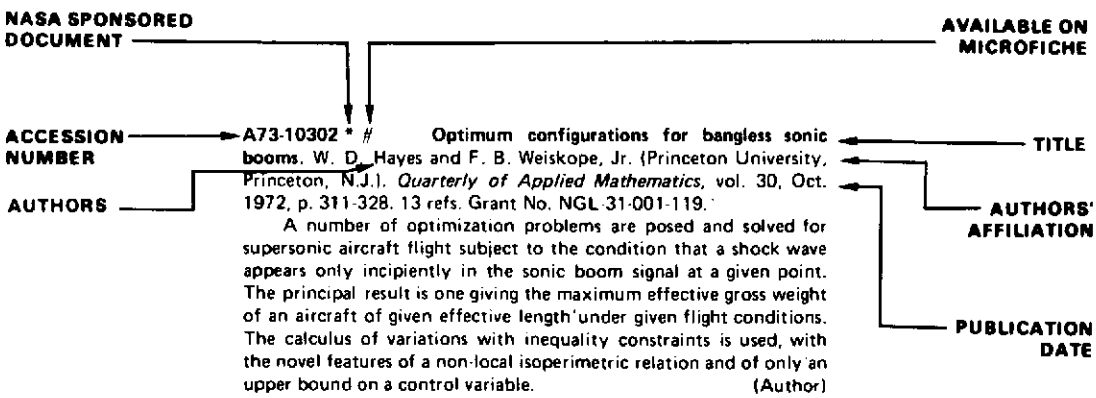

AERONAUTICAL ENGINEERING

A Special Bibliography (Suppl. 35) SEPTEMBER 1973

IAA ENTRIES

A73-30995 **New ferrite switch.** V. A. Gordeev, A. I. Nagornov, V. P. Vasil'ev, and Iu. F. Strygin. *(Radiotekhnika,* vol. 27, July 1972, p. 97-100.) *Telecommunications and Radio Engineering, Part II - Radio Engineering,* vol. 27, July 1972, p. 134-137. 5 refs. Translation.

Description of a ferrite element which can be used as a microwave power switch or modulator in radar and navigational avionics applications requiring small dimensions and high reliability. A ferrite cylinder is placed in the input branch of a waveguide Y junction; the application of a current pulse to a coil wound on the ferrite cylinder switches the anisotropy of the ferrite material and directs the microwave power to one or the other of the output branches. T.M.

A73-31044 # **Aircraft shimmy theory (Do teorii shimmi litaka).** L. G. Lobas (Kiivs'kii Politekhnichnii Institut, Kiev, Ukrainian SSR). *Akademiia Nauk Ukrains'koi RSR, Dopovidi, Seriia A - Fiziko-Tekhnichni i Matematichni Nauki,* vol. 36, Mar. 1973, p. 258-262. In Ukrainian.

Based on a synthesis of concepts embodying some elements of Keldysh's (1945) theory on aircraft nose wheel shimmy, this theory's elaboration by Neimark and Fufaev (1967), and Metelitzyn's (1952) point of view in the matter, a mathematical description is presented for the uniform rectiliniar rolling of an aircraft nose wheel fitted with a pneumatic tire. The excitation mechanism of shimmy auto-oscillations in the nose wheel of the landing gear of an aircraft undergoing velocity changes is examined, along with the effects of various nose wheel parameters on the upper limit of the stable-motion velocity range. M.V.E.

A73-31120 **A theory for rectangular wings with small tip clearance in a channel.** Y. Sugiyama (Nagoya University, Nagoya, Japan). *Aeronautical Quarterly,* vol. 24, May 1973, p. 103-119. 10 refs.

Equations are derived for the total lift about low aspect ratio wings in an inviscid, incompressible, uniform flow. The analysis extends Bollay's analysis, which followed the line suggested by Prandtl, and it is shown experimentally that Bollay's simplifying assumptions can still be applied. Agreement is good between the present theory and the author's experiment for values of total lift with small tip clearance. (Author)

A73-31121 **Separated flow past a slender delta wing at incidence.** J. E. Barsby (East Anglia, University, Norwich, England). *Aeronautical Quarterly,* vol. 24, May 1973, p. 120-128. 6 refs.

Solutions to the problem of separated flow past slender delta wings for moderate values of a suitably defined incidence parameter have been calculated by Smith, using a vortex sheet model. By increasing the accuracy of the finite-difference technique, and by replacing Smith's original nested iteration procedure, to solve the non-linear simultaneous equations that arise, by a Newton's method, it is possible to extend the range of the incidence parameter over which solutions can be obtained. Furthermore for sufficiently small values of the incidence parameter, new and unexpected results in the form of vortex systems that originate inboard from the leading edge have been discovered. These new solutions are the only solutions, to the author's knowledge, of a vortex sheet leaving a smooth surface. (Author)

A73-31122 * **The transonic aerofoil problem with embedded shocks.** H. Norstrud (Lockheed-Georgia Co., Marietta, Ga.). *Aeronautical Quarterly,* vol. 24, May 1973, p. 129-138. 21 refs. Contract No. NAS1-10665.

The integral equation approach to the mixed flow problem of infinite wings at high subsonic speeds is adopted for non-circulatory and circulatory (lifting) flows. The solutions are determined from a system of non-linear algebraic equations and, to ensure always unique solutions, the method of differentiation with respect to a parameter has been applied. The resulting Cauchy problem is then solved with the linearised flow solution as the initial value vector. For the case of embedded shocks in the flow field, the method of steepest descent has been added to the calculation scheme. Results for subcritical and supercritical flows past aerofoils are given and compared with solutions obtained by finite-difference techniques. (Author)

A73-31132 **The experimental data processing installation /EDP/ (Die experimentelle Datenverarbeitungsanlage /EDP/).** W. D. Miller. *Ortung und Navigation,* no. 4, 1972, p. 51-62. In German.

The planning stage of the EDP began about seven years ago. The project is concerned with the creation of a small-scale model of a semiautomatic digital route control system which makes use of the latest computational technology. The simulation installations of the system are to simulate the operational conditions of a semiautomatic control center. The logic of the data processing equipment is discussed together with the functions of the system computers and aspects of the communication between controller and system. G.R.

A73-31133 **Automatized radar near-traffic control /ARTS/ (Automatisierte Radar-Nahverkehrskontrolle /ARTS/).** A. R. Ridenour. *Ortung und Navigation,* no. 4, 1972, p. 63-70. In German.

In February 1969 an order concerning the delivery and the installation of ARTS III systems for 62 near-traffic control centers was placed. In addition, two systems were intended for educational and developmental objectives. In the ARTS III systems designed for secondary radar target tracking alphanumeric data blocks are displayed on the screen for the controller. Important operational processes which required up to now a great amount of coordination between controllers are completely automatized. G.R.

A73-31155 # **Unsteady separated free jet flow of an ideal fluid past a wing (Nestatsionarnoe obtekanie s otryvom strui kryla svobodnoi struei ideal'noi zhidkosti).** S. I. Krasnov. *Seminar po*

Kraevym Zadacham, Trudy, no. 9, 1972, p. 155-168. 10 refs. In Russian.

The influence of free (flow) surfaces on the hydrodynamic characteristics of a supercavitating wing of infinite span performing small vibrations at a zero cavitation coefficient is studied within the framework of a small perturbation theory for jet flows. Procedures for solving the problem in the case of short-time motions and in the case of steady harmonic vibrations are proposed. The unsteady forces acting on the wing (plate) are calculated. V.P.

A73-31195 # **Influence of weak viscous interaction on the drag of a wing profile (Vliianie slabogo viazkogo vzaimodeistviia na soprotivlenie krylovogo profilia).** V. Ia. Ivanov and V. M. Kovalenko (Akademiia Nauk SSSR, Institut Teoreticheskoi i Prikladnoi Mekhaniki, Novosibirsk, USSR). *Akademiia Nauk SSSR, Sibirskoe Otdelenie, Izvestiia, Seriia Tekhnicheskikh Nauk*, Feb. 1973, p. 45-51. 9 refs. In Russian.

The effects of viscous interaction on a symmetrical parabolic profile are examined; it is assumed that the shock wave originating at the sharp leading edge of the profile is rectilinear and that the laminar-to-turbulent boundary layer transition does not occur suddenly but occupies a certain extended region. The turbulent boundary layer is calculated by a better method than that used by Young et al. (1958) and Luxton et al. (1964). The supplementary wave friction drag is calculated for a wide range of incident-flow parameters and geometrical dimensions of the profile. T.M.

A73-31301 # **Linear problem for delta and V-shaped wings (Lineinaia zadacha dlia treugol'nykh i V-obraznykh kryl'ev).** M. I. Folle. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza*, Mar.-Apr. 1973, p. 181-185. 6 refs. In Russian.

A method is proposed for solving the problem of a supersonic (or hypersonic) flow about delta and V-shaped wings at arbitrary angles of attack. The linearized equations on which the method is based are applicable to wings of these types without restrictions on wing edges and cylindrical surfaces when those surfaces approach the surface of a wedge. V.Z.

A73-31318 # **Digital output wind system for airport use.** O. Koren (Atmospheric Environment Service, Toronto, Canada). *(American Meteorological Society, Symposium on Meteorological Observations and Instrumentation, 2nd, San Diego, Calif., Mar. 27-30, 1972.) Journal of Applied Meteorology*, vol. 12, Apr. 1973, p. 529-536. 16 refs.

Review of the present development status of a wind information system capable of providing a readout in digital form of representative current surface wind estimates to airport-approaching aircraft. The system developed to date consists of a standard Atmospheric Environment Service 3-cup anemometer and wind vane, a signal processing unit, and a digital display panel. The wind speed and direction information is displayed to the observer in the form of a one-sided 2-min running mean, while the gustiness is indicated by the peak gust in the last 10 min, decayed at a rate of 1 mph/min. The chief advantage of the system is that it is relatively inexpensive and that it possesses typical analog accuracy. M.V.E.

A73-31386 # **Parameters of rational airfield pavement design system.** W. R. Hudson and T. W. Kennedy (Texas, University, Austin, Tex.). *(American Society of Civil Engineers, National Structural Engineering Meeting, Cleveland, Ohio, Apr. 24-28, 1972, Preprint 1700.) ASCE, Transportation Engineering Journal*, vol. 99, May 1973, p. 235-253. 15 refs. Army-supported research.

The system is considered as a set of major subsystems, including inputs, the pavement structural model, outputs, decision criteria, and optimization approach, and concomitant variables. The major subsystems are presented in the form of a system block diagram. The diagram includes feedback and interactions among and within these major subsystems. Each subsystem has been broken into secondary subsystems containing more detailed listings of the more important variables influencing airfield pavement performance. Some of these variables are analyzed in terms of their influence on pavement characteristics and the interrelation with other variables. G.R.

A73-31387 # **Effect of openings on stresses in rigid pavements.** S. K. Wang, M. A. Sargious, and Y. K. Cheung (Calgary, University, Calgary, Alberta, Canada). *ASCE, Transportation Engineering Journal*, vol. 99, May 1973, p. 255-265. Research supported by the National Research Council of Canada.

Methods of pit construction in airfields are discussed together with the method of analysis, giving attention to the finite element mesh and boundary conditions for slabs with an opening and the location of cuts of a typical pavement slab with an opening. Influence lines and stress distributions are considered along with the effect of changes in the opening length and a method for calculating the area of steel around the opening required to resist the tensile forces due to load. G.R.

A73-31388 # **Subgrade strengthening of existing airfield runways.** Q. L. Robnett (Illinois, University, Urbana, Ill.). *ASCE, Transportation Engineering Journal*, vol. 99, May 1973, p. 267-287. 51 refs. USAF-sponsored research.

In connection with the increasing number of heavy aircraft at all levels of the air transportation system, many existing airfield pavements are requiring increased maintenance and repair, or extensive strengthening, or both. The feasibility to strengthen existing airfield pavements by improving the strength of the underlying subgrade is examined. Two typical airfield pavements are theoretically analyzed to determine changes in pavement structural behavior effected by subsurface strengthening. G.R.

A73-31389 * # **STOL aircraft flight and landing area considerations.** J. M. Riebe (NASA, Langley Research Center, Low-Speed Aircraft Div., Hampton, Va.). *(American Society of Civil Engineers, National Structural Engineering Meeting, Cleveland, Ohio, Apr. 24-28, 1972, Preprint 1726.) ASCE, Transportation Engineering Journal*, vol. 99, May 1973, p. 339-351. 13 refs.

One proposed solution to the total short-haul transportation system problem is to use existing low-wing-loading turbopropeller STOL aircraft. Deflected slipstream turboprop aircraft have also been considered for early STOL service. Aspects of current aircraft research are discussed together with the NASA research aircraft, field length and aircraft performance considerations, crosswind landings, crosswind reducing fences, elevated STOL ports, a guaranteed friction STOL runway, and problems of runway containment. G.R.

A73-31426 # **Evolution of the B-1 crew escape system.** T. H. McMullen (USAF, Aeronautical Systems Div., Wright-Patterson AFB, Ohio). *American Institute of Aeronautics and Astronautics, Aerodynamic Deceleration Systems Conference, 4th, Palm Springs, Calif., May 21-23, 1973, Paper 73-440.* 6 p. Members, $1.50; nonmembers, $2.00.

The Air Force's new B-1 bomber has a completely integrated crew escape module designed to safely recover the crew from throughout the aircraft operational envelope while providing a shirt-sleeve environment for mission accomplishment. The concept for the system was formulated in a series of funded studies prior to initiation of full-scale development of the weapon system; since that time significant refinements of the capsule configuration have resulted from design analysis and test. The development program is now in full-scale testing aimed to support first flight of the B-1 in early 1974. (Author)

A73-31436 # **A simplified dynamic model of parachute inflation.** D. Wolf (Sandia Laboratories, Albuquerque, N. Mex.). *American Institute of Aeronautics and Astronautics, Aerodynamic Deceleration Systems Conference, 4th, Palm Springs, Calif., May 21-23, 1973, Paper 73-450.* 9 p. 32 refs. Members, $1.50; nonmembers, $2.00. AEC-supported research.

This paper describes a dynamic inflation model for parachutes which predicts increased dimensionless inflation times and increased dimensionless inflation forces observed at high altitudes. As altitude is increased, greater relative parachute inertia results in increased inflation times, and greater relative forebody inertia results in increased maximum inflation forces. Upper limit effects of Mach number on inflation time and force are also predicted by the inflation model. (Author)

A73-31437 # Analysis of deployment and inflation of large ribbon parachutes. D. F. McVey and D. F. Wolf (Sandia Laboratories, Albuquerque, N. Mex.). *American Institute of Aeronautics and Astronautics, Aerodynamic Deceleration Systems Conference, 4th, Palm Springs, Calif., May 21-23, 1973, Paper 73-451.* 13 p. 13 refs. Members, $1.50; nonmembers, $2.00. AEC-supported research.

A method for predicting deployment and inflation of reefed ribbon parachutes is presented. The method is based on integration of axial and radial momentum equations developed in the paper. Axial and radial forces are assumed to be describable by drag and radial force coefficients. Computer solutions of the equations are compared to measured parachute loads and to parachute mouth and maximum diameters from tests of 23- and 76-ft diameter conical ribbon parachutes. Comparison of load histories indicates that snatch loads depend to a large extent on deployment bag design and packing influences. Computed loads and parachute size histories for the inflation process compared favorably with flight data. The concept of a radial force coefficient appears to have considerable merit as a means of computing inflation for most types of parachutes. (Author)

A73-31439 # A model and calculation procedure for predicting parachute inflation. R. M. Nerem (Ohio State University, Columbus, Ohio) and F. A. Pake (Goodyear Aerospace Corp., Akron, Ohio). *American Institute of Aeronautics and Astronautics, Aerodynamic Deceleration Systems Conference, 4th, Palm Springs, Calif., May 21-23, 1973, Paper 73-453.* 8 p. 17 refs. Members, $1.50; nonmembers, $2.00.

A procedure has been developed for the mathematical calculation of parachute inflation. This method is based on relating pressure changes in the parachute to the net mass inflow and to volume changes resulting from the forces acting on the parachute fabric. Provision is made for vents, gaps, and distributed canopy porosity. Initial calculations were carried out, using a four-phase inflation model in which fabric stresses are neglected, and results for both subsonic and supersonic inflation of a disk gap band parachute are presented. The more recent application of a finite-element model that includes fabric stresses is also discussed, and some preliminary results are presented. (Author)

A73-31445 * # Parachute mortar design. J. E. Pleasants (NASA, Langley Research Center, Systems Engineering Div., Hampton, Va.). *American Institute of Aeronautics and Astronautics, Aerodynamic Deceleration Systems Conference, 4th, Palm Springs, Calif., May 21-23, 1973, Paper 73-459.* 10 p. Members, $1.50; nonmembers, $2.00.

Mortars are used as one method for ejecting parachutes into the airstream to decelerate spacecraft and aircraft pilot escape modules and to effect spin recovery of the aircraft. An approach to design of mortars in the class that can accommodate parachutes in the 20- to 55-foot-diameter size is presented. Parachute deployment considerations are discussed. Comments are made on the design of a power unit, mortar tube, cover, and sabot. Propellant selection and breech characteristics and size are discussed. A method of estimating hardware weights and reaction load is presented. In addition, some aspects of erodible orifices are given as well as comments concerning ambient effects on performance. This paper collates data and experience from design and flight qualification of four mortar systems, and provides pertinent estimations that should be of interest on programs considering parachute deployment. (Author)

A73-31446 * # An advanced technique for the prediction of decelerator system dynamics. T. A. Talay, W. D. Morris, and C. H. Whitlock (NASA, Langley Research Center, Hampton, Va.). *American Institute of Aeronautics and Astronautics, Aerodynamic Deceleration Systems Conference, 4th, Palm Springs, Calif., May 21-23, 1973, Paper 73-460.* 6 p. Members, $1.50; nonmembers, $2.00.

An advanced two-body six-degree-of-freedom computer model employing an indeterminate structures approach has been developed for the parachute deployment process. The program determines both vehicular and decelerator responses to aerodynamic and physical property inputs. A better insight into the dynamic processes that occur during parachute deployment has been developed. The model is of value in sensitivity studies to isolate important parameters that affect the vehicular response. (Author)

A73-31447 # A stability analysis of tandem parachute mid-air recovery systems. M. W. Higgins and R. J. Speelman, III (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). *American Institute of Aeronautics and Astronautics, Aerodynamic Deceleration Systems Conference, 4th, Palm Springs, Calif., May 21-23, 1973, Paper 73-461.* 17 p. Members, $1.50; nonmembers, $2.00.

This paper presents the derivation and application of an analytical technique to quantify the performance/stability of a Mid-Air Recovery System (MARS) employing the tandem parachute configuration. In this configuration, a main parachute is used to control the rate of descent of the payload and a smaller parachute, tethered to the apex of this main chute serves as an engagement target for the recovery aircraft. Significant parameters relevant to the positional stability of the engagement parachute are identified, quantified and combined into a single numerical value representing positional stability as viewed by the recovery aircraft pilot. This analytical technique is then applied to the data from two different systems tested at El Centro, California. These tests made use of gliding and non-gliding main parachutes. (Author)

A73-31449 # A dynamic and aerodynamic analysis of an articulated autorotor decelerator system. M. C. Miller (U.S. Army, Edgewood Arsenal, Md.). *American Institute of Aeronautics and Astronautics, Aerodynamic Deceleration Systems Conference, 4th, Palm Springs, Calif., May 21-23, 1973, Paper 73-463.* 16 p. Members, $1.50; nonmembers, $2.00.

The articulated autorotor decelerator is a free spinning propeller type mechanism which utilizes a Magnus autorotor configuration as the blade component. An investigation of the performance characteristics of the device when applied as a decelerator system for an air delivered store is presented based on a detailed dynamic and aerodynamic analysis. Equations describing the dynamic and aerodynamic performance were evolved which utilize the sectional aerodynamic characteristics of Magnus autorotors as directly obtained from wind tunnel tests. The aft to forward blade deployment technique considered was found to provide positive initiation of blade autorotation due to an inherent gyroscopic effect. Analytical predictions for deployment transient and steady state performance show excellent correlation with experimental data obtained from wind tunnel tests of a representative full scale system. (Author)

A73-31450 # A parachute snatch force theory incorporating line disengagement impulses. H. G. Heinrich (Minnesota, University, Minneapolis, Minn.). *American Institute of Aeronautics and Astronautics, Aerodynamic Deceleration Systems Conference, 4th, Palm Springs, Calif., May 21-23, 1973, Paper 73-464.* 10 p. 12 refs. Members, $1.50; nonmembers, $2.00. Research sponsored by the Sandia Laboratories.

A method of determining parachute snatch forces incorporating the riser and suspension line disengagement impulses is presented. It is shown that the disengagement impulses strongly affect the magnitude of the snatch force which fact is important when designing parachute deployment bags. By means of deployment tests

in a windtunnel, the disengagement impulses of the standard USAF 28-ft parachute, Type C-9, were obtained. Forces calculated with consideration of disengagement impulses agree satisfactorily with measured snatch forces of the 28-ft parachute. (Author)

A73-31451 # **Drone recovery - Present and future.** D. W. Henke and N. L. Jeppesen (Goodyear Aerospace Corp., Akron, Ohio). *American Institute of Aeronautics and Astronautics, Aerodynamic Deceleration Systems Conference, 4th, Palm Springs, Calif., May 21-23, 1973, Paper 73-465.* 10 p. Members, $1.50; nonmembers, $2.00.

The present state of the art in drone recovery is discussed with emphasis on design innovations for incorporation on existing drones and both advanced and conceptual designs for integration into future sophisticated remotely piloted vehicles (RPV's). Discussions of the present state-of-the-art cover both surface impact and mid-air recovery techniques. Also reviewed is a recovery system presently being developed to provide recovery capability for the TALOS/Low Altitude Supersonic Target. The use of hot-air balloon systems for advanced recovery concepts, including aerial recovery, surface impact, and airborne platforms is described. The development status and relative merits of systems covered are discussed in summary. (Author)

A73-31452 # **Development of a high-performance ringsail parachute cluster.** W. C. Buhler and W. K. Wailes (Pioneer Parachute Co., Inc., Manchester, Conn.). *American Institute of Aeronautics and Astronautics, Aerodynamic Deceleration Systems Conference, 4th, Palm Springs, Calif., May 21-23, 1973, Paper 73-468.* 7 p. 6 refs. Members, $1.50; nonmembers, $2.00.

The main parachute system for the B-1 crew module uses three 69.8-ft ringsail parachutes. It originated as a scaled-down Apollo system. Early tests revealed deficiencies of erratic pilot chute performance and staggered, nonuniform main parachute deployment and inflation. The maximum dynamic pressure of 200 lb/sq ft and low-altitude escape requirements made such erratic performance unacceptable; therefore, alternative deployment techniques were investigated. In the selected system, the main parachutes deploy simultaneously, with improved uniformity of inflation. The three independent pilot chutes were replaced by two (redundant) pilot chutes connected together and to the three main parachutes by a three-legged bridle. (Author)

A73-31453 # **Development of an improved midair-retrieval parachute system for drone/RPV aircraft.** W. J. Everett (Pioneer Parachute Co., Inc., Manchester, Conn.). *American Institute of Aeronautics and Astronautics, Aerodynamic Deceleration Systems Conference, 4th, Palm Springs, Calif., May 21-23, 1973, Paper 73-469.* 14 p. Members, $1.50; nonmembers, $2.00. Contract No. F33657-72-C-0201.

To enhance and extend performance of midair-retrieval systems for drone/RPV applications, and extensive flight-test and developmental program was undertaken. Testing consisted of nearly 50 bomb-drop tests and a number of drone flights. The outcome of the program was the development of a tandem midair-retrieval parachute system, capable of operation with a family of drone/RPVs. The parachute system, including the first-stage decelerator, demonstrated successful operation over a suspended-weight range of 1790 to 6200 lb, and at deployment dynamic pressures of 28 to 748 lb/sq ft. During the program, a directionally stable gliding main parachute and a new configuration of engagement parachute were developed. (Author)

A73-31454 # **Aircraft recovery using an inflatable wing.** W. H. Eilertson (U.S. Naval Material Command, Ship Research and Development Center, Bethesda, Md.). *American Institute of Aeronautics and Astronautics, Aerodynamic Deceleration Systems Conference, 4th, Palm Springs, Calif., May 21-23, 1973, Paper 73-470.* 10 p. 18 refs. Members, $1.50; nonmembers, $2.00.

Aircraft recovery is possible using an inflatable wing canopy with steel cable of fiber suspension lines. These lines are attached to reels at the aircraft that not only provide stowage for the lines but braking during deployment to prevent high snatch forces. They can vary the inflated wings' angle of attack thereby controlling range and a flared landing maneuver. The inflated pressurized wing can carry a larger load than flexible gliding parachutes. This results in a much smaller canopy size, lower weight, and stowage volume. Its ranging capability is twice to three times that of current gliding parachutes. An example application to a Navy fighter indicates its weight fraction to be as low as 2%. (Author)

A73-31455 # **An airdrop system for testing large parachutes for recovery of loads in excess of 50,000 lb.** H. J. Hunter (USAF, 6511th Test Squadron, El Centro, Calif.). *American Institute of Aeronautics and Astronautics, Aerodynamic Deceleration Systems Conference, 4th, Palm Springs, Calif., May 21-23, 1973, Paper 73-471.* 7 p. Members, $1.50; nonmembers, $2.00.

A need exists for a method of testing large parachutes in clusters to recover loads weighing over 50,000 pounds. A systematic approach to the problem is made using data recently acquired during C-5A airdrop testing and by the 6511th Test Squadron during developmental efforts on high capacity extraction systems and airdrop platforms. A workable system is proposed consisting of the C-5A airplane, high capacity extraction systems, and a clean, relatively cheap weighted vehicle weighing from 40,000 to 90,000 lb with ample space for storage and capacity for attachment of the test recovery system. (Author)

A73-31456 # **A 14.2-ft-Do variable-porosity conical ribbon chute for supersonic application.** R. A. Toni (Pioneer Parachute Co., Inc., Manchester, Conn.). *American Institute of Aeronautics and Astronautics, Aerodynamic Deceleration Systems Conference, 4th, Palm Springs, Calif., May 21-23, 1973, Paper 73-472.* 8 p. 5 refs. Members, $1.50; nonmembers, $2.00.

A 14.2-ft variable-porosity conical ribbon parachute is selected to meet performance requirements of a drogue chute for use in the parachute recovery system for the B-1 crew module. This paper emphasizes the chute itself; that is, the paper discusses the chute not so much from the viewpoint that it belongs in the parachute recovery system for the B-1 crew module but rather with respect to its own aerodynamic characteristics and how they compare with those of previous, more conventional chutes for similar applications. This is done by presenting wind-tunnel, sled, and aerial test data, making a comparison of these data with those of other, more conventional chutes, and finally presenting conclusions. (Author)

A73-31457 * # **Drag and stability characteristics of high-speed parachutes in the transonic range.** W. C. Alexander (Goodyear Aerospace Corp., Akron, Ohio) and J. T. Foughner, Jr. (NASA, Langley Research Center, Loads Div., Hampton, Va.). *American Institute of Aeronautics and Astronautics, Aerodynamic Deceleration Systems Conference, 4th, Palm Springs, Calif., May 21-23, 1973, Paper 73-473.* 7 p. 10 refs. Members, $1.50; nonmembers, $2.00.

The results of wind tunnel tests of three parachute configurations in the wake of a cone-cylinder are presented. The tests were conducted to extend the drag and stability characteristics of selected parachutes through the transonic speed range. The configurations studied were the hemisflo ribbon, the cross, and the disk-gap-band types. The results are presented as the variation of the parachute drag coefficient with Mach number. General stability characteristics of the parachutes are discussed. The results are then correlated with some published subsonic and supersonic data. (Author)

A73-31458 * # **Parachute gore shape and flow visualization during transient and steady-state conditions.** V. G. Dereng (NASA, Langley Research Center, Fabrication Div., Hampton, Va.). *American Institute of Aeronautics and Astronautics, Aerodynamic Deceleration Systems Conference, 4th, Palm Springs, Calif., May 21-23, 1973, Paper 73-474.* 13 p. Members, $1.50; nonmembers, $2.00.

Single parachute gore segments were tested in an experimental

wind tunnel having a unique 'V' splitter plate test section with a glass panel on the near side and a grid of orifices for smoke injection on the back panel. The parachute gore shape and flow patterns were viewed in cross section during the inflation process and also during changing flow conditions as would occur with rapid reduction of payload weight. Observations of flow during inflation revealed a transient internal counterflow and the formation and degeneration of several traling vortices. Gore shapes observed compared well with those of free flight. (Author)

A73-31463 # **Experimental investigation and correlation of the ground impact acceleration characteristics of a full scale capsule and a 1/4 scale model aircraft emergency crew escape capsule system.** R. L. Peterson and E. O. Roberts (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). *American Institute of Aeronautics and Astronautics, Aerodynamic Deceleration Systems Conference, 4th, Palm Springs, Calif., May 21-23, 1973, Paper 73-480.* 11 p. 7 refs. Members, $1.50; nonmembers, $2.00.

A73-31465 # **Relative merit of the disc-gap-band parachute applied to individual aircrew member escape.** W. R. Pinnell (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio) and D. J. Kolega (USAF, Aeronautical Systems Div., Wright-Patterson AFB, Ohio). *American Institute of Aeronautics and Astronautics, Aerodynamic Deceleration Systems Conference, 4th, Palm Springs, Calif., May 21-23, 1973, Paper 73-483.* 13 p. 16 refs. Members, $1.50; nonmembers, $2.00.

Interim results of an experimental test program currently being conducted as an in-house effort by the USAF Flight Dynamics Laboratory to optimize the design of the disc-gap-band parachute for specific application to emergency escape from aircraft are presented. A wind tunnel test program has been completed and subsequent drop testing is currently being accomplished. Representative data and findings resulting from the completed wind tunnel phase of the overall effort are presented. Wind tunnel results indicated the steady state performance improvement potential of the disc-gap-band design (with added centerline) over the solid flat circular model and prompted a program of drop tests of personnel sized (28-ft diameter) parachutes. From the uncompleted drop test phase of the effort, data for one disc-gap-band gap placement, four geometric porosities, and six centerline lengths are presented and compared with similar data resulting from standard C-9 parachute system tests. (Author)

A73-31466 # **Parachute design and performance data bank.** J. H. DeWeese and R. E. McCarty (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). *American Institute of Aeronautics and Astronautics, Aerodynamic Deceleration Systems Conference, 4th, Palm Springs, Calif., May 21-23, 1973, Paper 73-484.* 8 p. Members, $1.50; nonmembers, $2.00.

This paper describes the development and operation of a system for computer-aided design and performance analyses of parachutes. The rationale used in initial conceptual planning and in establishing the operational procedures employed is included. In addition, the mechanics involved in the information storage and retrieval tasks are presented. The data bank stores only design details and performance data which have been extracted from various sources. A FORTRAN program providing highly flexible and very selective retrieval operates on the accumulated information base. Retrieval logic used in recovery is prepared from specific criteria as well as from more general narrative information. Only that data pertaining to a particular parachute environment, along with a variable depth of related information is recovered. (Author)

A73-31467 # **Development and testing of ballute stabilizer/decelerators for aircraft delivery of a 500-lb munition.** P. G. McGirr (USAF, Armament Laboratory, Eglin AFB, Fla.), A. C. Aebischer, and S. A. Weinberg (Goodyear Aerospace Corp., Akron, Ohio). *American Institute of Aeronautics and Astronautics, Aerodynamic Deceleration Systems Conference, 4th, Palm Springs, Calif., May 21-23, 1973, Paper 73-485.* 8 p. Members, $1.50; nonmembers, $2.00.

A73-31468 # **An omnidirectional gliding ribbon parachute and control system.** W. B. Pepper and J. R. Biesterveld (Sandia Laboratories, Albuquerque, N. Mex.). *American Institute of Aeronautics and Astronautics, Aerodynamic Deceleration Systems Conference, 4th, Palm Springs, Calif., May 21-23, 1973, Paper 73-486.* 5 p. 5 refs. Members, $1.50; nonmembers, $2.00. AEC-USAF-supported research.

An omnidirectional gliding, guided parachute and control system has been designed and tested. A 24-ft-diameter ribbon parachute has been modified by incorporating four controllable glide flaps 90 degrees apart at the skirt region and two roll flaps 180 degrees apart. The design includes a control system consisting of a remote command transmission site and an onboard sensing and receiving station. Four drop tests of a 2600-pound test vehicle have demonstrated that the system is feasible if the parachute is carefully modified, if glide flaps are provided for omnidirectional control, and if an on-board sensor is used for roll control. (Author)

A73-31470 # **Several computerized techniques to aid in the design and optimization of parachute deceleration and aerial-delivery systems.** J. D. Reuter (Pioneer Parachute Co., Inc., Manchester, Conn.). *American Institute of Aeronautics and Astronautics, Aerodynamic Deceleration Systems Conference, 4th, Palm Springs, Calif., May 21-23, 1973, Paper 73-488.* 9 p. Members, $1.50; nonmembers, $2.00.

A73-31471 # **Air navigation: Application of radio navigational aids and automated navigation complexes (Vozdushnaia navigatsiia: Primenenie radionavigatsionnykh sredstv i avtomatizirovannykh navigatsionnykh kompleksov).** V. I. Osadshii. Moscow, Izdatel'stvo Transport, 1972. 288 p. 26 refs. In Russian.

The handling specifications and theory of radio navigation aids and automatic navigation systems are outlined with the aim of familiarizing the reader with the basic idea and characteristics of air navigation. Particular attention is given to the handling of navigational aids to obtain maximum effectiveness in flight. The qualitative accuracy and reliability characteristics of navigational determinations are evaluated on the basis of the fundamental concepts in probability theory. V.P.

A73-31526 **International Conference on Offshore Airport Technology, 1st, Bethesda, Md., April 29-May 2, 1973, Proceedings. Volume 1.** Conference sponsored by the American Institute of Aeronautics and Astronautics, Federal Aviation Administration, and International Water Resources Association. New York, American Institute of Aeronautics and Astronautics, Inc., 1973. 177 p. Members, $10.00; nonmembers, $12.

Operational considerations in the design of offshore airports, a technological development scenario for offshore jetports, and the Cleveland concept for economic development are among the topics covered in papers concerned with offshore airport technology. Other topics covered include community acceptance, jurisdictional considerations, Maplin - London's third airport, and fog frequency and characteristics at the site of the proposed New York offshore airports, as compared with those of J. F. Kennedy International Airport.

M.V.E.

A73-31527 # **Design considerations for offshore airports.** D. R. Miller (Daniel, Mann, Johnson, and Mendenhall and Associates, Los Angeles, Calif.). In: International Conference on Offshore Airport Technology, 1st, Bethesda, Md., April 29-May 2, 1973, Proceedings. Volume 1. New York, American Institute of Aeronautics and Astronautics, Inc., 1973, p. 1-3. 6 refs.

Definition of the airport designer's role in an offshore airport program, and review of the functions to be considered. A design approach is suggested that analyzes the interfaces and constraints involved in a major offshore airport, and a procedure is outlined for the implementation of such a program. M.V.E.

A73-31528 # **Multi-purpose use potential of offshore airports.** W. D. Brinckloe (Pittsburgh, University, Pittsburgh, Pa.). In: International Conference on Offshore Airport Technology, 1st, Bethesda Md., April 29-May 2, 1973, Proceedings. Volume 1. New York, American Institute of Aeronautics and Astronautics, Inc., 1973, p. 5-14.

This paper considers the pros and cons of providing tenants on an offshore airport structure, other than those commonly planned for airports ashore, both to share the immense construction costs (which may be almost too much for airports to bear unaided) and to provide mutual support. There are two types of potential tenants: site-related facilities (which want the marine environment, or are unwanted ashore, or both), and airport-related facilities (which share airport customers or support airport operations). Site-related tenants include the following: deep ports, power plants, solid waste disposal plants, sewage or water treatment plants, solid waste landfill sites, refinery/tank farms, pipelines, and industrial parks. Airport-related tenants include the following: cruise ship ports, rapid transit or intercity rail terminals, truck terminals, and several of the site-related tenants which have airport interdependencies as well. (Author)

A73-31529 # **Access requirements for offshore airports.** R. E. Skinner, Jr. and A. J. Gellman (Alan M. Voorhees and Associates, Inc., McLean, Va.). In: International Conference on Offshore Airport Technology, 1st, Bethesda, Md., April 29-May 2, 1973, Proceedings. Volume 1. New York, American Institute of Aeronautics and Astronautics, Inc., 1973, p. 16-22. 15 refs.

It is shown that, in the design of an access system for a particular offshore airport, two aspects of the total design determine largely the access facility requirements: the passenger processing concept employed, and the extent and nature of the services and activities provided at the site of the runway/taxiway complex. Rapid transit and highway facilities are likely to represent the primary means of access; however, marine technology could potentially be employed for a significant secondary access system component. M.V.E.

A73-31530 # **Community acceptance and jurisdictional considerations.** W. D. Kies (FAA, Kennedy International Airport, N.Y.). In: International Conference on Offshore Airport Technology, 1st, Bethesda, Md., April 29-May 2, 1973, Proceedings. Volume 1. New York, American Institute of Aeronautics and Astronautics, Inc., 1973, p. 23-28. 15 refs.

In this paper the facets of community acceptance and jurisdictional consideration were reviewed to determine their impact on offshore airport planning. The major problems of community acceptance are aircraft noise, exposure factor, land use priorities and general public environmental concern. Placing an airport offshore obviously minimizes to a great degree citizen objection, except for the small remaining segment underlying departure or arrival flight paths. With, however, the steady government/industry progress in reducing aircraft noise, and the continuous refinement of noise abatement operating procedures, it must be deduced that community acceptance will be far easier to achieve for an offshore location as opposed to a similar land site. Jurisdictional aspects, while legally complicated, are not insurmountable, and could be achieved by international agreement or Congressional action. (Author)

A73-31531 # **Economics and offshore airports.** T. Fabian (Mathematica, Inc., Princeton, N.J.). In: International Conference on Offshore Airport Technology, 1st, Bethesda, Md., April 29-May 2, 1973, Proceedings. Volume 1. New York, American Institute of Aeronautics and Astronautics, Inc., 1973, p. 29-34.

Discussion of approaches to the determination of cost-effective sets of offshore airport alternatives and to the selection of the best among them on the basis of usage projection, and analyses of intrinsic costs, social benefits, and social costs. It is shown that, in offshore airport planning, there is a definite need of having a team of economists participate significantly in the planning and design effort to provide the required analyses. M.V.E.

A73-31532 # **Operational considerations in the design of offshore airports.** T. K. Vickers. In: International Conference on Offshore Airport Technology, 1st, Bethesda, Md., April 29-May 2, 1973, Proceedings. Volume 1. New York, American Institute of Aeronautics and Astronautics, Inc., 1973, p. 35-41.

This paper presents an overview of the special flight operational and safety problems which will affect offshore airports. The advantages of a single-axis runway concept are presented, together with possible techniques for coping with the stronger crosswind components which are likely to be encountered. The potential effects of surface ships on offshore airport approach systems are described, together with means of alleviating these problems. The paper briefly reviews the factors which affect airport capacity, and provides a check-list of 14 methods of increasing airport capacity. (Author)

A73-31533 # **Marine construction for offshore airports.** R. D. Harza (Harza Engineering Co., Chicago, Ill.). In: International Conference on Offshore Airport Technology, 1st, Bethesda, Md., April 29-May 2, 1973, Proceedings. Volume 1. New York, American Institute of Aeronautics and Astronautics, Inc., 1973, p. 42-46.

Review of some of the heavy-marine-structure engineering aspects involved in the planning of offshore airports. In particular, alternative types of structures, environmental factors, and construction conditions, materials and methods are discussed, along with dredges and other marine construction equipment. M.V.E.

A73-31534 # **A technological development scenario for offshore jetports.** R. Adams. In: International Conference on Offshore Airport Technology, 1st, Bethesda, Md., April 29-May 2, 1973, Proceedings. Volume 1. New York, American Institute of Aeronautics and Astronautics, Inc., 1973, p. 47-57. 9 refs.

Discussion of technology development programs relevant to offshore jetport planning, with emphasis on possibilities unique to the marine environment. Problems of grade-separated, elevated decks are discussed, particularly aerodynamics, and aircraft containment on such decks. Geometrics in takeoff and landing operations is described in normal and emergency modes, and appropriate flight deck designs are suggested. The current state of alternative landing gear technologies is assessed, including seaplane and air cushion, and the potential of these technologies for optimal jetport access solutions is examined. M.V.E.

A73-31535 # **Report on a new international airport in the Netherlands.** H. A. Berdenis van Berlekom (Netherlands Engineering Consultants, The Hague, Netherlands). In: International Conference on Offshore Airport Technology, 1st, Bethesda, Md., April 29-May 2, 1973, Proceedings. Volume 1. New York, American Institute of Aeronautics and Astronautics, Inc., 1973, p. 58-76.

Review of some aspects of the studies of five potential locations, including three offshore ones, currently pursued in the Netherlands by a planning commission toward the selection of a new international airport site. Using cost/benefit analysis approaches, these studies utilize the experience gained from large coastal and offshore projects recently accomplished in the Netherlands, where offshore reclamation works have become almost common practice. M.V.E.

A73-31536 # **Chicago's pioneer offshore airport concept.** F. T. Wheby (Harza Engineering Co., Chicago, Ill.). In: International Conference on Offshore Airport Technology, 1st, Bethesda, Md., April 29-May 2, 1973, Proceedings. New York, American Institute of Aeronautics and Astronautics, Inc., 1973, p. 88-93. 5 refs.

Chicago is the first major city to have given serious consideration and detailed study to the construction of a true offshore airport. The project as envisioned would be a 5-mile diameter polder constructed in Lake Michigan, protected from the Lake by an encircling rock or sand dike. The concept is unusual in several respects, perhaps the most important of which are the absence of developed construction materials sources in the immediate vicinity and the presence of a layer of soft clay at the Lake bottom. These problems would be overcome by the importation of some of the construction materials from distances exceeding 400 miles; the development of a lake-bottom quarry in a diked-off area; and the design of very flat dike slopes. (Author)

A73-31537 # **Progress reports on off shore airport projects. I - Copenhagen: The ordeal of political decision.** H. T. Molgaard (Copenhagen Airports Authority, Copenhagen, Denmark). In: International Conference on Offshore Airport Technology, 1st, Bethesda, Md., April 29-May 2, 1973, Proceedings. Volume 1. New York, American Institute of Aeronautics and Astronautics, Inc., 1973, p. 94-99.

Review of the historical background and present status of Denmark's offshore airport project focused on the island of Saltholm near Copenhagen and connected with the other long considered project of a bridge-tunnel link between Denmark and Sweden. After more than 10 years of political efforts, legislation for firm action has now been presented in Parliament for consideration and enactment. M.V.E.

A73-31538 # **Honolulu International Airport reef runway.** O. Miyamoto (Hawaii State Department of Transportation, Airports Div., Honolulu, Hawaii). In: International Conference on Offshore Airport Technology, 1st, Bethesda, Md., April 29-May 2, 1973, Proceedings. New York, American Institute of Aeronautics and Astronautics, Inc., 1973, p. 100-105. 14 refs.

This is a report on the planning for the construction of an off-shore runway to be built on the reef at Honolulu International Airport. Forecasts of air traffic activity indicated the need for additional airfield capacity and to reduce the effect of noise and overflights on densely populated areas adjacent to the airport. Consideration of various alternatives, including relocation of the airport, resulted in the decision to optimize existing airport facilities and to move all heavy jet aircraft operations to runways with over-water approach and departure paths. Planning for the runway was heavily influenced by concerns for environmental controls in addition to the need for meeting civil and military airfield design criteria. (Author)

A73-31539 # **Maplin - London's third airport.** D. W. Turner (British Airports Authority, London, England). In: International Conference on Offshore Airport Technology, 1st, Bethesda, Md., April 29-May 2, 1973, Proceedings. Volume 1.
New York, American Institute of Aeronautics and Astronautics, Inc., 1973, p. 106-113.

This paper describes the planning of London's Third Airport, which is to be built on reclaimed land off the Essex coast at Maplin, some 50 miles from the center of the capital. An outline history is given of the steps leading to the decision that the new airport should be sited off-shore, and the effects of this decision are discussed in some depth. The site-choice for the airport is linked with a further decision to create a new deep-water port alongside, and the joint land reclamation for these two major transportation facilities will create opportunities for Maplin to develop as a fully-integrated 'total port.' The project is seen in the context of sub-regional planning, with particular emphasis placed on the need for new large-scale urbanisation to support the employment demands in the future. The paper also examines the problems of access peculiar to the off-shore situation, and deals with the land-use planning for the airport, operational aspects, and the scale of the land reclamation involved. The major environmental factors are discussed, and finally a look is given to the project programme and prospects for the future. (Author)

A73-31540 # **An offshore airport for Los Angeles - A case study.** W. M. Schoenfeld (Los Angeles Department of Airports, Los Angeles, Calif.). In: International Conference on Offshore Airport Technology, 1st, Bethesda, Md., April 29-May 2, 1973, Proceedings. Volume 1. New York, American Institute of Aeronautics and Astronautics, Inc., 1973, p. 114-116.

As an opening for the offshore airport subject, a brief history of commercial aviation in Los Angeles is given. An early study for the need of an offshore airport was made, deeming such construction to be technically feasible. A subsequent consultant's report prepared for the Federal Aviation Administration questioned some of the design aspects, logistics problems, and declared the costs to be prohibitively exorbitant. The paper covers airspace and environmental considerations peculiar to the Southern California area, compares costs, and discusses plans now being implemented for the development of the Palmdale Intercontinental Airport to take care of future transportation needs. (Author)

A73-31541 # **Status of off-shore airport - Miami.** N. W. Arnold (Howard, Needles, Tammen and Bergendoff, Alexandria, Va.). In: International Conference on Offshore Airport Technology, 1st, Bethesda, Md., April 29-May 2, 1973, Proceedings. Volume 1. New York, American Institute of Aeronautics and Astronautics, Inc., 1973, p. 117-119.

This paper discusses the reasoning which lead to the decision not to consider an off-shore site for a new major airport to serve Miami and South Florida. A brief examination of suggested off-shore sites indicated the necessity for extensive and detailed studies which would be justified only if it were demonstrated that a satisfactory on-shore site did not exist. There is a strong suspicion that an off-shore site could not be shown to be preferable to the recommended site in any case. (Author)

A73-31542 # **Offshore airport planning in Osaka-Bay, Japan - New Kansai International Airport.** T. Satoi (Kansai /Osaka/ International Airport Terminal Building Co., Ltd., Osaka, Japan). In: International Conference on Offshore Airport Technology, 1st, Bethesda, Md., April 29-May 2, 1973, Proceedings. Volume 1. New York, American Institute of Aeronautics and Astronautics, Inc., 1973, p. 126-132.

Discussion of offshore airport planning in Japan, and review of the alternative construction plans considered for Kansai International Airport. The relative costs and merits of such alternative construction methods as those based on the reclamation, polder, pile-deck, and floating concept are examined for the various sites considered. Local community reactions are also reviewed. M.V.E.

A73-31543 # **San Diego offshore airport study.** C. J. Lord (Ralph M. Parsons Co., Los Angeles, Calif.). In: International Conference on Offshore Airport Technology, 1st, Bethesda, Md., April 29-May 2, 1973, Proceedings. Volume 1.
New York, American Institute of Aeronautics and Astronautics, Inc., 1973, p. 133-141.

This paper summarizes the results of a study of the San Diego offshore airport. During the study seven offshore sites were investigated and evaluated. The proposed airfield includes a dual independent runway system designed to meet air carrier demand for San Diego to the year 1990 and beyond. The offshore airport includes all necessary airfield, terminal, parking, and access facilities. Each of the airport sites is analyzed and evaluated with regard to air traffic capacity, environmental impact, access, effects on the marine ecology and littoral regime, and construction cost. A numerical rating system compares unquantified evaluation factors which, in addition to the estimated costs of construction, are used as bases for determining the relative merit of each site. (Author)

A73-31544 # **Progress report on Tel Aviv offshore airport project.** H. Marom (Airport Engineering Hugo Marom, Ltd., Lod International Airport, Israel). In: International Conference on Offshore Airport Technology, 1st, Bethesda, Md., April 29-May 2,

1973, Proceedings. Volume 1. New York, American Institute of Aeronautics and Astronautics, Inc., 1973, p. 146-156. 5 refs.

For Tel Aviv's shorthaul civil airport combined with a military base, an offshore intown site was selected which is adjacent to the existing, but inadequate, Dov Hos airport. The 560,000 sq m of reclaimed land (on fill) will support the main 2000-m runway and the 930-m cross-wind runway, with their parallel taxiways. A lagoon for recreational activities is provided between the main runway and the shore. Landing approach and takeoff climb paths, and holding patterns, are all over water. The onshore terminal facilities will be part of a vast civic center complex. The design respects all the airport's immediate neighbors: the municipality, the electric power-station, and the Atarim Marina-City, whilst meeting all CAA and Air Force requirements. (Author)

A73-31545 # Toronto's new airport - The bureaucracy of government. J. C. Crang (MRAIC, Toronto, Canada). In: International Conference on Offshore Airport Technology, 1st, Bethesda, Md., April 29-May 2, 1973, Proceedings. Volume 1. New York, American Institute of Aeronautics and Astronautics, Inc., 1973, p. 157-161.

The Canadian Government's intention to proceed with the construction of a second land-based jetport in the Toronto area in spite of environmental and community objections is deplored, and the merits of an offshore airport alternative are examined. Since Lake Ontario is a fresh deep water lake with a dense urban population surrounding it, it is believed to be the ideal place for an offshore airport. M.V.E.

A73-31546 # Fog frequency and characteristics at the site of the proposed New York offshore airport, as compared with those at J. F. Kennedy International Airport - A preliminary report. R. K. Hinz, Jr. (New York, State University, Stony Brook, N.Y.). In: International Conference on Offshore Airport Technology, 1st, Bethesda, Md., April 29-May 2, 1973, Proceedings. Volume 1. New York, American Institute of Aeronautics and Astronautics, Inc., 1973, p. 162-172. 47 refs. Research supported by the State University of New York.

A73-31547 # Practical aerodynamics of the An-24 aircraft /2nd revised and enlarged edition/ (Prakticheskaia aerodinamika samoleta An-24 /2nd revised and enlarged edition/). L. E. Bogoslavskii. Moscow, Izdatel'stvo Transport, 1972. 200 p. In Russian.

The aerodynamic and design characteristics of the An-24 medium-range airliner powered by two AI-24 turboprop engines are examined. The maximum weight is 21,000 kgf. The principal aspects of the flying technique are discussed, guidelines for handling the aircraft under various flight conditions are proposed. V.P.

A73-31548 # Special equipment for civil-aviation aircraft and helicopters /2nd revised and enlarged edition/ (Spetsial'noe oborudovanie samoletov i vertoletov grazhdanskoi aviatsii /2nd revised and enlarged edition/). A. G. Gamulin and E. V. Sofronov. Moscow, Izdatel'stvo Transport, 1972. 376 p. In Russian.

The design, principles of operation, and characteristics of modern aircraft and helicopter navigation systems, automatic control systems, electrical systems, oxygen equipment, and aircraft instruments are discussed. Basic information on radio communications systems, radar systems, and radio navigation systems is presented. V.P.

A73-31573 # Roll coupling moment of deflected wing-body combination. S. Tsukamoto (Tokyo, University, Tokyo, Japan). *Tokyo, University, Institute of Space and Aeronautical Science, Report* no. 488, vol. 37, Dec. 1972, p. 329-368. 9 refs.

A method of analysis based on the slender-body theory has been developed to investigate the characteristics of the roll coupling moment due to the flow induced by deflected wings and cross flow. The method makes use of conformal mapping of the well-known hydrodynamics and numerical integration. Flow patterns on the wing have been obtained in the form of elliptic integrals and are shown for various values of span to body radius ratio. Calculations have been performed for uniformly canted and elastically deflected wings in planar and cruciform wing-body combinations. It is shown that there exists a considerably wide region (from the root to 50-57% of the wing span) where induced velocity has negative sign for the elastically deflected wings. (Author)

A73-31629 A generalized gas turbine model. G. S. Mueller (Waterloo, University, Waterloo, Ontario, Canada). *International Journal of Control, First Series,* vol. 17, May 1973, p. 977-993. 14 refs. Research supported by the Board of Trade and Ministry of Technology of England and National Research Council of Canada.

A method of simulating the dynamic behavior of gas turbines based on the theory of one-dimensional flow is developed. The analysis results in two sets of spatial differential equations, containing independent functions defining the gas flow phenomena taking place in the engine, whose integration allows evaluation of the time derivatives of the engine rotor speeds. The technique allows the inclusion of such phenomena as compression and expansion, heat transfer, area change, separation and mixing of gas streams, friction, drag, and combustion occurring individually or simultaneously in the gas turbine model. The method is general, in that any gas turbine can be modeled provided its gas flow processes can be defined. The results of an application to an actual engine are given. (Author)

A73-31633 Israel Annual Conference on Aviation and Astronautics, 15th, Tel Aviv and Haifa, Israel, March 14, 15, 1973, Proceedings. Conference supported by the Ministry of Transport of Israel; Ministry of Defence of Israel, Armament Development Authority; Ministry of Commerce and Industry of Israel, et al. *Israel Journal of Technology,* vol. 11, no. 1-2, 1973. 99 p.

Integral equations for nondestructive determination of buckling loads for elastic plates and bars are developed, and the buckling of cylindrical panels under nonuniform axial compression is examined. The buckling analysis of elastically constrained stiffened conical shells under hydrostatic pressure by the cc..ocation method is treated. Hybrid rocket combustion is investigated. Two-dimensional incompressible potential flow around multi-component airfoils, random techniques for flutter testing in wind tunnel and in flight, and forces and moments on a triaxial ellipsoid in potential flow are studied. Attention is given to transverse velocity and pressure variations in finite journal bearings and cylinders, and to the solar radiation damping of a gravity-oriented satellite using the WKB method. Natural convection in aircraft fuel tanks is discussed. F.R.L.

A73-31637 Two-dimensional incompressible potential flow around multi-component airfoils. B. L. Coleman and Y. Roth (Israel Aircraft Industries, Ltd., Lod, Israel). *(Israel Annual Conference on Aviation and Astronautics, 15th, Tel Aviv and Haifa, Israel, Mar. 14, 15, 1973.) Israel Journal of Technology,* vol. 11, no. 1-2, 1973, p. 27-32. 8 refs. Research sponsored by the Ministry of Defence of Israel.

The Martensen-Jacob method replaces the airfoil by a surface distribution of vorticity leading to a Fredholm equation of second type with one degree of freedom, corresponding to the circulation. The airfoil is replaced by line elements of constant vorticity and the integral equation by a matrix equation. The novelty is in calculating the matrix elements as the average mutual influence between line elements, leading to greater accuracy when neighboring parallel elements are concerned and automatically ensuring matrix singularity. Computational results are compared with known practical and theoretical pressure distributions. The programme used complex arithmetic. (Author)

A73-31643 Natural convection in aircraft fuel tanks. G. D. Mallinson and G. de Vahl Davis (New South Wales, University,

Kensington, Australia). *(Israel Annual Conference on Aviation and Astronautics, 15th, Tel Aviv and Haifa, Israel, Mar. 14, 15, 1973.) Israel Journal of Technology*, vol. 11, no. 1-2, 1973, p. 89-101. 28 refs.

The wing of an aircraft in supersonic flight is subject to heat input from its upper and lower surfaces as a result of frictional heating. The degree of thermal stressing induced will be dependent on the rate at which this heat is transferred to the inner structure. In smooth level flight, natural convection currents established in wing fuel tanks contribute significantly to this heat transfer. This paper describes a theoretical and experimental study of the natural convection phenomena. A numerical method has been used to solve the governing equations of motion and energy, and to calculate the resultant fluid motion and heat transfer properties. An experimental study has shown that the numerical method is capable of predicting the motion with remarkable accuracy. (Author)

A73-31670 # **Finite chord effects on vortex induced wing loads.** L. T. Filotas (Ministry of Transport, Ottawa, Canada). *AIAA Journal*, vol. 11, June 1973, p. 888-890.

Extension of previous work by Filotas (1972) on vortex induced wing loads to some further analysis of wing-vortex interaction. It is shown that, for a vortex passing closely over the center section of a very large aspect ratio wing, the previously proposed lifting line solution overestimates the magnitude of the rolling moment by a factor of two. M.V.E.

A73-31728 **Tilt-table alignment for inertial-platform maintenance without a surveyed site.** G. E. Carlson (Missouri, University, Rolla, Mo.) and M. E. Bott (McDonnell Douglas Corp., St. Louis, Mo.). *IEEE Transactions on Aerospace and Electronic Systems*, vol. AES-9, May 1973, p. 406-411.

A method for aligning the rotary tilt table for an inertial-platform maintenance facility without surveying the site is analyzed and evaluated. The method utilizes multiple measurements of the tilt-table azimuth alignment error with different inertial platforms to determine a best estimate of the alignment error. Error analysis indicates that useful facility performance can be obtained with only a small number of measurements. The tilt-table alignment accuracy can be improved as more measurements of the alignment error are made during normal facility operation. (Author)

A73-31731 **An analysis of helicopter rotor modulation interference.** I. Kadar (Grumman Aerospace Corp., Bethpage, N.Y.). *IEEE Transactions on Aerospace and Electronic Systems*, vol. AES-9, May 1973, p. 434-441. 9 refs.

In satellite-to-helicopter communications, interference exists on the incoming signal when the receiving antenna is located below the rotor blades. A bound is established for the performance of a coherent fixed-tone ranging system operating at L band in this interference environment. The scalar diffracted field beneath the rotating blades, at L band and above, is found to satisfy the criterion of Fresnel diffraction, and is computed using the techniques of Fourier optics. The diffracted field is expressed in terms of a narrow-band signal. The amplitude and phase components are calculated from a Fourier Series expansion using the FFT algorithm. The significant harmonics of the phase component of the interference combine with the base-band of the narrow-band, phase-modulated ranging signal. (Author)

A73-31737 **Exfoliation corrosion of aluminum alloys.** S. K. Ketcham and I. S. Shaffer (U.S. Naval Material Command, Naval Air Development Center, Warminster, Pa.). In: Localized corrosion - Cause of metal failure; Proceedings of the Symposium, Atlantic City, N.J., June 27-July 2, 1971. Philadelphia, American Society for Testing and Materials, 1972, p. 3-16. 23 refs.

This paper is a general review of the subject of exfoliation corrosion of aluminum alloys summarizing both published and unpublished work. Present thinking on mechanisms is presented. Susceptible alloys and the corrosive environments in which exfoliation occurs are discussed, as well as effect of varying degrees of exfoliation on static and dynamic fatigue strength of 7075-T6 and on life of an actual aircraft structure. Protective coatings and special heat treatments to minimize exfoliation are discussed. (Author)

A73-31740 **Significance of intergranular corrosion in high-strength aluminum alloy products.** B. W. Lifka and D. O. Sprowls (Aluminum Company of America, Chemical Metallurgy Div., New Kensington, Pa.). In: Localized corrosion - Cause of metal failure; Proceedings of the Symposium, Atlantic City, N.J., June 27-July 2, 1971. Philadelphia, American Society for Testing and Materials, 1972, p. 120-144. 39 refs.

The causes of susceptibility to intergranular corrosion in the 2XXX and 7XXX aluminum alloys are reviewed, and the susceptibility of the various tempers with regard to product serviceability is placed in perspective. The intent has been to show that susceptibility to intergranular attack in an accelerated corrosion test does not preclude, per se, reliable serviceability. It is shown that the relative rating for resistance to exfoliation and stress corrosion cracking of the principal aerospace alloys and tempers does not follow a consistent trend with regard to whether or not intergranular attack can occur. F.R.L.

A73-31743 * # **Advanced supersonic inlet technology.** N. E. Sorensen, D. B. Smeltzer, and E. A. Latham (NASA, Ames Research Center, Aerodynamics Branch, Moffett Field, Calif.). *Journal of Aircraft*, vol. 10, May 1973, p. 278-282. 13 refs.

Recently, relatively new analytical procedures have been successfully used to design bleed systems for mixed-compression inlets designed to operate efficiently up to Mach number 2.65. The procedures used constitute a major advance in inlet technology by offering a promising approach to attain high internal and external performance for mixed-compression inlets that operate over a large supersonic Mach number range. Unfortunately, there is a lack of data describing bleed hole performance characteristics to verify these procedures at high Mach numbers. This paper briefly discusses the analytical procedures for designing advanced inlet systems and suggests facility modifications wherein the procedures can be verified on large-scale inlet models up to approximately Mach number 4.5. (Author)

A73-31744 # **Nonplanar wings in nonplanar ground effect.** J. E. Davis (Acurex Corp., Mountain View, Calif.) and G. L. Harris (California Institute of Technology, Pasadena, Calif.). *Journal of Aircraft*, vol. 10, May 1973, p. 308-312. 11 refs.

A discrete singularity numerical method is developed for solving the problem of a wing in arbitrary nonplanar ground effect. Numerical calculations were performed for various thin, uncambered planar and nonplanar wings (including two wings connected in tandem) in planar and nonplanar ground effect. Some of the numerical calculations were corroborated by experiment. (Author)

A73-31746 * # **Remarks on vortex-lattice methods.** G. R. Hough (NASA, Ames Research Center, Moffett Field, Calif.). *Journal of Aircraft*, vol. 10, May 1973, p. 314-317. 6 refs.

Results are presented of some numerical experiments on simple planar configurations. The experiments serve to establish more precisely some ground rules for optimum lattice arrangements. In particular, the location of both the horseshoe vortex elements and the control points at which the surface boundary conditions are to be satisfied is uniquely determined. Questions of lattice arrangement are discussed together with numerical results and problems of control point location. G.R.

A73-31747 # **Normal mode solution to the equations of motion of a flexible airplane.** P. D. Schmitz (USAF, Aeronautical Systems Div., Wright-Patterson AFB, Ohio). *Journal of Aircraft*, vol. 10, May 1973, p. 318-320. 6 refs.

A73-31833 # **Influence of air oxygen concentration on the thermochemical stability of jet fuels (O vliianie kontsentratsii kisloroda v vozdukhe na termokhimicheskuiu stabil'nost' reaktivnykh topliv).** Ia. B. Chertkov and R. M. Kolobova. *Khimiia i Tekhnologiia Topliv i Masel,* vol. 18, no. 5, 1973, p. 47-49. 9 refs. In Russian.

Review of the operational circumstances under which jet fuels are used to propel supersonic aircraft. It is shown that fuel oxidation may be expected to drop to a minimal level at an altitude of 20 km while, in its interaction capabilities, the air approaches the character of an inert gas. M.V.E.

A73-31905 # **An approximate method for the calculation of the velocities induced by a wing oscillating in subsonic flow (Un método aproximado para el cálculo de las velocidades inducidas por un ala, oscilando en el seno de una corriente subsónica).** F. J. Alvarez Vara, J. M. Poncel Iñiguez, and J. J. Martínez García (Escuela Técnica Superior de Ingenieros Aeronáuticos, Madrid, Spain). *Ingeniería Aeronáutica y Astronáutica,* vol. 24, no. 128, Nov.-Dec. 1972, p. 7-15. In Spanish.

The perturbation velocity potential for the oscillating wing is investigated, taking into account an approximation provided by the linearized theory. Semianalytical expressions and alternative forms of functions are presented and asymptotic relations are derived for large values of the variable. G.R.

A73-32063 Mathematical model for nonstationary linear aero-autoelasticity. S. M. Belotserkovskii. *(Akademiia Nauk SSSR, Doklady,* vol. 207, Nov. 21, 1972, p. 557-559.) *Soviet Physics - Doklady,* vol. 17, May 1973, p. 1048-1050. Translation.

The behavior of an elastic flight body is analyzed that moves through a continuous medium. The study of its flight control involves the combined solution of problems of aerodynamics, automatic control, and elasticity theory. This problem complex is therefore termed aeroautoelasticity. The analysis uses a rigorous approach based on linear nonstationary theory. M.V.E.

A73-32126 # **Comments to the integral equation of the supporting rectangular plane (Bemerkungen zur Integralgleichung der tragenden Rechteckfläche).** H. Schubert (Halle, Universität, Halle, East Germany). In: Continuum mechanics and related problems of analysis. Moscow, Izdatel'stvo Nauka, 1972, p. 677-685. 6 refs. In German.

A thin rectangular airfoil in parallel flow at a small angle of attack is considered. The flow characteristics are analyzed, taking into account the Prandtl theory of the acceleration potential (1936) with the Euler equations. The mathematical assumptions inherent in the analysis are discussed together with a transformation and the investigation of the obtained function. The integral equation derived is transformed into the integral equation of Weissinger (1963). G.R.

A73-32163 A numerical integration method for the determination of flutter speeds. A. J. Bell and D. M. Brotton (University of Manchester Institute of Science and Technology, Manchester, England). *International Journal of Mechanical Sciences,* vol. 15, June 1973, p. 473-483. 9 refs. Research supported by the Science Research Council.

A method of determining the flutter speed of a structural system using a numerical integration method is described. The response of the system to a random disturbance is determined at various wind speeds. From these the system dampings are calculated and the wind speed for which damping is zero is the flutter speed. The method has been developed for application to suspension bridge problems in which the flutter modes are not known functions and to configurations involving structural and aerodynamic nonlinearities. (Author)

A73-32186 # **Aircraft noise and prospects for its control.** J. E. Ffowcs Williams (Cambridge University, Cambridge, England) and D. G. Crighton (Imperial College of Science and Technology, London, England). *Science Progress,* vol. 60, Winter 1972, p. 429-447. 5 refs.

This article describes the progress achieved in the last 20 years in the theoretical understanding and practical control of a variety of noise source mechanisms which operate in jet engines. The main features of the noise fields associated with the jet exhaust, at high and low speeds, with rotating machinery and with sources within the engine are described, with an assessment of the current position, and of future trends, in the quest for the quiet aircraft. (Author)

A73-32190 # **Fatigue tests of wing spar samples (Unavove zkousky vzorku pasnic kridla).** V. Kahanek. *Zpravodaj VZLU,* no. 2, 1973, p. 7-21. 7 refs. In Czech.

Results of static and fatigue tests of lower wing spar elements typically used in the root sections of small trainer and passenger aircraft. The samples were tested at stress levels employed in testing complete wing structures. This made it possible to determine the scatter in fatigue properties required in calculations of safe fatigue life. Results obtained with 24 samples were used to construct an S-N curve that provides a quantitative measure of lifetime. T.M.

A73-32191 # **Some findings from a preliminary fatigue experiment with model light-alloy specimens (Nektere poznatky z nastupniho unavoveho experimentu s modelovymi vzorky z lehke slitiny).** V. Nejedly. *Zpravodaj VZLU,* no. 2, 1973, p. 23-35. 16 refs. In Czech.

Discussion of the results of fatigue tests carried out with a nonhomogeneous set of model specimens of the root section of helicopter main rotor blades. The preliminary tests considered were carried out with specimens made from an Al-Cu-Mg-Mn-Si-Cr-Ti light alloy. The initial results demonstrate the effects of a number of material and technological factors associated with the fabrication of these complex elements. The influence of these factors on the fatigue properties is evaluated using simple graph-analytical methods of mathematical statistics. T.M.

A73-32194 * # **Nuclear air cushion vehicles.** J. L. Anderson (NASA, Lewis Research Center, Cleveland, Ohio). *American Ordnance Association, High-Performance Ships Symposium, Washington, D.C., May 8, 9, 1973, Paper.* 39 p. 42 refs.

This paper serves several functions. It identifies the 'state-of-the-art' of the still-conceptual nuclear air cushion vehicle, particularly the nuclear powerplant. Using mission studies and cost estimates, the report describes some of the advantages of nuclear power for large air cushion vehicles. The paper also summarizes the technology studies on mobile nuclear powerplants and conceptual ACV systems/missions studies that have been performed at NASA Lewis Research Center. (Author)

A73-32203 # **A method for complex design of axial-flow compressor stages at the mean streamline (Metoda komplexniho navrhu stupne axialniho kompresoru na stredni proudnici).** Z. Hujecek and V. Vanek. *Zpravodaj VZLU,* no. 1, 1973, p. 21-28. 5 refs. In Czech.

A73-32351 # **Runway visual range (Startbahnsicht).** F. Stauffert. *Zeitschrift für Meteorologie,* vol. 23, no. 3-4, 1972, p. 117-120. In German.

The runway visual range has been defined by the ICAO as the greatest distance in takeoff or landing direction at which the runway or the light illuminating its boundaries can be seen from a point which is located at a height of 5 m above the runway center line. The various factors affecting the runway visual range are discussed, giving

attention to the light intensity, ideal achromatic threshold values, practical threshold values, and environmental brightness conditions. G.R.

A73-32362 **Dallas/Fort Worth - A giant among airports.** T. M. Sullivan (Dallas/Fort Worth-Airport, Tex.). *Airport Forum,* May 1973, p. 31,33-37, 39-42. In English and German.

The jumbo jetport, going up midway between Dallas and Fort Worth, covers more than 27 square miles. On opening, the airport will provide a three-runway layout capable of simultaneous aircraft operations, with a total of 66 passenger gates and 12 cargo gates. Some 8,000,000 passengers are anticipated, during the first year of operations. The passenger will find himself concerned with only one small terminal area. Ticketing, check-in services and baggage check, as well as lunch counters and personal service facilities will be in close proximity to the check-in areas. Access roads and the internal transportation system are also discussed together with air cargo planning and the airport's impact on the environment. G.R.

A73-32363 **The difficulties of airport capacity planning.** G. A. Champniss and C. J. Phillips (British Airports Authority, London, England). *Airport Forum,* May 1973, p. 43, 44 (5 ff.). In English and German.

It is impossible to achieve perfection in the design of an airport because there are so many conflicting interests. While the airport designer will attempt to forecast the needs for ten to fifteen years ahead, many changes are likely which will have a serious effect on the operation of the airport. The main factors affecting the capacity of the airports include the passenger handling capability, the runway capacity, the capacity of the ground movement guidance and control system, the terminal area capacity, the apron capacity, the method of air traffic control operation, the ground access, the aircraft mix, and the weather. G.R.

A73-32364 **Roskilde - Copenhagen's first satellite.** N. Thorsboll (COWICONSULT, Copenhagen, Denmark) and K. P. Harboe (Danmarks Tekniske Hojskole, Lyngby, Denmark). *Airport Forum,* May 1973, p. 53-61. In English and German.

Roskilde airport is an element in a projected system of airports to serve the Copenhagen metropolitan area. The system will comprise a central airport for large commercial aircraft operations and a number of satellite airports along the boundaries of the metropolis to serve general aviation and some of the domestic traffic. The planning stage for the airport is discussed together with the general layout, the pavements, drainage system, lighting and navigation aids, buildings, and figures concerning the major operations involved in building the airport. G.R.

A73-32365 **The VFW 614 on the airport.** G. Kern (Vereinigte Flugtechnische Werke-Fokker GmbH, Bremen, West Germany). *Airport Forum,* May 1973, p. 77, 78, 80-87. In English and German.

A jet aircraft capable of replacing the often obsolescent propeller-driven models presently in use is needed for short-haul air travel, particularly in areas with low traffic volume. However, up to the present there has been no aircraft of suitable capacity and technology available for this purpose. In order to fill this gap, the VFW 614, a twin-jet low-wing aircraft, has been especially designed for economic low-density short-haul operation. The VFW 614 can carry 44 passengers over a distance of up to 650 nautical miles. The M45 H-501 engine is an advanced technology bypass model. Aspects of aircraft handling are discussed together with manoeuvrability on the ground and runway loads. G.R.

A73-32366 **Airport fire precautions.** L. Scheichl (Bundesministerium der Verteidigung, Bonn, West Germany). *Airport Forum,* May 1973, p. 101, 103, 104 (6 ff.). In English and German.

The basic steps taken to preserve aircraft from fire must observe two principles, the principle of maximum distance between the danger areas, and the principle of separation of the ignition sources. Ground measures include air-navigation facilities, airport lighting, facilities and measures to eliminate the dangers due to obstructions and to overrunning the end of the runway, snow clearance, runway deicing, and fog dispersal. One special method of preventing crash fires is that of foaming the runway. Two mechanisms are discussed to explain the effect of the foam carpet. Various approaches of fighting crash fires are considered, giving attention also to fire fighting rockets and the fighting of crash fires on small or 'poor' airports. G.R.

A73-32414 **Aircraft noise: Should the Noise and Number Index be revised.** London, HMSO, 1972. 14 p. $0.50.

A comparison and evaluation of the findings of the first (1961) and second (1967) surveys of aircraft noise nuisance near London (Heathrow) Airport leads to recommendations based on technical grounds against modification of the presently employed formula for calculating the Noise and Number Index (NNI). It is also considered that any change in such a well established scale as the NNI would have some disadvantages even if the modifications would in themselves be of benefit. T.M.

A73-32415 **Aircraft noise: Selection of runway sites for Maplin Airport.** London, HMSO, 1972. 15 p. $0.50.

A previous study on the choice of runway sites for an airport at Maplin, England is examined from the viewpoint of the significance of aircraft noise as a site selection factor. The quality of information supplied about noise effects in the form of the noise and number index (NNI) is evaluated in technical terms, and the impact of predicted noise levels on future urban growth in the vicinity of the airport is discussed. T.M.

A73-32421 # **Radio devices for flight vehicle control systems (Radioustroistva sistem upravleniia letatel'nymi apparatami).** S. A. Volkovskii, E. I. Onoprienko, and V. A. Savinov. Moscow, Izdatel'stvo Mashinostroenie, 1972. 408 p. 38 refs. In Russian.

Detailed information is presented concerning radio devices and radio systems used for controlling various types of flight vehicles - rockets, spacecraft, and automatically controlled aircraft. The topics discussed include the principles of radio control of flight vehicles, radio signals and devices used in control systems, the effect of noise on radio communication, radio systems for measuring the coordinates of motion of flight vehicles, radio systems for transmitting data, radio complexes for controlling jet-powered missiles and aircraft, and radio complexes for controlling spacecraft. A.B.K.

A73-32426 **Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volumes 1 & 2 (Electronique et aviation civile; Colloque International, Paris, France, June 26-30, 1972, Communications. Volumes 1 & 2).** Conference sponsored by the Union des Associations Techniques Internationales and Société des Electriciens, des Electroniciens et des Radioélectriciens. Paris, Editions Chiron, 1972. Volume 1, 629 p.; vol. 2, 475 p. In French and English. Price of volume 1, $13.45; volume 2, $11.90.

The sessions were devoted to telecommunications, radar and air traffic control, navigation, reliability and safety, landing, and pilotage. Among the subjects discussed are computer-aided design and testing of large antennas, runway surveillance equipment, elimination of clutter, various radar devices, air traffic control problems, self-reconfiguring computer complexes for ATC systems, automation, tracking methods, data processing systems, distance measuring equipment, Doppler VOR developments, inertial navigation systems, operational surveillance of the 300B Airbus, and optimization of electronic equipment. Attention is given to a nonimage glide path antenna, bad weather automatic approach for helicopters, microwave guidance, and pilot display equipment. F.R.L.

A73-32427 **Application of digital transmissions to an Aerosat system (Application des transmissions numériques à un système Aérosat).** G. David (Télécommunications Radioélectriques et Téléphoniques, Le Plessis-Robinson, Hauts-de-Seine, France). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 1. Paris, Editions Chiron, 1972, p. 5-19. 10 refs. In French.

To resolve the problems of compatibility imposed by the variety of supports to be considered and the information to transmit, an attempt is made to show the advantages of a system where all the information is digitized and transmitted with the help of a data transmission system of high output. Such a solution corresponds to the actual tendency where more and more the machines deal with each other without human intervention. The base digital channel should be capable of carrying on a telephonic conversation. The choice of a process of digitization of vocal signals, the use of a delta coding in a transmission network, control and surveillance, and the channeling of messages are discussed. F.R.L.

A73-32428 **Data Link and Aerosat - Study of a common on-board equipment (Data Link et Aérosat - Intéret d'un équipement de bord commun).** M. Duquenne (Télécommunications Radioélectriques et Téléphoniques, Le Plessis-Robinson, Hauts-de-Seine, France). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 1. Paris, Editions Chiron, 1972, p. 20-32. In French.

A review of the problems posed by the integration of on-board Data Link and Aerosat materials indicates that it is possible to define a common UHF receiver. The Data Link can make use of the emission amplifier of the Aerosat system. From the interface point, with the on-board equipment, studies now in progress should make it possible to arrive at a common solution. The possibility of integrating the two equipments appears more attractive than on the synoptic plan. F.R.L.

A73-32429 **VOLMET transmission automation with the aid of the 'DECLAM' system using a speech synthetizer (Automatisation des émissions VOLMET à l'aide du système 'DECLAM' utilisant un synthétiseur de parole).** D. Flichy (CIT-Alcatel, Centre de Villarceaux, Nozay, Essonne, France). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 1. Paris, Editions Chiron, 1972, p. 66-73. In French.

A73-32431 **The Corail radar - Automatic equipment for runway surveillance (Le radar Corail - Equipement de surveillance automatique des pistes).** R. Davidson (Paris, Aéroport, Paris, France) and M. Schneider (Laboratoire Central de Télécommunications, Villacoublay, Yvelines, France). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 1. Paris, Editions Chiron, 1972, p. 82-89. In French.

The Corail radar ensures, under the most unfavorable conditions of visibility, the automatic surveillance of a runway and of the approach zone in the landing procedure. It compares at any instant the data which it recovers from different motions with preestablished criteria and releases an alarm to the control tower when an unusual event occurs. The flight controllers are immediately informed of the nature and locality of the incident, and can thus take the necessary precautions. The Corail is a monopulse Doppler radar. F.R.L.

A73-32434 **Use of associative processors for radar data processing in air traffic control systems.** H. Ebert (Telefunken AG, Ulm, West Germany). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 1. Paris, Editions Chiron, 1972, p. 115-124.

A73-32435 **Relay of radar information (Déport des informations radar).** M. Faÿsse and M. Duquesne (Direction de la Navigation Aérienne, Service Technique, Paris, France). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 1. Paris, Editions Chiron, 1972, p. 125-135. In French.

The control of air traffic is accomplished in France in the three centers of Paris, Aix-en-Provence, and Bordeaux, while the radar stations are distributed throughout the territory. So that the controllers may have a complete radar image, it is indispensable that the information can be relayed from the station to the control center over a distance which may reach several hundred kilometers. The system used is a narrow band digital relay carried by telephone line. On arrival at the control center the information enters directly into a computer which generates an entirely synthetic radar image which can feature the plots issued from several radars, as well as alphanumerical information. F.R.L.

A73-32437 **The air traffic control R & D program of the Federal Aviation Administration.** D. R. Israel (FAA, Washington, D.C.). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 1. Paris, Editions Chiron, 1972, p. 148-163.

A73-32438 **Superposition of goniometric vectors on the radar image (Superposition des vecteurs gonio sur l'image radar).** M. Millot (Société Industrielle des Nouvelles Techniques Radioélectriques et de l'Electronique Française, Asnières, Hauts-de-Seine, France) and M. Neu (Rohde et Schwarz France, Paris, France). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 1. Paris, Editions Chiron, 1972, p. 164-170. In French.

The advantages of radio direction finding involve its ability to function in conditions where radars can only work with difficulty (e.g., certain types of clouds, or a radar target so low that it cannot be distinguished from a chain of mountains). On the other hand, a radio direction finder has advantages if it is desired to observe an aircraft which is outside the zone covered by a given radar. In this case, a biangulation or a triangulation, eventually superposed on a radar image, is of great interest. In addition to the possibility of thus putting a direction finding display at the disposition of the controller, this superposition represents a procedure of identification of echoes presented on the radar screen which is not laborious. F.R.L.

A73-32439 **Self-reconfiguring computer complexes for A.T.C. Systems.** M. Freedman (Plessey Co., Ltd., Weybridge, Surrey, England). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 1. Paris, Editions Chiron, 1972, p. 171-177.

A computer complex which has been specially designed for air traffic control systems is described which combines the advantages of two previous approaches, one of which was for an experimental electronic telephone exchange at Morris, Ill., and the other the No. 1 ESS (Electronic Switching System) which is now the standard medium-to-large telephone exchange in the United States. The computer complex uses only one or two redundant modules of each type, but includes built-in hardware for fault detection. It is suggested that anyone setting out to design an ATC system with an availability requirement similar to that specified for the U.S. en route system should seriously consider the use of self-reconfiguring computer complexes. F.R.L.

A73-32440 **Hard/soft optimization of ATC systems (Optimisation hard/soft des systèmes ATC).** M. Lepetit (TVT, Meudon, Hauts-de-Seine, France). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 1. Paris, Editions Chiron, 1972, p. 178-184. In French.

Derivation of criteria for the optimal selection of techniques to be used in radar information processing systems. The application of these criteria is illustrated by a specific example of hardware and

software selections made for the optimal implementation of a set of defined functions. M.V.E.

A73-32441 **Automation of the print-out of strips of flight plans for air traffic control (Automatisation de l'impression des strips de plans de vol pour le contrôle du trafic aérien).** M. Hebert (Société Anonyme d'Etudes et Réalisations Nucléaires, Paris, France). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 1.
Paris, Editions Chiron, 1972, p. 185-192. In French.

A73-32442 **Functioning in multiprocessing of two 10020 computers at the Bretigny Eurocontrol Experimental Center (Fonctionnement en multitraitement de deux ordinateurs 10020 au Centre Expérimental Eurocontrol de Brétigny).** A. Dumont (Compagnie Internationale pour l'Informatique, Vélizy-Villacoublay, Yvelines, France). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 1.
Paris, Editions Chiron, 1972, p. 193-202. In French.

A73-32444 **Automated system of mixed /civil and military/ control (Système automatisé de contrôle mixte /civil et militaire/).** P. Abraham (Société Industrielle des Nouvelles Techniques Radioélectriques et de l'Electronique Française, Asnières, Hauts-de-Seine, France). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 1. Paris, Editions Chiron, 1972, p. 211-218. In French.

Following definition of the requirements and functions of a mixed civil and military airspace control system, the air traffic control equipment and air-defense materiel capable of implementing such a system are discussed. As an example of a system of this kind, the MINISTRIDA system, in particular, is described. M.V.E.

A73-32445 **CIRCA - An air traffic control system (CIRCA - Système de contrôle de la circulation aérienne).** M. Tetreau (ISS, Paris, France). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 1. Paris, Editions Chiron, 1972, p. 219-225. In French.

Review of the purposes, circumstances, functions, hardware and software organization, and operations start of the CIRCA air traffic control system. The considerable programmed-logic integration possibilities afforded by the CIRCA equipment and the latter's functional flexibility are discussed. M.V.E.

A73-32446 **Operational control.** M. Farooq (International Civil Aviation Organization, Baghdad, Iraq). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 1. Paris, Editions Chiron, 1972, p. 233-237.

Operational control has been defined as the exercise of authority over initiation, continuation, diversion, or termination of flight. In many cases, it has become either impossible or unpracticable for the pilot in command to assess alone all the various factors requiring consideration prior to and during a flight operation. Approval of the flight plan requires generally joint agreement by the pilot in command and the qualified ground personnel. The continued assessment of weather information, monitoring of adequacy of fuel, and recommendations of alternative plans necessitate an extension of the preflight duties throughout the course of the actual flight operation. G.R.

A73-32447 **Some remarks on operational problems associated with the introduction of automatic data processing into air traffic control.** H. Günter (EUROCONTROL, Brussels, Belgium). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 1.
Paris, Editions Chiron, 1972, p. 238-246.

A73-32448 **MADAP - Implementation of a large size real time data processing system.** R. Ehrmanntraut (Eurocontrol, Beek, Netherlands). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 1.
Paris, Editions Chiron, 1972, p. 247-258.

Some historical facts and the purpose of the MADAP system are given. The operational, technical, and software characteristics of the system are explained in a way, so that the auditor may get an impression on the size of the system and the real-time software task. It is rather aimed at characterizing the system than describing it. After this, the different phases of the MADAP implementation are discussed, whereby false estimations at the beginning and the necessary remedy actions are highlighted. Some statistics are given concerning the staff situation, work allocation and usage of computer time. Finally it is tried to make an analysis of some events of the contract which may be considered as being successful.
(Author)

A73-32449 **PRS-system for determination of position of flight inspection aircraft for control of ILS-and VOR facilities.** T. Breien (Trondheim, Universitetet, Trondheim, Norway) and B. Forssell (Norwegian Institute of Technology, Trondheim, Norway). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 1.
Paris, Editions Chiron, 1972, p. 277-282.

A73-32451 **A low-cost phased-array airborne weather radar.** R. A. Applegarth (Aradar Corp., Plymouth Meeting, Pa.). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 1.
Paris, Editions Chiron, 1972, p. 292-296.

The phased-array X band radar described is suitable for use in light aircraft including single-engine types for weather detection and ground mapping. For use in a single-engine aircraft the entire antenna and transmitter/receiver must fit inside the wing with no bulges and with a minimum effect on the aircraft structure. The resolution displayed should provide sharply defined mapping of large bodies of water and shore lines. The design approaches selected to satisfy the various requirements are discussed. G.R.

A73-32452 **Doppler VOR developments in Australia.** B. R. Johnson and J. G. N. Lee (Amalgamated Wireless /Australasia/, Ltd., Alwych, London, England). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 1. Paris, Editions Chiron, 1972, p. 297-305. 12 refs.

It is pointed out that Doppler VOR provides a VOR system which is entirely compatible with existing VOR receivers and overcomes a wide variety of site problems whilst producing a fundamentally more accurate system. The economics of Doppler VOR are discussed together with system problems, giving attention to the blending function, the antenna system, and questions of ground measurement and monitoring. A system description is given, taking into account the transmitter, aspects of sideband generation, blending function generation, and reference modulation. Questions of flight measurements and instrumentation are also considered. G.R.

A73-32453 **Special VOR systems (Systèmes VOR spéciaux).** M. de la Chapelle (Thomson-CSF, Levallois, Hauts-de-Seine, France). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 1. Paris, Editions Chiron, 1972, p. 306-315. In French.

Review of the French VOR system development effort, started in 1970 and aimed at the definition of a single type of equipment capable to operate on any site at performance levels meeting ICAO standards. The description of antenna systems, the effort's main application object, is given special attention. M.V.E.

A73-32454 A VOR sensor of advanced design - The Bendix RVA-33A. J. L. Whittaker (Bendix Corp., Avionics Div., Fort Lauderdale, Fla.). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 1. Paris, Editions Chiron, 1972, p. 316-323.

Advances in available technology and the decision by the airline industry to define an ILS sensor for autoland systems separate from the VOR sensor, have resulted in the development of a new VOR sensor of revolutionary design. Specific features which differentiate the RVA-33A from the device formerly used include receiver improvements, digital outputs, new analog outputs, constant deviation, data smoothing, and the absence of moving parts. G.R.

A73-32455 Presentation of the area navigation computer-TCE-71 A. A. Beriot (Thomson-CSF, Malakoff, Hauts-de-Seine, France). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 1. Paris, Editions Chiron, 1972, p. 324-332.

A description of the system is presented, giving attention to the navigation computer unit, the control display unit, and the automatic data entry unit. The system operating modes are discussed together with sensor inputs, system concept, aspects of lateral navigation, vertical navigation, waypoint parameter storage, and reversion to sensor outputs. Questions of system input and output are considered together with the control display unit and system main features and specifications. G.R.

A73-32456 Principle and results of the Doppler VOR system. H. Popp (Standard Elektrik Lorenz AG, Stuttgart, West Germany). In: Electronics and civil aviation, International Conference, Paris, France, June 26-30, 1972, Reports. Volume 1. Paris, Editions Chiron, 1972, p. 333-345.

In the national airway structures, cockpit navigation of civil aircraft is primarily accomplished by reference to the VOR/DME radio navigation system. The azimuth and distance information when processed by an airborne computer can be used as basis for area navigation. The bearing information transmitted by a VOR station can suffer deterioration of signal quality as a result of wave propagation disturbances. The Doppler VOR practically eliminates the drawbacks of the conventional VOR system. The degree of signal quality improvement under poor siting conditions corresponds to a factor between 5 and 8 as operationally demonstrated. By insertion of an additional frequency-modulated reference signal, the bearing accuracy can be increased to plus or minus 0.5 degree. (Author)

A73-32457 The MGC 30 inertial system (Le système inertiel MGC 30). J. Hardouin (Société d'Applications Générales d'Electricité et de Mécanique, Paris, France). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 1. Paris, Editions Chiron, 1972, p. 346-355. In French.

Description of the French MGC 30 inertial navigation system designed to meet fully but economically the requirements of civil aviation. Following a review of the physical and technological aspects of its design, with special attention to its inertial platform, gyroscopes, accelerometers, electronics, and digital subassembly, the ease of its maintenance is discussed, along with its application range. M.V.E.

A73-32458 Operational monitoring of the A 300 B airbus (Surveillance opérationnelle de l'airbus A 300 B). M. Le Bouar and A. Moline (Société Nationale Industrielle Aérospatiale, Blagnac, Haute-Garonne, France). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 1. Paris, Editions Chiron, 1972, p. 357-364. In French.

Review of the passive and active monitoring provisions meeting the operational supervision requirements of the A 300 B airbus. A discussion of the visual and aural routine and emergency-warning active indicator system is followed by a brief outline of the passive system of digital flight data recording, acquisition, and entry. M.V.E.

A73-32459 The safety, the reliability, and redundancy in the automatic flight control system of the A300-B Airbus (La sécurité, la fiabilité, la redondance dans le système de contrôle automatique du vol de l'Airbus A300-B). J. Bodin (Société Française d'Equipements pour la Navigation Aérienne, Vélizy-Villacoublay, Yvelines, France). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 1. Paris, Editions Chiron, 1972, p. 365-376. In French.

A73-32460 Onboard electronic equipment optimization and redundancy (Optimisation des équipements électroniques de bord et redondance). J. de Corlieu (Thomson-CSF, Bagneux, Hauts-de-Seine, France). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 1. Paris, Editions Chiron, 1972, p. 377-384. In French.

The optimization of redundancy in application to onboard electronic equipment for civil and military aircraft is discussed. In particular, the hypotheses underlying the concept of reliability are reviewed, along with future trends in the philosophy and practices of reliability and redundancy. M.V.E.

A73-32461 An ILS sensor for fail operative automand systems - The Bendix RIA-32A. J. L. Whittaker (Bendix Corp., Avionics Div., Fort Lauderdale, Fla.). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 1. Paris, Editions Chiron, 1972, p. 385-394.

The receiver sections of the RIA-32A, in both the localizer and the glide slope, are conventional superheterodynes. Fixed tuned bandpass is utilized together with preselectors and triple conversion. Two areas were given particular attention in the receiver design, including the IF selectivity package and the AGC filter. The deviation circuits are discussed together with the integrity monitor, the failure mode and the effect analysis, the self-test features, and the malfunction memory. G.R.

A73-32462 ARINC-573 recording system - Application to maintenance (Système d'enregistrement ARINC 573 - Application à la maintenance). C. Jouvenot (Société de Fabrication d'Instruments de Mesure, Massy, Essonne, France). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 1. Paris, Editions Chiron, 1972, p. 405-412. In French.

Discussion of the use of data from onboard flight parameter recorders in the solution of problems of aircraft maintenance and for improving the cost efficiency of airborne materiel. While the art of so using these flight record data is as yet far from perfection, such a utilization of these data is illustrated by a few specific examples including the cases of the Mercure and A-300 Airbus aircraft prototypes. M.V.E.

A73-32463 A non-image glide path antenna. O. H. Longva (Trondheim, Universitetet; Norwegian Institute of Technology, Trondheim, Norway). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 1. Paris, Editions Chiron, 1972, p. 426-432.

The described design of the glidepath antenna for an ILS system takes into account the specifications of the Convention of Interna- Pasadena, Calif.). *Optical Engineering,* vol. 11, Nov.-Dec. 1972, p. 119-126. Contract No. NAS7-100.

The digital star tracker represents a novel departure from previous analog designs in terms of circuit implementation and operational capabilities. As an element of an all-digital spacecraft control system, it combines proven low-level analog signal processing with digital error control and command functions. Additional capabilities that are obtainable with the digital circuitry include programmable intensity threshold gates, commanded electronic pointing control, and an acquisition/control algorithm which minimizes the effects of straylight disturbances. The capabilities inherent in the implementation have been successfully demonstrated in a laboratory model of the instrument. (Author)

A73-32464 An instrument approach system for Hong-Kong International Airport. E. J. Proctor (Civil Aviation Department, Queensway, Hong Kong). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 1. Paris, Editions Chiron, 1972, p. 433-445.

Hong Kong has but a single runway extending into the sea for which one approach is provided with Instrument Landing guidance in more or less the conventional configuration. The other approach to the runway is currently a visual one necessitating two 45 deg turns because of nearby mountains and airspace restrictions. In an effort to provide some form of instrument guidance on this approach, certain feasibility trials have been carried out with the normal elements of an Instrument Landing System and which would provide guidance for approaching aircraft to within two miles of touchdown after which a visual approach with one 45 deg turn would be required for landing. This paper deals with the ideas behind, and the feasibility trials of, an unusual Instrument Approach System at Hong Kong International Airport. (Author)

A73-32465 Automatic helicopter approach in poor visibility (L'approche automatique des hélicoptères par mauvaise visibilité). D. Autechaud (Société de Fabrication d'Instruments de Mesure, Massy, Essonne, France). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 1. Paris, Editions Chiron, 1972, p. 446-452. In French.

Problems associated with helicopter landing approaches in poor visibility are discussed, along with the flight security aids designed to solve these problems. Following a review of typical civil and military helicopter tasks, and of helicopter-flight and landing-approach peculiarities, particularly in poor visibility, a brief description is given of the nature and capabilities of some French materiel including ground facilities and onboard equipment that make possible safe automatic helicopter landing approaches. M.V.E.

A73-32467 The SYDAC system (Le système SYDAC). M. Presles (Direction de la Navigation Aérienne, Service Technique, Paris, France). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 1. Paris, Editions Chiron, 1972, p. 463-473. In French.

Description of the landing system SYDAC (French acronym for C-band landing system) that operates on 5000 MHz and uses the classical ILS angular coding method. Less costly than ILS, SYDAC uses simplified onboard equipment. Originally designed for meeting tactical military needs, a civil aviation SYDAC version has been designed for secondary airports, including STOL ports and minor Alpine airports, that cannot afford ILS. M.V.E.

A73-32468 Microwave guidance in relation to the new operational requirements. J. Benjamin (Royal Aircraft Establishment, Radio Dept., Farnborough, Hants., England). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 1. Paris, Editions Chiron, 1972, p. 474-483. 5 refs. Research sponsored by the Civil Aviation Authority of England.

Several civil and military statements of operational requirements now exist for microwave guidance systems. All are provisional and may be modified in due course. A common feature has been the change in emphasis compared with current landing systems from 'guidance' to 'position measurement.' The widest variations are concerned with coverage requirements. Implications of position measuring capability, and operational configurations and choice of coordinate measuring system are discussed. Microwave propagation is considered, treating problems of shadowing and of fading due to ground reflections. Aspects of the microwave landing system are reviewed. F.R.L.

A73-32469 Scanning beam landing system for civil aviation in the 1970's. F. X. Kelly (Cutler-Hammer, Inc., AIL Div., Farmingdale, N.Y.). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 1. Paris, Editions Chiron, 1972, p. 484-492.

Scanning beams simultaneously provide wide volumetric coverage, highly precise information which is equally accurate at any point in the coverage, and means for discrimination against signal reflections and obstructions that are inevitable at many sites. The ground equipment produces two separate fan-shaped scanning beams. One sweeps horizontally across a relatively broad sector, e.g., 20 deg either side of the runway centerline, and the other sweeps vertically from about 20 deg above the horizontal down to the horizontal. The equipment and procedures are described and discussed. It is considered that this technology can provide solutions to specific problems for civil aviation pending the implementation of the microwave landing system. F.R.L.

A73-32470 The 'AIL-CO-SCAN' system of landing (Le système d'atterrissage 'AIL-CO-SCAN'). M. Adam (Engins MATRA, S.A., Vélizy-Villacoublay, Yvelines, France). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 1. Paris, Editions Chiron, 1972, p. 493-502. In French.

The CO-SCAN system of landing is the latest of scanning beam equipments developed by a division of Cutler-Hammer for the requirements of STOL aircraft and helicopters. Within the framework of its department of airport layout, the Matra company was led to study an economical system whose installation is not restricted by the environment. CO-SCAN is a scanning beam landing system which features 'localizer' and 'glide' functions. In practice, the system provides an approach window 13.5 km wide and 6.7 km high at a distance of 18.5 km from the beacon. F.R.L.

A73-32471 Situation errors in microwave landing systems (Les erreurs de situation des systèmes d'atterrissage en micro-ondes). P. Fombonne (Thomson-CSF, Gennevilliers, Hauts-de-Seine, France). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 1. Paris, Editions Chiron, 1972, p. 503-512. In French.

The future landing system should be much better protected than the ILS against the effects of multiple paths. This is a requirement which is found at the head of all operational specifications. If only the framework of system indicators of angles which constitute the majority of numerous proposed solutions is considered, a simple and effective means of procuring the radio link between the ground station and the aircraft would consist of equipping the former with a directional antenna. When considering only situation errors, the beating beam system combats them in a very effective way. It consists of refraining from radiating the energy where it is not useful. For the Doppler system to rival the beating beam system, it would be necessary to complicate the power supply to the network or install an on-board tracking filter. F.R.L.

A73-32472 Electronics and piloting (Electronique et pilotage). J. C. Buck (Organisme du Contrôle en Vol, Paris, France). In:

Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 1.
Paris, Editions Chiron, 1972, p. 513-516. In French.

The piloting loop consists of observations of the real track by means of available instruments, evaluation of separations between the observed track and the track desired, working out of track correction orders, and transmission of the orders by action on the flight controls. So that pilotage is correct, it is necessary that the different elements of the loop - i.e., the instruments, the pilot, and the aircraft possess certain qualities. It is there that electronics intervenes. Electronics and piloting instruments, electronics and airline pilot training, and electronics and flying qualities are discussed. F.R.L.

A73-32473 Efficient flight management - A step forward in flight safety. E. Marmisolle-Daguerre (Sperry Rand France, Puteaux, Hauts-de-Seine, France). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 1. Paris, Editions Chiron, 1972, p. 535-544.

Following a review of early blind flying instrumentation and procedures, present-day devices are described and discussed. The Sperry zero reader, a pioneer flight director system, was developed to relieve the pilot's burden. The Sperry Integrated Instrument System arrived in time for the first generation of jet transports. The most critical instrument for short-term flight management is the attitude direction indicator. Horizontal situation indicators provide a semi-pictorial display of ground track data. The radio magnetic indicator has undergone considerable change in adapting to technological progress. The instrument comparison monitor is an integrity assessment tool. A useful device for easing crew workload is the thrust rating system. Some future devices such as advanced cathode-ray tube displays are discussed. F.R.L.

A73-32474 Electronics and the pilotage of the Concorde (L'électronique et le pilotage du Concorde). R. Deque (Société Nationale Industrielle Aérospatiale, Blagnac, Haute-Garonne, France). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 1. Paris, Editions Chiron, 1972, p. 545-553. In French.

In recent aircraft, and especially with the appearance of the SST, electronics finds application in practically all systems. The importance of electronics in the fields of flying qualities and pilotage of the Concorde is discussed. The problems of pilotage and the solutions adopted to resolve them are outlined. The systems described include electric flight controls, an artificial system of restitution of forces, an electric trim computer, autostabilizers, an automatic throttle, and an automatic pilot. The systems were required to be safe in normal operation and in case of breakdown, be of minimum size and complexity, and be easy to maintain in service. Results of numerous tests carried out on the ground and in flight are described. F.R.L.

A73-32475 System of electric control of surveillance of the control surfaces of the Concorde (Système de commande électrique de surveillance des gouvernes du TSS Concorde). H. Boutva (Thomson-CSF, Issy-les-Moulineaux, Hauts-de-Seine, France). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 1.
Paris, Editions Chiron, 1972, p. 554-563. In French.

The Concorde will be the first commercial aircraft in the world truly equipped with electric linkage flight controls. The mechanical system is a safety linkage which does not intervene in any way in the course of supersonic flight. The basic concepts which led the constructors to envisage such a system are to improve the performance of the aircraft by nearly eliminating hysteresis, to reduce the friction forces considerably, and to ensure a more exact return of the control surfaces to zero. It is also expected that the integration of the systems can be improved. The aircraft is equipped with six elevons and two directional control surfaces. The Thomson-CSF equipment is described in detail, with discussion of principles. F.R.L.

A73-32476 The lowering of minima of third-level and business aircraft (L'abaissement des minima des avions d'affaires et du troisième niveau). M. Chalimon (Société Française d'Equipements pour la Navigation Aérienne, Vélizy-Villacoublay, Yvelines, France). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 1.
Paris, Editions Chiron, 1972, p. 564-575. In French.

The product considered is an aircraft of small or medium weight which must carry passengers and freight from one point to another. All the devices put on board the aircraft must work together for the success of this mission. The criteria taken into account are price, speed and range, comfort, reliability, safety, and simplicity of operation. The Mini-Tapir system is described, which is a compromise between the different criteria envisaged. The apparatus includes detectors for vertical control, a gyrometer and an accelerometer, and a static pressure reference. The Mini-Tapir system was conceived to satisfy Categories I and II weather minima. F.R.L.

A73-32477 The application of the mini-computer to the computation of the N 1 limit of a jet engine (L'application du mini-calculateur au calcul du N 1 limite d'un réacteur). L. Camberlein and G. Ferlet (Société d'Applications Générales d'Electricité et de Mécanique, Division Aéronautique, Paris, France). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 1.
Paris, Editions Chiron, 1972, p. 576-586. In French.

The evolution of technology has made it possible to develop small universal digital computers which lend themselves particularly to decentralized computation systems aboard aircraft. The system of computation of the N 1 limit of the engines of the A300-B Airbus is an example of significant utilization. The principles are reviewed and the apparatus is described, with emphasis on the characteristics of the UTD minicomputer, which can be used in many other aircraft equipments, such as inertial navigators, aerodynamic central stations, automatic pilots, and AIDS. F.R.L.

A73-32478 New structure of on-board microcomputers using large-scale integrated logic circuits (Nouvelle structure de micro-calculateurs embarqués utilisant des circuits logiques intégrés à grande échelle). J. Zirphile and J. C. Belmonte (Société Générale de Constructions Electriques et Mécaniques Alsthom, Grenoble, France). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 1.
Paris, Editions Chiron, 1972, p. 587-596. 11 refs. In French.

A73-32479 Civil avionics - The last quarter century and the next one. P. J. Klass. In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 2. Paris, Editions Chiron, 1972, p. 686-699.

A blueprint for the future drafted 25 years ago by the Radio Technical Committee for Aeronautics was based on using higher-frequency radio navigation aids such as VOR and distance measuring equipment, both of which were largely in the experimental stage. Primary radar was expected to play a key role in the terminal area, but the principal ground-based sensor for ATC was projected to be secondary radar and the airborne transponder. The driving force behind future predictions is the certainty that the number of civil aircraft which must be accomodated will increase. There must be increased use of automation, with extensive use of microelectronics. Line-of-sight limitations impose operational restraints in certain parts of the world, and can be eliminated by use of artificial satellites. Possible procedures are considered in detail. F.R.L.

A73-32480 Digital modulation procedures adapted to aeronautical transmissions by satellite (Procédés de modulations numériques adaptés aux transmissions aéronautiques par satellite). C. Olier (Télécommunications Radioélectriques et Téléphoniques, Le Plessis-Robinson, Hauts-de-Seine, France). In: Electronics and civil

aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 2. Paris, Editions Chiron, 1972, p. 706-722. 5 refs. In French.

A73-32481 **Technologies applicable to the development of an onboard L-band transmitter (Technologies applicables à la réalisation d'un émetteur de bord en bande L).** J. Maupetit (Société Anonyme de Télécommunications, Paris, France). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 2. Paris, Editions Chiron, 1972, p. 723-730. In French.

A73-32482 **Automation of the Yugoslav AFTN network and its future expansion (Automatisation du réseau AFTN Yougoslave et son expansion future).** B. Marinkovic (Savezna Uprava za Civilnu Vazdusnu Plovidbu, Belgrade, Yugoslavia). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 2. Paris, Editions Chiron, 1972, p. 731-740. In French.

The actual configuration of the Yugoslav Aeronautical Fixed Telecommunications Network (AFTN) is based on the principle of two networks in star form, because of the separation of the country in two regions for reasons of air traffic safety. The regions are Belgrade and Zagreb. The authorities undertook automation to eliminate the inconveniences of the network and the actual centers according to experience acquired by the exploitation of different automatic systems throughout the world, and by study of documentation of modern equipment. Given the flexibility of the automatic digital computer-controlled system, it is possible to envisage an expansion of the system over the short and long terms. F.R.L.

A73-32483 **Some characteristics of automated systems of air traffic control (Quelques caractéristiques des systèmes automatisés de controle de la circulation aérienne).** R. Bulin (EUROCONTROL, Brussels, Belgium). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 2. Paris, Editions Chiron, 1972, p. 741-752. In French.

Whatever may be the differences in the basic philosophy or the technique of development of flying control systems, they all have a point in common, i.e., systems of information processing in real time. It was considered useful to separate the common characteristics of these systems while taking the opportunity, as a function of acquired experience, notably at Eurocontrol, to provide indications of certain particular solutions. An attempt is made to examine the systems of information processing in real time for the control of air traffic by regrouping their characteristics in three categories: those which arise because these systems are intended for air traffic control, because the systems are in real time, and because the systems are 'overall systems.' F.R.L.

A73-32484 **Application of the visualization of radar information in television (Application de la visualisation d'informations radar en télévision).** C. Georges (TVT, Meudon, Hauts-de-Seine, France). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 2. Paris, Editions Chiron, 1972, p. 753-763. In French.

Among the images presented and put at the disposal of air traffic controllers, television takes a preponderant part. In effect, the visualization of images of air traffic control in rooms said to be daylight illuminated is more and more an operational imperative. The synthetic visualization, at a high rate of renewal of information of air traffic control issuing from automated systems of radar information processing could be secured by a system of television visualization, thus making it possible to increase the reliability and availability of the information without profoundly modifying the conditions of exploitation. F.R.L.

A73-32485 **The London Air Traffic Control Centre radar data processing system.** F. K. Spokes (Civil Aviation Authority, London, England) and P. Q. Stubbs (Plessey Co., Ltd., Weybridge, Surrey, England). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 2. Paris, Editions Chiron, 1972, p. 764-772.

During the last decade, the U.K. Air Traffic Control Display System has evolved from the crude form of dark display of primary radar, to the highly sophisticated system of today where synthetic displays of primary and secondary data, viewed in a bright environment, will be operational by the end of this year. This development has been carried out in a number of phases and the paper describes how this was implemented. In a project of this complexity it was necessary to resolve many problems as they arose. This was achieved by close co-operation between the Authority and industry. (Author)

A73-32486 **Graphical distribution in colors adapted to traffic control (La visualisation graphique en couleurs adaptée au controle de trafic).** G. Melchior (CIT-Alcatel, Paris, France). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 2. Paris, Editions Chiron, 1972, p. 773-790. In French.

Following a study carried out in the Laboratories of Marcoussis, Center of Research of the CGE, the Division of Electronic Applications of CIT-ALCATEL developed a graphic peripheric of high performance: the VG 1610 system. The characteristic which makes the device original and of interest is color. Commercial production and marketing has been achieved. The graphic visualization offers this improvement without any opposing disadvantages concerning the other performances. F.R.L.

A73-32487 **Operational utilization of an aeronautical satellite system for air traffic control over the North Atlantic.** M. O'Hagan and G. H. Stephens (Plessey Co., Ltd., Weybridge, Surrey, England). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 2. Paris, Editions Chiron, 1972, p. 791-799.

A73-32488 **Procedures and ground methods associated with the exploitation of a system of aeronautical satellites (Procédures et moyens au sol associés à l'exploitation d'un système de satellites aeronautiques).** J. de Barbeyrac and P. G. Caumon (Société d'Etudes des Systèmes d'Automation, Paris, France). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 2. Paris, Editions Chiron, 1972, p. 800-811. In French.

Attention is first given to an exposition of the actual state and the developments foreseen in the air traffic situation above the North Atlantic, under the double aspect of the channeling of communications between the aircraft and the ground, and the control of traffic. There follows a presentation of the principles of procedures of control and the channeling of communications which could be established thanks to a system of geostationary satellites. Some factors concerning certain ground elements of this system are discussed. F.R.L.

A73-32489 **Guidance of aircraft according to techniques of trajectory plotting with a clock (Guidage des avions d'après les techniques de la trajectographie à l'horloge).** J. Besson and J. Boillot (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 2. Paris, Editions Chiron, 1972, p. 812-827. 8 refs. In French.

A73-32490 **Precision DME equipment.** D. Graziani (Fabbrica Apparecchiature per Comunicazioni Elettriche Standard S.p.A., Milan, Italy). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 2. Paris, Editions Chiron, 1972, p. 828-838.

Civil and military authorities considered it necessary to adopt precision DME as a complementary aid to the new microwave landing system. The accuracy was to be better than 8 m, and since such accuracy is not possible with the ICAO DME, new techniques had to be developed solving both the problems of accuracy and security on the L band. A frequency hopping principle is described in which it is proposed to stay on each hopped channel for 3 msec (dwelling time), employing 0.1 msec for hopping from one channel to the other (settling time). F.R.L.

A73-32491 **Area navigation operational overview.** R. J. Hallabeck (Eastern Air Lines, Inc., Flushing, N.Y.). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 2. Paris, Editions Chiron, 1972, p. 839-845.

An STOL demonstration was conducted by Eastern Air Lines in 1968 in conjunction with McDonnell-Douglas, Breguet, Decca, the FAA and other supplementary avionics equipment manufacturers to investigate the feasibility of area navigation. In this demonstration on the Northeast Corridor (Boston to Washington) area navigation concepts were authenticated. There is an indication of a significant saving of time on all segments. Air traffic controller acceptance provided the major difficulty. F.R.L.

A73-32492 **Limitations in the use of all-electric systems for vital application in civil aircraft.** C. Britnell (Civil Aviation Authority, London, England). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 2. Paris, Editions Chiron, 1972, p. 846-854.

Electronic systems employed for vital applications in civil aircraft invariably have to contain a number of independent channels to ensure that the probability of loss of the whole system during a single flight is adequately remote. The great advantage of using this technique is only achieved if single faults which can affect all channels or otherwise cause total system failure can be eliminated. The difficulty of proving beyond doubt that such faults do not exist is seen to be hindering the application of electronic systems to civil aircraft and in some instances is resulting in non-electric subsystems being retained for use should the primary electronic system fail. (Author)

A73-32493 **Study of the integrity of an equipment - Application to radio altimeters for category III landing (Recherche d'intégrité d'un équipement - Application aux radioaltimètres d'atterrissage catégorie III).** R. Gallois and J. P. Landrot (Télécommunications Radioélectriques et Téléphoniques, Le Plessis-Robinson, Hauts-de-Seine, France). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 2. Paris, Editions Chiron, 1972, p. 855-860. In French.

A73-32494 **System of recording based on partial on-board processing (Système d'enregistrement fondé sur un traitement partiel à bord).** C. Gouillon (Union de Transports Aériens, Le Bourget, Seine-St-Denis, France). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 2. Paris, Editions Chiron, 1972, p. 861-876. In French.

When KLM, SAS, Swissair, and UTA (KSSU) decided to standardize their future fleet of large aircraft, one of the objectives was to equip these aircraft with an elaborate system of recording which could be used both as a management tool and for technical and operational studies. The regions in which the companies expect to profit are flight safety, flight analysis, development of an automatic landing system, and surveillance of systems and aircraft performances, e.g., engines and fuel consumption. The system of acquisition and recording of data (Aircraft Integrated Data System) which KSSU installed on its Boeing 747 and McDonnell Douglas DC-10 aircraft is in fact a very elaborate system which ensures the surveillance and the recording of about 400 parameters during all the flight phases. The system comprises an on-board digital computer which computes overlimits, analyses and preliminary diagnoses, visualization of information, and makes possible selective recording of essential information. F.R.L.

A73-32495 **Analysis of the reliability of airborne material in an airline company - Objectives and methods (L'analyse de la fiabilité du matériel volant dans une compagnie aérienne - Objectifs et méthodes).** J. L. Lesage (Secrétariat Général à l'Aviation Civile, Paris, France). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 2. Paris, Editions Chiron, 1972, p. 877-890. In French.

All major airlines carry out a permanent follow-up of the reliability of their airborne material. Overall, the methods utilized at Air France are not unique, and can be found in other European and American countries. This is due to the very good relations which exist between the technical services of different companies, which favor the exchange of information or new methods. Reliability is defined as a method of maintaining safety at an acceptable level, and a method of reducing costs. In the course of the last ten years the balance sheet of reliability studies at Air France has been largely positive. F.R.L.

A73-32496 **AIDS and operational flight control (A.I.D.S. et controle opérationnel des vols).** M. Rohou (Air France, Direction du Matériel, Orly, Val-de-Marne, France). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 2. Paris, Editions Chiron, 1972, p. 891-894. In French.

Discussion of the merits of aircraft integrated data systems (AIDS) for use on commercial passenger aircraft. Assessed as a means for verifying the soundness of each aircraft system's utilization, for studying incidents affecting flight safety and control, and for gathering data for flight statistics, AIDS is shown to be a valuable tool for optimizing the operation of commercial aircraft. M.V.E.

A73-32497 **Microwave holography application to landing without visibility (Application de l'holographie hertzienne à l'atterrissage sans visibilité).** S. Lefeuvre (Ecole Nationale Supérieure d'Electronique, d'Electrotechnique, d'Informatique et d'Hydraulique, Toulouse, France) and J. Pavaux (Ecole Nationale de l'Aviation Civile, Toulouse, France). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 2. Paris, Editions Chiron, 1972, p. 906-915. In French.

The applicability of microwave holography to all-weather landings is discussed. Following a review of holography fundamentals and the microwave usability limits compatible with sharp-image holography, various implementation alternatives capable to ensure all-weather landing safety are presented. M.V.E.

A73-32498 **ILS localizer antenna for difficult locations.** O. P. Hakonsen (Trondheim, Universitetet; Norwegian Institute of Technology, Trondheim, Norway). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 2. Paris, Editions Chiron, 1972, p. 916-927.

The localizer antenna system is usually positioned at the far end of the runway, as seen from an approaching aircraft. It radiates two signals of identical frequency, the CSB and the SBO signals. The localizer antenna may be a linear array, orthogonal and symmetric with respect to the runway center line. Steps taken to obtain an improved localizer antenna system are discussed, giving attention to the selection of log-periodic dipole antennas. G.R.

A73-32499 **Need and requirements for the ILM.** R. Schilling (Swissair AG, Zurich Airport, Switzerland). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 2. Paris, Editions Chiron, 1972, p. 928-934.

It is concluded on the basis of weather statistics that problems presented by the occurrence of fog will be essentially solved if operations in the case of RVR's of about 150 m are possible. It is very desirable that short and long haul fleets should have such operational capabilities. A number of fundamental methods for obtaining these capabilities are discussed, taking into account fail-operational autoland, approaches for fog dissipation, and fail-passive autoland plus visibility augmentation. G.R.

A73-32500 **PB-75 flight guidance system.** D. L. Beckman (Bendix Corp., Avionics Div., Teterboro, N.J.). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 2. Paris, Editions Chiron, 1972, p. 935-947.

The flight guidance system examined is considered primarily for medium to large jet transports where basic Cat IIIA operation is required. The required devices can be installed into existing air frames without primary control system modification. A system description is presented, giving attention to system operating modes, ILS control laws, redundancy and monitoring, torque slaving, and the built-in test capability. G.R.

A73-32501 **FGS-70 flight guidance system.** A. T. Kirchhein (Bendix Corp., Avionics Div., Fort Lauderdale, Fla.). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 2.
Paris, Editions Chiron, 1972, p. 948-964.

The new flight guidance system was designed primarily for general aviation, commercial and military transports, with specific attention to interchangeability, growth, maintainability, and integration between the autopilot and flight director. A system description is presented, giving attention to functional capabilities, the augmentation control laws, questions of the autopilot/flight director integration, the attitude director indicator, built-in test equipment, and problems of line maintenance. G.R.

A73-32502 **The testing and evaluation of an experimental Doppler landing guidance system.** F. G. Overbury, P. K. Blair (Standard Telecommunication Laboratories, Ltd., Harlow, Essex, England), and J. M. Jones (Royal Aircraft Establishment, Farnborough, Hants., England). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 2. Paris, Editions Chiron, 1972, p. 965-975.

A73-32503 **The multipath challenge for the microwave landing system.** L. L. Sanders (ITT Gilfillan, Inc., Van Nuys, Calif.). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 2.
Paris, Editions Chiron, 1972, p. 976-986.

One of the important objectives of a new microwave landing system (MLS) is a substantial improvement in freedom from siting effects compared to the current UHF/VHF ILS. This should provide improved accuracies at currently instrumented airports and make it practical to install the microwave equipment at airports where it is not feasible to install the UHF/VHF ILS. In this paper, the various forms of multipath reflection effects are categorized so that an engineering evaluation can be made of the success in achieving this goal. A typical model is given for each situation, together with estimates of the characteristics of the reflected signals. The major problems for the elevation guidance element include highly reflective ground and rising terrain in the approach zone. Multipath problems for the azimuth guidance element include reflections from large hangars and aircraft. There are also unique problems from moving aircraft. (Author)

A73-32504 **M.A.D.G.E. - Microwave Aircraft Digital Guidance Equipment: Description of the system (M.A.D.G.E. - Microwave Aircraft Digital Guidance Equipment: Description du système).** C. Viret (Société d'Optique, de Mécanique, d'Electricité et de Radio, Argenteuil, Val-d'Oise, France). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 2. Paris, Editions Chiron, 1972, p. 987-1002. In French.

A73-32505 **The MADGE system - Operational results and stretch potential.** M. Derwent (MEL Equipment Co., Ltd., Crawley, Sussex, England). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 2. Paris, Editions Chiron, 1972, p. 1003-1012.

Two years of test flying enables an accurate evaluation of the MADGE system to be given. The results obtained are discussed, also the influence of parasitic reflections (multipath signals). The tests were principally carried out by the Royal Aircraft Establishment, also by NATO during an evaluation of four different systems at Saint Raphael (Frejus). The MADGE system has the possibility of being extended to provide the following: (1) landing aid for civil aviation, (2) area navigation, and (3) automatic data transmission in conjunction with a ground system or a satellite. (Author)

A73-32506 **Electronic displays of flight information.** J. H. Sones (Smiths Industries, Ltd., Cheltenham, Glos., England). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 2.
Paris, Editions Chiron, 1972, p. 1013-1022.

Electronic displays are very useful because they provide the precise data required only at the time when the data are needed. Besides, the data are presented in a manner in which they can be easily assimilated. The employment of the cathode ray tube makes it possible to display a wide variety of parameters at once in a fairly small space. The characteristics of the electronic head-up display are discussed together with the symbols used for providing the information, the function of a typical head-down display, advances in colored displays, and questions of device installation. G.R.

A73-32507 **Flight-control head-up display (Dispositif de pilotage tête haute).** M. Martin (Thomson-CSF, Issy-les-Moulineaux, Hauts-de-Seine, France). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 2. Paris, Editions Chiron, 1972, p. 1023-1032. In French.

Discussion of the assessed advantages of a flight-control head-up display providing information on the velocity vector, angle of attack, potential slope, and real or synthetic ground reference data. Two types of equipment are discussed: a simple one for flight by visual observation in good visibility, and a complex one for instrument-based flight. M.V.E.

A73-32508 **Experimental testing of flight-control head-up displays (Expérimentation de dispositifs de pilotage tête haute).** M. Berjal (Compagnie Nationale Air France, Orly, Val-de-Marne, France). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 2. Paris, Editions Chiron, 1972, p. 1033-1046. In French.

Discussion of the results of a series of flight tests performed since 1965 upon five flight-control head-up display systems developed in France. The test purposes, system design, equipment installation particulars, and obtained results pertaining to each test series are reviewed, along with the merits of each system tested. Some targets for future research are pointed out. M.V.E.

A73-32509 **Experimental approach for utilization of cathode ray tube piloting instruments (Approche expérimentale de l'utilisation des instruments de pilotage à tube à rayons cathodiques).** R. Matichard (Société Industrielle des Nouvelles Techniques Radioélectriques et de l'Electronique Française, Asnières, Hauts-de-Seine,

France). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 2. Paris, Editions Chiron, 1972, p. 1047-1055. In French.

A73-32510 Instrument-panel electronic display system (Dispositif électronique de visualisation sur planche de bord). M. Coussediere (Thomson-CSF, Malakoff, Hauts-de-Seine, France). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 2. Paris, Editions Chiron, 1972, p. 1056-1065. In French.

The electronic display design desiderata generated by present and future aircraft performance trends are discussed, along with presently mastered or developing techniques and technologies that hold promise to fulfill these desiderata. Current instrument panel design philosophy is reviewed and illustrated by specific design accomplishments. M.V.E.

A73-32511 Training simulator for civil aviation schools (Simulateur d'entrainement pour les écoles d'aviation civile). G. Burny (Ateliers de Constructions Electriques de Charleroi, Charleroi, Belgium). In: Electronics and civil aviation; International Conference, Paris, France, June 26-30, 1972, Reports. Volume 2. Paris, Editions Chiron, 1972, p. 1066-1075. In French.

Review of the considerations that led to the adoption of selected design problem solutions in the development of a general-purpose training simulator for civil-aviation student pilots. In particular, the principal design and operational characteristics of the SIACEC 301 simulator are described. M.V.E.

A73-32547 # STOL and ATC. G. A. Gilbert. *CATCA Journal*, vol. 5, Spring 1973, p. 4-8.

Short haul STOL service can satisfy both metropolitan and rural transportation requirements. Typical stage lengths are under 500 miles and vary in duration from 15 minutes to perhaps two hours. Air transportation modes considered include the intercity mode, the intraurban mode, the regional jetport mode, the intrastate mode, the recreational mode, and the natural resources mode in which men and supplies are transported to remote areas. STOL landing/takeoff facilities are discussed together with questions of reliability and delays, STOL approach/departure profiles, STOL impact on ATC, navigation and surveillance, ATC system support, and prototype STOL operations. G.R.

A73-32551 Role of the Juridical Committee of the International Civil Aviation Organization in the elaboration of air law (Rôle du Comité juridique de l'Organisation de l'aviation civile internationale dans l'élaboration du droit aérien). G. Guillaume. *Secrétariat Général à l'Aviation Civile, Revue,* May 15, 1973, p. 13-19. In French.

A73-32552 The capacity concept (Le concept de capacité). G. Nepveu de Villemarceau and J.-M. de Raffin-Dourny. *Secrétariat Général à l'Aviation Civile, Revue,* May 15, 1973, p. 30-33. In French.

An attempt is made to clarify the concept of hourly airport capacity or, more generally, of an air traffic control system. Following a treatment of the hourly landing and takeoff capacity concept in terms of hourly demand as a function of mean waiting time, a statistical definition is offered that is independent of the mean wait time parameter. M.V.E.

A73-32553 All-weather landing - An economic analysis (L'atterrissage tout temps - Analyse économique). M. Fourneyron. *Secrétariat Général à l'Aviation Civile, Revue,* May 15, 1973, p. 34-40. In French.

Discussion of the technology and economics of all-weather landing, and review of its overall merits. Following a brief survey of the ground and airborne equipment involved, the results of recently performed analytical studies of benefits and costs are summarized. M.V.E.

A73-32554 History, evolution, and role of the Civil Aviation Secretariat General (Histoire, évolution et rôle du Secrétariat général à l'Aviation civile). C. Collet. *Secrétariat Général à l'Aviation Civile, Revue,* May 15, 1973, p. 41-52. In French.

Review of the genesis, evolution, and current status of the office of Secretary General for Civil Aviation since its inception in 1920. Special attention is given to the present organization of the administrative, technical, and advisory services and to the data processing systems and management structure. M.V.E.

A73-32555 Freight - The most elusive air transportation activity (Le fret - Activité la plus insaisissable du transport aérien). J. Audoin. *Secrétariat Général à l'Aviation Civile, Revue,* May 15, 1973, p. 59-67. In French.

Some of the factors involved in the air cargo transportation growth since 1945 are discussed. This growth is shown to have evolved far less regularly than the concurrent one of air passengers. Growth predictions of cargo transportation by air are presented for the next ten years. M.V.E.

A73-32556 Maintenance of public transportation aircraft - Evolution of methods (L'entretien des avions de transport public - Evolution des méthodes). M. Gouet. *Secrétariat Général à l'Aviation Civile, Revue,* May 15, 1973, p. 72-78. In French.

Brief review of conventional approaches to aircraft maintenance, and discussion of present and future trends. Traditional visual and mechanical materiel inspection techniques and the practice of applying corrective action only after findings indicating its need have been obtained are shown to give way to materiel condition monitoring techniques made possible by maintenance-biased design and by various other procedures including ultrasonic, X- and gamma-ray inspection, and lubricating and hydraulic fluid analyses, that make costly inspection dismountings unnecessary. It is felt that at some time in the future the expendable equipment concept may do away altogether with the need for maintenance. M.V.E.

A73-32557 Civil aeronautics research (La recherche aéronautique civile). R. Chanut. *Secrétariat Général à l'Aviation Civile, Revue,* May 15, 1973, p. 79-85. In French.

The changing circumstances of civil aviation research and progress are examined and discussed. In the past, progress was spurred by the fierce competition among carriers which would usually lead one of them to order new equipment while it was still in the design stage only to be soon followed by all the other carriers. Merciless competition among aircraft manufacturers also stimulated research and progress. Since the start of the present decade, the economic crisis in air transportation due largely to the new competition of nonregular carriers and the Boeing 747 introduction have changed the old patterns. Economic survival is the most urgent concern of carriers and improving air transportation economics is the most pressing task of civil aviation research. A concerted European effort is recommended. M.V.E.

A73-32558 The D.N.A. program of action (Le programme d'action de la D.N.A.). J.-M. Giraud (Direction de la Navigation Aérienne, Paris, France). *Secrétariat Général à l'Aviation Civile, Revue,* May 15, 1973, p. 88-98. In French.

Review of some of the problems faced by the French air traffic control authority, D.N.A. (abbreviation for Direction de la Navigation Aérienne). France's position at the crossing of air lanes connecting northern and southern Europe by the intercontinental East-West air lanes is shown to generate a number of challenging en-route and terminal airport area problems. Various approaches to the solution of these problems are explored and discussed. M.V.E.

A73-32559 Evolution of radio navigation (L'évolution de la radionavigation). B. Palayret (Direction de la Navigation Aérienne, Service Technique, Paris, France). *Secrétariat Général à l'Aviation*

Civile, Revue, May 15, 1973, p.99-106. In French.

Review of recent French developments in the field of radio navigation and landing-aid equipment. New Thomson-CSF ILS-371, VOR-TAH-511, and DME-TAH-720 major airport and airline equipment put on the market in 1971, 1972, and 1973, respectively, is discussed, along with simplified ILS-372 and BB-VOR, as well as SYDAC equipment for smaller airports. M.V.E.

A73-32560 The nuisance abatement effort (La lutte contre les nuisances). J.-P. Roche (Direction de la Navigation Aérienne, Service Technique, Paris, France). *Secrétariat Général à l'Aviation Civile, Revue,* May 15, 1973, p. 106-112. In French.

Discussion of some of the technological and social aspects of aircraft noise and noise abatement problems. Following a review of the origin of the airport noise problem, the latter's neutralization through noise-reducing aircraft design, removal of populations from the vicinity of airports, and noise-minimizing patterns of airport operation is considered. M.V.E.

A73-32561 Technical studies and research on airport infrastructure (Les études et recherches techniques sur l'infrastructure aéroportuaire). P. Marty. *Secrétariat Général à l'Aviation Civile, Revue,* May 15, 1973, p. 133-140. In French.

Review of recent studies on airport runway design, construction, and testing procedures. Special attention is given to airport studies concerning the load carrying capacity, antiskid characteristics, and draining properties of runways. Runway surface regularity control and optimal leveling procedures are discussed, along with various arresting devices and runway stress gauging techniques. M.V.E.

A73-32562 Meteorological satellites in the service of aeronautics (Les satellites météorologiques au service de l'aéronautique). A. Villevieille (Météorologie Nationale, Bureau de Météorologie Spatiale, France). *Secrétariat Général à l'Aviation Civile, Revue,* May 15, 1973, p. 160-168. In French.

Space-based meteorology is expected to supply at the end of the present decade the essential part of meteorological observations. It is shown that, when this happens, aeronautics should be one of the major beneficiaries of this development in terms of both aviation safety and economy. M.V.E.

A73-32563 Development of meteorological instrumentation for airports (Développement de l'instrumentation météorologique sur les aérodromes). C. Fichaux and A. Bettan (Météorologie Nationale, Centre Technique et du Matériel, Trappes, France). *Secrétariat Général à l'Aviation Civile, Revue,* May 15, 1973, p. 175-179. In French.

Description of some of the meteorological equipment that is to be used at the Roissy-en-France International Airport which is to be put in service in March 1974. In particular, the TNA 1500 telemeter for measuring the cloud base height and the LYNX transmission meter for measuring the runway visibility range are discussed. M.V.E.

A73-32581 # The flow around wings of arbitrary planform in the case of supersonic flow - A computational method (Die Umströmung von Flügeln beliebiger Grundrisse bei Überschall - Ein Berechnungsverfahren). W. Schmidt. Aachen, Rheinisch-Westfälische Technische Hochschule, Fakultät für Maschinenwesen, Dr.-Ing. Dissertation, 1972. 104 p. 22 refs. In German.

Presently known approaches for determining wing design parameters in the case of supersonic aircraft are reviewed, giving attention to the lift problem, the displacement problem, questions of coordinate transformation, Hancock's method, the Evvard procedure extended by Friedel, the partial plane method of Diesinger, and the approach proposed by Fenain. Certain disadvantages in these approaches are to be overcome by a new method based on linear potential theory. Theoretical relations are derived for steady flows. An extension of the approach to cover unsteady flows, however, is possible. The parameter values obtained with the new method in the case of lift and displacement studies are very accurate. An example shows the suitability of the computer program incorporating the new approach for the wing design in the case of a given pressure distribution. G.R.

A73-32653 Survival and Flight Equipment Association, Annual Symposium, 10th, Phoenix, Ariz., October 2-5, 1972, Proceedings. North Hollywood, Calif., Western Periodicals Co.; Canoga Park, Calif., Survival and Flight Equipment Association, 1972. 117 p. $17.50.

The survival and rescue of endangered aircraft crew members and passengers are treated in papers dealing with protective equipment, ejection systems, survival procedures, and search and rescue operations. Attention is given to survival equipment problems discovered in actual sea escape and evasion episodes in Southeast Asia, measures for head restraint during acceleration, multiple-occupant flotation devices, behavioral stress response to passenger briefings and emergency warning systems on commercial airlines, engineering solutions to air piracy, injuries induced by high-speed ejection, evaluation of jet fuels from the viewpoint of enhancing aircraft combat survivability, evaluation of fabrics for thermal protective clothing, and safety in a manned space laboratory.

Individual items are announced in this issue. T.M.

A73-32654 Restraint of the head during acceleration. E. Hendler and M. Schulman (U.S. Naval Material Command, Naval Air Development Center, Warminster, Pa.). In: Survival and Flight Equipment Association, Annual Symposium, 10th, Phoenix, Ariz., October 2-5, 1972, Proceedings. North Hollywood, Calif., Western Periodicals Co.; Canoga Park, Calif., Survival and Flight Equipment Association, 1972, p. 26-29.

The heads of volunteer subjects, who were exposed to vertical and horizontal inertial loads, were restrained by using an inflated air bag placed under the chin. The present report describes the technique used in applying impulsive loads to the body and in measuring the resultant displacements of the head. Although bag development is continuing, results obtained so far have indicated that this kind of device may prove effective in reducing nonimpact types of head injury and in maintaining optimum pre-ejection posture in ejection seats without face curtains. Some of the problems yet to be solved are discussed. (Author)

A73-32659 Certification program for the DC-10 slide/raft. W. H. Shook (Douglas Aircraft Co., Long Beach, Calif.). In: Survival and Flight Equipment Association, Annual Symposium, 10th, Phoenix, Ariz., October 2-5, 1972, Proceedings.
North Hollywood, Calif., Western Periodicals Co.; Canoga Park, Calif., Survival and Flight Equipment Association, 1972, p. 43-45.

In early November of last year, National Airlines took delivery of the first aircraft in the United States which was certified for use with evacuation slide/rafts as part of the standard equipment. The certification process for the slide/raft was unique in that no FAA Technical Standard Order was available to judge the acceptability of the slide/raft concept. In order to prove the concept, Douglas and Pacific Inflatables (PICO) presented a test plan to the FAA in early August for evaluation and approval. This test plan included nine major items which were considered critical by Douglas and PICO. These items were: (1) interface with the airframe, (2) reliability of the slide/raft, (3) pressure retention, (4) lighting of the slide/raft, (5) pool tests to prove capacity rating, (6) sea trials to prove seaworthiness, (7) personnel evacuation rate of the slide/raft, (8) on aircraft testing, and (9) compliance and/or compatibility with applicable regulations. (Author)

A73-32660 Behavioral stress response related to passenger briefings and emergency warning systems on commercial airlines. M. A. Becker (USAF, Aeromedical Evacuation Squadron, Van Nuys Air

National Guard Base; California State University, Los Angeles, Calif.). In: Survival and Flight Equipment Association, Annual Symposium, 10th, Phoenix, Ariz., October 2-5, 1972, Proceedings. North Hollywood, Calif., Western Periodicals Co.; Canoga Park, Calif., Survival and Flight Equipment Association, 1972, p. 46-50. 11 refs.

A survey of U.S. air carrier accidents between July 1954 and June 1964 which involved land planes terminating their flights in water revealed that of the 1266 passengers and crew members on board these 23 aircraft, 720 (56.9%) died. Many deaths were attributable to 'behavioral inaction.' Various incidents confirming this viewpoint are described. Airline safety procedures are normally based on a set of assumptions which have not been tested and may be unwarranted. Recommendations are made for changes which could increase the survivability for passengers following aircraft accidents. These recommendations involve briefings, practice, specialized passenger training, simplicity in directions, standardization, and load planning. F.R.L.

A73-32661 **A new approach to aircraft exterior lighting.** J. K. Crosley (U.S. Army, Aeromedical Research Laboratory, Fort Rucker, Ala.). In: Survival and Flight Equipment Association, Annual Symposium, 10th, Phoenix, Ariz., October 2-5, 1972, Proceedings. North Hollywood, Calif., Western Periodicals Co.; Canoga Park, Calif., Survival and Flight Equipment Association, 1972, p. 51-53.

Results of in-flight research to determine the most effective means of increasing aircraft visibility in the daytime through the judicious use of exterior-applied paints and tapes. Concurrently, in-flight studies have also been performed to evaluate the use of high intensity lighting as another method of enhancing daytime aircraft conspicuity. These studies have shown that xenon gas-filled discharge tubes are capable of being effective visual stimulators and have led to the design and fabrication of a day/night lighting system for U.S. Army aircraft application. A system of this type is deemed appropriate for installation on civilian as well as other military aircraft, and would significantly aid in the reduction of midair collisions. (Author)

A73-32662 **An engineering solution to air piracy.** A. P. Kelley (Talley Industries, Inc., Mesa, Ariz.). In: Survival and Flight Equipment Association, Annual Symposium, 10th, Phoenix, Ariz., October 2-5, 1972, Proceedings. North Hollywood, Calif., Western Periodicals Co.; Canoga Park, Calif., Survival and Flight Equipment Association, 1972, p. 54-57. 6 refs.

Air piracy continues to threaten worldwide civil aviation in spite of the introduction of a number of security measures designed to discourage the would-be hijacker. These measures emphasize screening passengers and luggage. This paper approaches the problem from a neglected viewpoint - the redesign and modification of aircraft systems to sever the air pirate's access and communication links to the flight crew, thus removing his means of in-flight coercion. Alterations to existing aircraft are suggested which promise an order of magnitude of cost effectiveness over current surveillance measures. (Author)

A73-32663 **The secret of time compression of training while improving safety.** A. G. Heimerdinger and J. M. McCabe (Douglas Aircraft Co., Long Beach, Calif.). In: Survival and Flight Equipment Association, Annual Symposium, 10th, Phoenix, Ariz., October 2-5, 1972, Proceedings. North Hollywood, Calif., Western Periodicals Co.; Canoga Park, Calif., Survival and Flight Equipment Association, 1972, p. 58-62.

The prime objective of the Douglas Aircraft Company training program is to prepare pilots and flight engineers for safe and efficient on-the-line operations for all possible conditions. A need was felt by both the Company and the airlines to modernize the training concepts. This need was then identified as a subgoal to the prime objective, to program a predetermined level of proficiency for aircrew members which was higher than previous standards, yet lessen the time spent in achieving this high proficiency level. With the introduction of the DC-10, we teamed up with the airlines to pool the talent and develop a scientific technique, now identified as the Instructional System Approach. The working committee quickly agreed that the primary focus in the future should not be on the airplane itself, but rather on the knowledge and skill required by the crew to operate the machine. The training program was customized to the airplane, the airline, and crew performance requirements, through analyses and development of specific behavioral objectives (SBOs). These SBOs defined and continuously evaluated the program, which has resulted in compressed, but more effective crew training. (Author)

A73-32664 **Injuries induced by high speed ejection - An analysis of USAF noncombat operational experience.** D. L. Buschman and S. E. Rittgers (USAF, Aerospace Medical Research Laboratory, Wright-Patterson AFB, Ohio). In: Survival and Flight Equipment Association, Annual Symposium, 10th, Phoenix, Ariz., October 2-5, 1972, Proceedings. North Hollywood, Calif., Western Periodicals Co.; Canoga Park, Calif., Survival and Flight Equipment Association, 1972, p. 63-66.

Survey of experience in the emergency use of ejection seat devices in the U.S. Air Force to determine the scope and severity of flail type injuries. The escapes studied constitute a complete list of ejections from aircraft flown in noncombat missions during the period from Jan. 1, 1957, to Dec. 31, 1970. Over 2500 ejection escape records were analyzed to identify all cases in which a flail type injury might have occurred. Then a further examination was made of these incidents based on detailed information from the official accident reports, aircrew statements, and the medical investigator's findings. Portions of the original data pertinent to this investigation were extracted and then combined with additional pieces of information produced by report examination. From this revised set of approximately 900 ejection escapes, it was then possible to zero in on specific injuries, their bodily location, relative incidence, and probable causative factors. Results to date have shown a significant occurrence of the windblast/flail type injury with a rapid rise in the number of cases as indicated airspeed increases. (Author)

A73-32666 **Single point emergency equipment divestment /SPEED/ system.** R. H. Frost (Frost Engineering Development Corp., Englewood, Colo.), G. D. Klotz (Teledyne McCormick Selph, Hollister, Calif.), and F. B. Pollard (Aircraft and Missile Consultants, Manhattan Beach, Calif.). In: Survival and Flight Equipment Association, Annual Symposium, 10th, Phoenix, Ariz., October 2-5, 1972, Proceedings. North Hollywood, Calif., Western Periodicals Co.; Canoga Park, Calif., Survival and Flight Equipment Association, 1972, p. 70-73.

A new single point emergency equipment divestment (SPEED) system has now been developed, successfully demonstrated, and field tested under static loads up to 600 psi with instantaneous (4 msec) release of canopy strap assemblies, lap belts, leg restraints, and parachute harness. The new system frees the wearer from the cumbersome and time-consuming task of manually releasing those critical devices necessary to his escape. SPEED consists of a modification of existing parachute and restraint hardware by combining them with an extremely mild-effects pyrotechnic actuation system incorporating HIVELITE (high velocity ignition propagation cord). SPEED is actuated by an aircrew member by simply operating a single initiation device mounted in a manifold in the belt area of the crewman's uniform or flight gear. Upon initiation, the various restraint fasteners are immediately unlatched - allowing harnesses to fall free of his body. A special feature of SPEED is that if the system is inadvertently initiated, immediate total reconnection can be accomplished very quickly in flight. (Author)

A73-32667 **Performance improvement of the F/RF-101 ejection seat system.** G. Miseyko (Stencel Aero Engineering Corp., Asheville, N.C.). In: Survival and Flight Equipment Association,

Annual Symposium, 10th, Phoenix, Ariz., October 2-5, 1972, Proceedings. North Hollywood, Calif., Western Periodicals Co.; Canoga Park, Calif., Survival and Flight Equipment Association, 1972, p. 74-77.

The present upgrade kit developed by the Stencel Aero Engineering Corporation for the F/RF-101 ejection seat is described. The various components of the kit, the rationale for their selection, and their function and description are discussed. The components included are those necessary for propulsion, trajectory control, seat divergence, and rapid parachute opening. The most complex physical change in the upgrade kit is the replacement of the catapult with a rocket/catapult. The addition of the upgrade kit provides propulsion permitting ground level ejection at velocities between zero and the maximum speed of the aircraft. F.R.L.

A73-32668 UPSTARS - A single escape subsystem providing stabilization, retardation, and separation. R. Sadler (Universal Propulsion Co., Tempe, Ariz.) and J. Johnston (USAF, Wright-Patterson AFB, Ohio). In: Survival and Flight Equipment Association, Annual Symposium, 10th, Phoenix, Ariz., October 2-5, 1972, Proceedings. North Hollywood, Calif., Western Periodicals Co.; Canoga Park, Calif., Survival and Flight Equipment Association, 1972, p. 78-80.

UPSTARS (Universal Propulsion STAbilization, Retardation and Separation) will provide seat/man stability, seat/man retardation, and seat/man separation all combined into a single subsystem. The UPSTARS program is divided into four phases: (1) computer study, analysis, and subscale evaluation testing, (2) component development, (3) system verification, and (4) system qualification. The UPSTARS concept, the program plan, and current status are described, and the UPSTARS subscale test bed used to demonstrate the feasibility of the concept is presented. (Author)

A73-32669 The ESCAPAC IE Advanced Stabilized Ejection Seat. C. M. Severance, III (Douglas Aircraft Co., Long Beach, Calif.). In: Survival and Flight Equipment Association, Annual Symposium, 10th, Phoenix, Ariz., October 2-5, 1972, Proceedings. North Hollywood, Calif., Western Periodicals Co.; Canoga Park, Calif., Survival and Flight Equipment Association, 1972, p. 81-84.

The ESCAPAC IE Advanced Stabilized Ejection Seat is the newest of the Douglas ESCAPAC series of ejection seats to be put into production. Three new subsystems are featured in this new ESCAPAC version: a STAPAC gyro controlled vernier rocket pitch stabilization subsystem, a rocket type man/seat separation subsystem and a yaw thrustor/aero vane subsystem to provide lateral divergence of trajectories for the S-3A four-place application. The ESCAPAC IE escape system was thoroughly tested by Douglas, Lockheed, and Northrop with a 100% successful recovery record for all 39 system ejection tests. These tests included single, dual, and quadruple ejections and from a speed of 0 to 450 knots. A high degree of reliability is expected from the ESCAPAC IE through its design simplicity, service proven components, fail-safe design, redundancy, and stringent qualification. Performance predictions are shown to match test results with exceedingly good correlation, thus allowing high confidence in performance predictions for adverse attitudes and inverted flight conditions. (Author)

A73-32670 Evaluation of JP8 versus JP4 fuel for enhancement of aircraft combat survivability. R. G. Clodfelter (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio). In: Survival and Flight Equipment Association, Annual Symposium, 10th, Phoenix, Ariz., October 2-5, 1972, Proceedings.
North Hollywood, Calif., Western Periodicals Co.; Canoga Park, Calif., Survival and Flight Equipment Association, 1972, p. 85-88. 5 refs.

Because of the large quantity and dispersed storage of fuel onboard aircraft, a high probability exists that gunfire hits will occur in fuel areas with consequent damaging effects of fire, explosion, and/or fuel depletion. A low penalty means for enhancing aircraft survivability is to utilize a fuel which is less susceptible to fire and explosion. The paper reviews the status of Air Force investigations directed towards the establishment of the aircraft combat survivability advantages offered by lower volatility fuels such as JP8 compared to the present Air Force operation JP4 fuel. (Author)

A73-32674 SAVER AERCAB feasibility demonstration. J. J. Barzda (Kaman Aerospace Corp., Bloomfield, Conn.). In: Survival and Flight Equipment Association, Annual Symposium, 10th, Phoenix, Ariz., October 2-5, 1972, Proceedings.
North Hollywood, Calif., Western Periodicals Co.; Canoga Park, Calif., Survival and Flight Equipment Association, 1972, p. 100.

To increase aircrewmen's chances of safe rescue after ejection over enemy environs, an advanced escape rescue capability (AERCAB) is being evaluated which would fly the crewmen away from hostile areas after ejection. The concept involves a compact deployable autogyro which folds and stows in the aircraft cockpit to serve as the crewman's seat during normal flight. In an emergency, the device ejects with the crewman and converts automatically to the flight vehicle. Completed experimental tests have verified the predicted feasibility, performance, and capability of the SAVER concept thus far. F.R.L.

A73-32676 A method of determining spinal alignment and level of vertebral fracture during static evaluation of ejection seats. B. H. Kaplan (U.S. Army, Aeromedical Research Laboratory, Fort Rucker, Ala.). In: Survival and Flight Equipment Association, Annual Symposium, 10th, Phoenix, Ariz., October 2-5, 1972, Proceedings. North Hollywood, Calif., Western Periodicals Co.; Canoga Park, Calif., Survival and Flight Equipment Association, 1972, p. 104, 105.

A73-32678 General aviation aircraft in-flight structural failures, 1960-1971. R. G. Snyder (Michigan, University, Ann Arbor, Mich.). In: Survival and Flight Equipment Association, Annual Symposium, 10th, Phoenix, Ariz., October 2-5, 1972, Proceedings. North Hollywood, Calif., Western Periodicals Co.; Canoga Park, Calif., Survival and Flight Equipment Association, 1972, p. 108.

Disastrous failure of airframe structural members may occur in light aircraft when the vertical induced velocities exceed the design gust limits. This study has analyzed data for the period 1960-1971 from National Transportation Safety Board and Federal Aviation Administration accident reports and from selected accidents investigated by the author in which in-flight failures resulted, to determine the incidence, nature, biomechanics of injury, and environmental conditions related to in-flight structural failures in general aviation operations. (Author)

A73-32794 On the possibility of turbulent thickening of weak shock waves. J. E. F. Williams and M. S. Howe (Cambridge University, Cambridge, England). *Journal of Fluid Mechanics*, vol. 58, May 8, 1973, p. 461-480. 22 refs. Research sponsored by Rolls-Royce, Ltd.

Examination of the possible thickening of an initially sharp sonic boom by the turbulence it encounters in passing to the ground. Three apparently different viewpoints, all indicating substantial thicknening, are shown to be actually identical and to give an irrelevant upper bound on wave thickness. Although a wavefront folding mechanism ultimately accounts for an apparent thicknening as individual rays are weakened and tangled by turbulence, this process is too slow to be effective in the practical boom situation. An attempt is then made to determine what linear thickening of a wave packet results from propagation through atmospheric turbulence, and it is concluded that, in the relevant limit, a wave may be thickened by a factor of about 2 at the most. The conclusion is therefore reached that atmospheric turbulence cannot be the cause of the thousandfold discrepancy between the measured wavefronts and their Taylor thickness. (Author)

A73-32802 **Experimental setup of jet simulation in a wind tunnel (Montage expérimental de simulation de jet en soufflerie).** C. Couëdor (Bréguet Aviation, Saint-Cloud, Hauts-de-Seine, France). *Association Aéronautique et Astronautique de France, Colloque d'Aérodynamique Appliquée, 9th, Saint-Cyr-l'Ecole, Yvelines and Paris, France, Nov. 8-10, 1972, Paper.* 22 p. In French.

The purpose of this purely technological exposition is to describe the test technique in a low speed wind tunnel devised for the simulation of jet outputs of the French-German 'Alpha-Jet' trainer and fire-support aircraft. The Alpha-Jet is a subsonic two-place twin jet aircraft weighing from 4.6 to 7 tons, with a moderately swept back high wing, with nozzles situated slightly upstream of and below the tail surfaces. The model, always without contact with the simulation circuit, is weighed on an internal balance. The tests were conducted jointly by Dassault/Breguet, Dornier, and the personnel of AVA Göttingen. F.R.L.

A73-32808 # **Critical study of the effects of gusts on an aircraft (Etude critique de la représentation des effets de rafales sur l'avion).** R. Hirsch, J. J. Perrin, and H. Lethuy (Société Nationale Industrielle Aérospatiale, Paris, France). *Association Aéronautique et Astronautique de France, Colloque d'Aérodynamique Appliquée, 9th, Saint-Cyr-l'Ecole, Yvelines and Paris, France, Nov. 8-10, 1972, Paper.* 27 p. In French.

The difference between other methods of studying aircraft response to gusts, which are limited to supplying overall results, and the method presented here is an attempt at detailed analysis of the phenomenon in respect to the plan and basic factors of the physical mechanism. Thus account is taken of the unsteady establishment of lift, of transitory deflection of the tail surfaces, of the effect of this in relation to the span, and finally of the deformation of the structure. Application of this method to several known and projected STOL aircraft is discussed. F.R.L.

A73-32809 # **Some aerodynamic problems applicable to the light aircraft (Quelques problèmes d'aérodynamique appliquée à l'avion léger).** Y. Gardan. *Association Aéronautique et Astronautique de France, Colloque d'Aérodynamique Appliquée, 9th, Saint-Cyr-l'Ecole, Yvelines and Paris, France, Nov. 8-10, 1972, Paper.* 7 p. In French.

The light aircraft is constructed in small numbers at a price which must not exceed 4 to 5 times the price of the average automobile. The official regulations concerning the delivery of an airworthiness certificate are very demanding concerning flight characteristics and minimal performance. Thus the engineer who conceives a light aircraft must apply his aerodynamic knowledge with a slant toward simplicity and economy. Some key ideas concerning the choice of wing characteristics, control surfaces, and general layout for a light aircraft are presented. F.R.L.

A73-32810 # **The three-dimensional turbulent boundary layer - Theoretical and experimental analysis (Couche limite turbulente tridimensionnelle - Analyse experimentale et théorique).** J. Cousteix and C. Quemard (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *Association Aéronautique et Astronautique de France, Colloque d'Aérodynamique Appliquée, 9th, Saint-Cyr-l'Ecole, Yvelines and Paris, France, Nov. 8-10, 1972, Paper.* 29 p. 12 refs. In French.

A theoretical analysis of the behavior of a three-dimensional turbulent boundary layer is carried out on the basis of similarity solutions obtained with the aid of an improved mixing length scheme. Several comparisons demonstrate that these solutions provide a family of velocity profiles (particularly the transverse velocity profile) which are in good agreement with experimental data and which can be used to construct reasonable hypotheses for developing an integral method of computation. In addition, a method of solving local equations is developed for theoretical cases such as a delta wing of infinite span. T.M.

A73-32813 # **Gust simulation in a wind tunnel (Simulation d'une rafale en soufflerie).** J. P. Le Hetet, J. Commelin, and P. Lafon (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *Association Aéronautique et Astronautique de France, Colloque d'Aérodynamique Appliquée, 9th, Saint-Cyr-l'Ecole, Yvelines and Paris, France, Nov. 8-10, 1972, Paper.* 15 p. 6 refs. In French.

Description of experimental equipment and results of wind-tunnel simulation studies of the behavior of STOL aircraft during low-velocity flight in a turbulent atmosphere near the ground. Emphasis is placed on a small-scale gust-generating facility mounted in a small subsonic wind tunnel. The gust generator consists of two airfoils positioned at the inlet of the test section and equipped with fluid flaps. The latter are provided by the use of perforated pipes running lengthwise along the airfoils and ejecting compressed air from the holes while turning about their axes. T.M.

A73-32814 # **Theoretical and experimental study of a swept-back wing at low velocity over a wide range of angles of attack (Etude théorique et expérimentale d'une aile en fleche à faible vitesse et dans un large domaine d'incidences).** M. Ledoux and B. Monnerie (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *Association Aéronautique et Astronautique de France, Colloque d'Aérodynamique Appliquée, 9th, Saint-Cyr-l'Ecole, Yvelines and Paris, France, Nov. 8-10, 1972, Paper.* 25 p. In French.

A73-32816 **Three-dimensional calculations of hypersustentation (Calculs tridimensionnels d'hypersustentation).** P. Perrier and J. J. Deviers. *Association Aéronautique et Astronautique de France, Colloque d'Aérodynamique Appliquée, 9th, Saint-Cyr-l'Ecole, Yvelines and Paris, France, Nov. 8-10, 1972, Paper.* 82 p. 116 refs. In French.

The departure point of the full computation of hypersustentation in a viscous fluid with detachment rests in an evaluation of the potential flow. An exact three-dimensional calculation of a hypersustained aircraft is now possible with the means of computation and the programs developed by Marcel Dassault Aircraft. The most important points in the computer program are the geometric definition and computation of the potential flow around the hypersustained profile, the calculation of boundary layers and detachments, the calculation of wakes, and the calculation of detached zones and iterations on the boundary layers and the detachments. F.R.L.

A73-32819 # **Calculation of the characteristics of tail fins in the vortical field of a wing (Calcul des caractéristiques d'empennages dans le champ tourbillonnaire d'une voilure).** M. Yermia (Société Nationale Industrielle Aérospatiale, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *Association Aéronautique et Astronautique de France, Colloque d'Aérodynamique Appliquée, 9th, Saint-Cyr-l'Ecole, Yvelines and Paris, France, Nov. 8-10, 1972, Paper.* 49 p. 7 refs. In French.

A73-32846 # **Analysis of fan noise in ducts.** C. J. Moore (Rolls-Royce, Ltd., Derby, England). *British Acoustical Society, Proceedings*, vol. 2, Spring 1973, 5 p. 7 refs.

The generation and propagation of sound in the annular ducts of axial flow fans is discussed. Techniques are proposed for the measurement of the modal distribution of in-duct fan noise for studying noise sources in fan ducts and for the prediction of far field radiation from ducts. Fourier transforms in circumferential and radial directions are applied in the execution of these techniques. V.Z.

A73-32914 **Acoustic radiation from the end of a two-dimensional duct - Effects of uniform flow and duct lining.** S. M. Candel (California Institute of Technology, Pasadena, Calif.). *Journal of Sound and Vibration*, vol. 28, May 8, 1973, p. 1-13. 12 refs.

A73-32915 **Determinants for aircraft noise annoyance - A comparison between French and Scandinavian data.** R. Rylander, S. Sorensen (National Environment Protection Board, Stockholm, Sweden), A. Alexandre (Paris, University, Laboratory of Applied Anthropology, Paris, France), and P. Gilbert (Centre Scientifique et Technique du Bâtiment, Paris, France). *Journal of Sound and Vibration*, vol. 28, May 8, 1973, p. 15-21. 8 refs.

Data on aircraft annoyance from a French study of 1965-1966 have been re-evaluated in the light of findings from a recent Scandinavian study. Comparison of the results of the two studies provides further confirmation of the conclusions reached as a result of the Scandinavian studies. Broadly stated, these conclusions are (1) that the number of overflights does not appear to influence annoyance in the manner implied by current total energy noise exposure indices but instead simply serves to categorize an area as a high exposure or low exposure area and (2) for an area of a given type (high or low exposure) the determinant of the annoyance is primarily the noise level of a single, representative overflight. The implication of these results is clearly that reduction of noise of individual aircraft is of primary importance in reducing annoyance. (Author)

A73-32917 **An investigation of impulsive rotor noise of a model rotor.** J. W. Leverton and C. B. Amor (Westland Helicopters, Ltd., Yeovil, Somerset, England). *Journal of Sound and Vibration*, vol. 28, May 8, 1973, p. 55-71. 10 refs. Research supported by the Ministry of Defence and Westland Helicopters, Ltd.

The investigation of gust induced impulsive rotor noise was made by using a three bladed, 9-ft diameter, model rotor. The gust was produced by a series of air-jets placed under the rotor disc and the noise characteristics were determined for a range of gust lengths and amplitudes. The main emphasis was placed on experimental measurements and theoretical prediction of discrete noise. The theoretical estimation of discrete noise was made by using a simple point dipole theory and a more complex rotational noise theory. The theoretical results have been compared with measurements and show good agreement both in amplitude and characteristics over the full range of gust profiles used in the experimental programme. (Author)

A73-32922 # **Up-rating the fuel system flow capacity with high rotational speed.** *Aircraft Engineering*, vol. 45, May 1973, p. 34, 35, 37.

The design modifications which, together with the introduction of high rotational speeds, have led to an improved flow capacity and a substantial reduction in weight of the Concorde fuel system are discussed. An essential feature of the modified system is that the turbo pump is required to operate only during the take-off, climb, and approach phases, and is shut off during cruising flight. Another feature is that the LP spool governer is integrated into the flow control unit and is electrically operated. The principal control valves of the system are illustrated and discussed. V.P.

A73-32923 # **Fuel system controls.** G. Marriette (Flight Refuelling, Ltd., Wimborne, Dorset, England). *Aircraft Engineering*, vol. 45, May 1973, p. 37, 40.

The major problems (and their solutions) involved in the design and manufacture of valves and other accessories to ensure long-term service reliability and ease of maintenance are examined. The components studied are intended to control refuelling, in-flight trim transfer, inter-tank fuel transfer, fuel jettisoning, and engine feed. There are also fuel air/no fuel valves and float drain valves, which prevent fuel from entering the system venting arrangement, and relief valves which protect the tanks from damage by over-pressurization. Particular attention is given to the selection of seal materials capable of withstanding fuel temperatures in the range from -40 to +80 C. V.P.

A73-32924 # **Installing the heater cable directly in the redesigned leading edge.** *Aircraft Engineering*, vol. 45, May 1973, p. 43.

The technique selected for application of electrical ice protection to wing leading edges in front of the engine and in the engine intake ramps is described. The heater cables are preformed in such a way as to provide the required heat concentration pattern. The preformed cables are then brazed to 0.25-mm thick nickel foil, resulting in a heater assembly which in itself provides all the design requirements of light weight, flexibility, ease of handling, and excellent heat transfer characteristics. V.P.

A73-32925 # **Preventing the shut-off punkah louvre from jamming.** H. Brierley. *Aircraft Engineering*, vol. 45, May 1973, p. 44.

Developing the Concorde punkah louvre (a variable movable nozzle air terminal unit) it was found that if a unit was shut off after handling extremely cold air and not turned on again until air temperatures were considerably warmer, the shut-off of the louvre would jam owing to the fine tolerances of the parts and the minimal thermal expansion of the plastic materials. It is shown how the problem was overcome by making the valve section of maranyl nylon and the body of the louvre in melamine formaldehyde. The choice of these plastics was based on their different expansion and friction coefficients. V.P.

A73-32970 **The battle of noise (La bataille du bruit).** L. Augeron. *Revue Générale de l'Air et de l'Espace*, vol. 36, no. 1, 1973, p. 9-18. In French.

The problem of aircraft noise is not new, but has only recently received attention. The noise of a jet engine comes from the compressor, the interior of the combustion chamber, and from the gases ejected by the nozzle. Aspects of the noise to be expected from the Concorde are discussed on some detail. The goal sought by the FAA is 90 EPNdB at takeoff by 1981. Only the super DC-9 actually attains this level, but at the cost of increased weight. The question of the supersonic band is examined. An experimental 'silent' aircraft, the Bertin Aladin II is described. F.R.L.

A73-32971 **The international regime of route rentals. II - Regional systems (Le régime international des redevances de route. II - Les systèmes régionaux).** R. Goy (Rouen, Université, Rouen, France). *Revue Générale de l'Air et de l'Espace*, vol. 36, no. 1, 1973, p. 29-65. 126 refs. In French.

If more and more states immediately institute rentals for the use of installations and route services, and if they prefer a national system to a regional system, certain among them will encounter increasing difficulties to provide themselves the installations and services because of the slenderness of their airspace at a period of long international flights, and of the paucity of their resources in regard to the technical necessities and the costs of management imposed. Also they are forced to undertake a regional collaboration in this field. If ICAO recommends an international tariff of route rentals, it will not fail to encourage initiative of this type. A regional integrated system, ASECNA (agency for safety of air navigation in Africa and Madagascar) is discussed in detail. The sources of the system, and the elements of the system of rentals are extensively treated. F.R.L.

A73-32972 **Air piracy (Piraterie aérienne).** *Revue Générale de l'Air et de l'Espace*, vol. 36, no. 1, 1973, p. 78-102. In French.

The convention for the repression of illegal acts directed against the safety of civil aviation, signed at Montreal Sept. 23, 1971 is set forth, as well as the actions of the ICAO juridical committee at the 20th (special) session of Jan. 9 to 30, 1973. The propositions of the delegations of Switzerland, the U.K., Denmark, Finland, Norway, and Sweden are discussed along with the U.S.-Cuba agreement on air piracy are presented. F.R.L.

A73-32973 # **Certain aspects of helicopter rotor aerodynamics (Niektore zagadnienia aerodynamiki wirnikow smiglowcow).** Z. Brodzki. *Technika Lotnicza i Astronautyczna*, vol. 28, Apr. 1973, p. 11-17. 9 refs. In Polish.

The achievement of higher helicopter flight speeds and the optimization of rotors with respect to efficiency and generated noise necessitate detailed analyses of requirements posed for the rotor profile. Contemporary studies account for the variable operating conditions of blade profiles and thus encroach into the domain of unsteady flow theory. The complex three-dimensional flow fields about helicopter rotors are analyzed with allowance for variability of Mach number, inclination of the blade axis to the flow direction, blade angle of attack, complex rotor trajectories, and variability of the Reynolds number. Vortex shedding patterns are discussed along with recent improvements in rotor design. T.M.

A73-32974 # **Airport illumination. II (Oswietlenie lotnisk. II).** M. Pasek. *Technika Lotnicza i Astronautyczna*, vol. 28, Apr. 1973, p. 17, 18, 40, 41. In Polish.

Description of the objectives, typical specifications, and arrangement of low-, moderate-, and high-intensity lighting systems used as visual landing aids at airports. Attention is given to the proper disposition of runway lights, satisfactory brightness levels, and accurate orientation of the light beams. Factors affecting visibility of airport lights are considered along with the utility of flashing lights. T.M.

A73-33013 **Balancing equipment for jet engine components, compressors, and turbine - Rotating type for measuring unbalance in one or more than one transverse planes.** *SAE Aerospace Recommended Practice*, ARP 587A, Oct. 7, 1972. 54 p.

A73-33014 **Maintenance of pitot-static systems of transport aircraft.** *SAE Aerospace Information Report*, AIR 975, July 1972. 24 p. 41 refs.

The principles and practices for maintenance of pitot and static pressure systems of transport aircraft are set forth in a single document. Available information is given, maintenance limits are suggested, and principal papers on the subject are listed. V.Z.

A73-33015 **Definitions and procedures for computing the effective perceived noise level for flyover aircraft noise.** *SAE Aerospace Recommended Practice*, ARP 1071, June 1972. 7 p.

A multistep procedure is set forth for calculation of discrete frequency corrections for one-third octave band spectra of flyover aircraft noise. A representative calculation chart is included for determining a discrete frequency correction for this spectrum. V.Z.

A73-33016 **Selection, application, and inspection of electric overcurrent protective devices.** *SAE Aerospace Recommended Practice*, ARP 1199, Aug. 1972. 36 p.

A73-33017 **High-temperature low pressure hose assembly, convoluted-, tetrafluoroethylene-, for aerospace.** *SAE Aerospace Recommended Practice*, ARP 1227, Nov. 1972. 12 p.

A73-33019 **Identification and coding of fluid and electrical piping system functions.** *SAE Aerospace Information Report*, AIR 1273, Aug. 1972. 4 p. 23 refs.

A73-33020 **Standard indoor method of collection and presentation of the bare turboshaft engine noise data for use in helicopter installations.** SAE Aerospace Recommended Practice, *ARP 1279, Aug. 1972. 2 p. 5 refs.*

A73-33023 **Electronic developments for performance gliding. III (Elektronische Entwicklung für den Leistungssegelflug. III).** I. Westerboer. *(Organisation Scientifique et Technique Internationale du Vol à Voile, Congress, 13th, Vrsac, Yugoslavia, July 13-21, 1972.) Aero-Revue*, May 1973, p. 274, 275. 7 refs. In German.

A73-33024 **Computational program for calculating the Re-number-dependent polar of a glider with arbitrary double trapezoidal wing (Rechenprogramm zur Berechnung der Re-Zahl-abhängigen Polare eines Segelflugzeuges mit beliebigem Doppeltrapezflügel).** W. Dirks (Akademische Fliegergruppe, Darmstadt, West Germany). *(Organisation Scientifique et Technique Internationale du Vol à Voile, Congress, 13th, Vrsac, Yugoslavia, July 13-21, 1972.) Aero-Revue*, May 1973, p. 275-277. In German.

A73-33027 **An airline view of composite airframe structure.** M. Kuperman and R. G. Wilson (United Air Lines, Inc., San Francisco, Calif.). In: New horizons in materials and processing; Proceedings of the Eighteenth National Symposium and Exhibition, Los Angeles, Calif., April 3-5, 1973. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1973, p. 7-20. 16 refs.

United Air Lines evaluated the impact of a composites airframe on airline operations, the environment, and the flying customer. The report begins by revieweing the impact of composite structure as it effects the airline maintenance operations of existing jet aircraft. Present and future airframe maintenance philosophies are then discussed. The anticipated impact on airline operations of unresolved problems anticipated with new design composite structure is assessed. Also, research and development criteria necessary to insure long term structural integrity coupled with minimum maintenance costs, are discussed. In conclusion, the value of in-service testing of components is outlined. (Author)

A73-33028 **Design criteria.** D. L. Reed and C. W. Rogers (General Dynamics Corp., Convair Aerospace Div., Fort Worth, Tex.). In: New horizons in materials and processing; Proceedings of the Eighteenth National Symposium and Exhibition, Los Angeles, Calif., April 3-5, 1973. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1973, p. 23-34. 7 refs.

The design criteria adopted for advanced composites has to date been identical with the criteria currently being used for the design of metallic aircraft structure. Recent critical experimental work has defined the unique properties of advanced composite materials and it is evident that new design criteria should be developed. A set of design criteria which recognize the unique characteristics of composite materials is expected to affect the design process, the structural verification process, and the geometry for structural designs. (Author)

A73-33029 **Erosion in aircraft jet engines.** H. M. Green (GE Material and Process Technology Laboratories, Lynn, Mass.). In: New horizons in materials and processing; Proceedings of the Eighteenth National Symposium and Exhibition, Los Angeles, Calif., April 3-5, 1973. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1973, p. 35-46. 6 refs.

In general, pure jet or turbojet aircraft engine parts powering either military or commercial aircraft do not suffer from sand erosion problems. However, sand erosion does cause serious life reductions of compressor airfoils in engines powering aircraft, such as helicopters, that take-off and land from unprepared or dirty landing sites. The relative erosion resistances of a large number of materials are shown to be independent of the type of erosion test. The requirements that erosion protection coatings should possess for compressor airfoil applications are described as is the evolution of a potential protective coating system. (Author)

A73-33031 **Advanced rain erosion resistant coating materials.** G. F. Schmitt, Jr. (USAF, Materials Laboratory, Wright-Patterson AFB, Ohio). In: New horizons in materials and processing; Proceedings of the Eighteenth National Symposium and Exhibition, Los Angeles, Calif., April 3-5, 1973. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1973, p. 57-75. 5 refs.

The development of elastomeric and ceramic coatings for protection of aircraft and missile radomes in subsonic and supersonic rain erosion environments is described. Polyurethane and fluorocarbon elastomeric coatings provide long term subsonic resistance and slip cast alumina ceramic coatings demonstrate short term protection at Mach 3.0. (Author)

A73-33032 **Lightning and protection for non-metallic materials and structures.** J. D. Robb (Lightning and Transients Research Institute, St. Paul, Minn.). In: New horizons in materials and processing; Proceedings of the Eighteenth National Symposium and Exhibition, Los Angeles, Calif., April 3-5, 1973. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1973, p. 76-79.

An initial review of the lightning contact and damage mechanisms for such composite structures as boron or graphite fibers in an epoxy resin shows that the composites may be struck by any of the major lightning discharge components. Any of these components can produce localized damage. Extensive damage can occur (in contrast to metallic or conductive dielectric composite materials) even by low lightning discharge currents. Possible means of lightning protection are examined. V.P.

A73-33034 **Lightning protection for advanced composite aircraft.** M. P. Amason and J. T. Kung (Douglas Aircraft Co., Long Beach, Calif.). In: New horizons in materials and processing; Proceedings of the Eighteenth National Symposium and Exhibition, Los Angeles, Calif., April 3-5, 1973. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1973, p. 99-105. 16 refs.

Lightning protection design considerations for advanced boron and graphite composite aircraft structures are discussed on the basis of the zonal lightning protection design concept. Basic design criteria for Zone 1, Zone 2, and Zone 3 lightning protection regions are established. A lightning protection scheme in which the lightning channel makes intermittant contact with protrusions on the aircraft surface, so that the lightning channel appears to sweep back over the aircraft surface, is described. (Author)

A73-33035 **Lightning protection for production advanced composites.** S. J. Dastin and G. Lubin (Grumman Aerospace Corp., Bethpage, N.Y.). In: New horizons in materials and processing; Proceedings of the Eighteenth National Symposium and Exhibition, Los Angeles, Calif., April 3-5, 1973. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1973, p. 106-119.

A variety of lightning protection schemes are studied for boron/epoxy and graphite/epoxy composites. Particular reference is made to the boron/epoxy production horizontal stabilizer of the F-14. An effective and light-weight surface protection scheme is shown to consist of 2-in. wide, 0.004-in. thick 2024-T81 aluminum strips spaced 2.25 inches apart. V.P.

A73-33036 **Lightning protection techniques for large aircraft canopies.** R. Aston, R. Gorton, and G. L. Weinstock (McDonnell Aircraft Co., St. Louis, Mo.). In: New horizons in materials and processing; Proceedings of the Eighteenth National Symposium and Exhibition, Los Angeles, Calif., April 3-5, 1973. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1973, p. 120-124. Contract No. F33615-71-C-1581.

The primary hazard from a lightning strike to an aircraft canopy occurs if the canopy punctures and the lightning strikes the pilot. This hazard was analyzed mathematically and was extensively tested on flat polycarbonate sheets, a simulated canopy, and an actual fighter aircraft canopy. The analysis showed that canopy puncture would not occur because of the lower breakdown dielectric strength and the dielectric constant of the surrounding air. Lightning simulation tests were performed in three steps. First, tests were performed on flat polycarbonate sheets to determine the relationship between surface flashover in air and when breakdown through the material would occur. The second series of tests was performed on an actual canopy to investigate the possibility of puncture by a long spark (between 36 and 80 in.). The third series of tests was to investigate the safety margin of the high speed fighter aircraft canopy. Side effects of a lightning strike to the canopy area were also considered. Corona, triggering of the canopy ejection system, and the possibility of the current welding the canopy frame to the aircraft frame were found not to be a hazard. (Author)

A73-33064 **Glass fabric structures for aircraft composites.** C. E. Knox (Uniglass Industries, New York, N.Y.). In: New horizons in materials and processing; Proceedings of the Eighteenth National Symposium and Exhibition, Los Angeles, Calif., April 3-5, 1973. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1973, p. 527-533.

Structural analysis of glass fabrics as reinforcement components of aircraft composites is conducted with particular attention to the strengthening effect of glass fabrics. Values of tensile, compressive and flexural strength and flexural moduli are given for some representative epoxy laminates with glass fabric structures. Unidirectional and bidirectional fabric designs are discussed. The feasibility of glass fabric composites which meet projected performance criteria in aerospace applications is noted. V.Z.

A73-33069 **Comparative structural studies on pressurized fuselage sections.** P. Garnatz, E. Loechelt, and W. Maurer (Fokker Vereinigte Flugtechnische Werke-Fokker GmbH, Bremen, West Germany). In: New horizons in materials and processing; Proceedings of the Eighteenth National Symposium and Exhibition, Los Angeles, Calif., April 3-5, 1973. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1973, p. 576-598.

Optimal pressurized fuselage section designs with sandwich structures and bonded joints in Al and Ti materials were developed and tested for a short-haul airliner carrying about 40 passengers. Estimates suggest that a weight reduction payoff of about 20% could be achieved by this fuselage structure design. Strength analysis in production is visualized for 1973/74. V.Z.

A73-33071 **Titanium castings for European aerospace.** E. A. Williams. In: New horizons in materials and processing; Proceedings of the Eighteenth National Symposium and Exhibition, Los Angeles, Calif., April 3-5, 1973. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1973, p. 619-627.

Titanium is a much sought after metal wherever strength-weight is a factor. However, the cost of metal removal has been a deterrant to its use. Now titanium castings are being produced which have guaranteed physical strength properties comparable to wrought material and tolerances are being met which have substantially reduced the need for machining. Applications for such items as Flap Tracks, Brake Torque Tubes, and Arrestor Hook Mounting Brackets are examples of structural aircraft applications now being considered for some European aircraft. (Author)

A73-33080 **Fly-by-wire servo is quad-redundant.** D. A. Wiggins (Hydraulic Research and Manufacturing Co., Valencia, Calif.). *Hydraulics and Pneumatics*, vol. 26, May 1973, p. 99-102.

Description of the design and operation of a small fly-by-wire control system which has been tested in a modified F-8C high-speed jet aircraft. The system described is equipped with two-fail/operate and fail/safe actuators consisting of four independent modules which control a triplex actuator from two separate hydraulic supplies. With a malfunction in the primary channel, a switch is made to the backup system. Then the three standby channels control the actuator and operate simultaneously. When the primary channel fails, a pressure switch in that channel provides a signal which automatically energizes the solenoid valves of the standby channels, transferring control to the single-stage, force-summed jetpipe servovalves of the latter channels. A.B.K.

A73-33086 # **Cost-of-ownership design philosophy for inertial navigators.** R. L. Ringo (USAF, Avionics Laboratory, Wright-Patterson AFB, Ohio). *Astronautics and Aeronautics*, vol. 11, June 1973, p. 59-63.

The AN/ASN-101 gimbaled electrostatic gyro aircraft navigation system (GEANS) has from its inception been designed and developed to provide precision navigation with a low total-life-cycle cost. GEANS employs a unique gyro, the electrostatic gyro. Electrically suspended gyros inherently have exceptional performance characteristics. The GEANS technology base is discussed together with the design approach used, questions of the development technology, the target cost-structure, aspects of material cost, maintenance action, and physical characteristics. The AN/ASN-101 GEANS is now being optimized to both improve further its reliability and maintainability and further reduce its cost of ownership. G.R.

A73-33098 **Stopping vibration with dynamic analysis.** W. M. Hawkins, Jr. (Spectral Dynamics Corp., San Diego, Calif.). *Machine Design*, vol. 45, May 31, 1973, p. 86-91.

Description of a dynamic analysis procedure for locating sources of harmful vibrations without simulated service tests. The proposed procedure is performed in three distinct but closely related steps. First, a narrow-band spectrum analysis is made which includes (1) either a swept-frequency analysis or a signature-ratio analysis and (2) rpm tracking. Then a transfer function analysis is made to determine how the machine and its surrounding structures respond to the self-generated vibrations plotted during the narrow-band spectrum analysis. Finally, a modal study is made in which the structural surfaces are mapped at all frequencies that showed resonances during the transfer function analysis. A.B.K.

A73-33101 **Charters, the new mode - Setting a new course for international air transportation.** J. Scoutt, Jr. (World Airways, Inc., Oakland, Calif.) and F. J. Costello. *Journal of Air Law and Commerce*, vol. 39, Winter 1973, p. 1-28. 79 refs.

In this article, the authors argue that a multilateral approach is the most direct and efficient method of establishing the international rights of non-scheduled air transportation. The need for an international system comprised of both non-scheduled and scheduled services is emphasized. The authors believe that the present de jure regime that relies almost exclusively on scheduled services has not satisfied the needs of the public. They urge instead that all nations should work for freedom of the skies by the elimination of unnecessary restrictions on charter services; there should be a de jure recognition of the new system of barter for international charter air transportation. (Author)

A73-33102 **Skyjacking - Its domestic civil and criminal ramifications.** M. C. McClintock (Gonzaga University, Spokane, Wash.). *Journal of Air Law and Commerce*, vol. 39, Winter 1973, p. 29-80. 244 refs.

A73-33103 **Recent developments in inverse condemnation of airspace.** J. H. Russell. *Journal of Air Law and Commerce*, vol. 39, Winter 1973, p. 81-101. 174 refs.

The current concern for environmental protection has two significant impacts on aviation. First, controlling or preventing adverse effects of airport noise and aircraft pollution and second, when these preventive measures fail, developing legal remedies for the invasion of the use and enjoyment of property. In this second area, the traditional concepts of nuisance and trespass are being displaced by the development of the theory of inverse condemnation as a method of compensation when an airport's activities interfere with the rights of adjacent landowners. Mr. Russell analyzes the rights of airspace ownership, the available remedies for invasions of those rights, and posits additional questions requiring resolution if the concepts of real property law are to keep pace with the growth of the technology of aviation. (Author)

A73-33126 **Realism in environmental testing and control; Proceedings of the Nineteenth Annual Technical Meeting, Anaheim, Calif., April 2-5, 1973.** Meeting sponsored by the Institute of Environmental Sciences. Mount Prospect, Ill., Institute of Environmental Sciences, 1973. 532 p. Members, $15.; nonmembers, $20.

The monitoring, simulation, and control of environmental variables are considered in papers dealing with laboratory tests of equipment designed to sustain various adverse effects, equipment standards and test procedures for ensuring human safety, and the assessment and management of the earth's resources. Topics considered include digital computer simulation of physical processes which are continuous functions of time, psychophysiological preparation of environmental stress experiments with humans, data acquisition and evaluation in studies of environmental pollution and resources management, test equipment and procedures in crash-survivability research, environmental considerations in the operation and planning of nuclear systems, the development and control of vibration and impact tests, and simulation of aerospace environments. T.M.

A73-33133 # **Prediction and measurement of aircraft noise.** G. Bricken. In: Realism in environmental testing and control; Proceedings of the Nineteenth Annual Technical Meeting, Anaheim, Calif., April 2-5, 1973. Mount Prospect, Ill., Institute of Environmental Sciences, 1973, p. 97-102. 6 refs.

Various single- and composite-source acoustical indices developed for evaluating noise levels at airport areas are reviewed along with computerized prediction models providing noise contour patterns for the benefit of land-use programs, abatement regulations, and the design of neighboring structures. Methods of noise measurement and equipment currently used at airports for this purpose are also described. T.M.

A73-33137 # **Vibration and shock qualification testing of an airborne early warning radar.** W. W. Jochen and F. H. Lyon (General Electric Co., Aircraft Equipment Div., Utica, N.Y.). In: Realism in environmental testing and control; Proceedings of the Nineteenth Annual Technical Meeting, Anaheim, Calif., April 2-5, 1973. Mount Prospect, Ill., Institute of Environmental Sciences, 1973, p. 231-238.

The development of a vibration and shock qualification testing program for radar equipment to be used on aircraft is described in terms of specified test parameters, hardware developed to meet these specifications, and typical operational procedures in testing. The test program was divided into preproduction-test and acceptance-test phases necessitating separate equipment and test stands. The preproduction tests involved a mass of 2500 lbs for the radar plus 3500 lbs for the fixture being driven between 5 and 500 Hz at levels up to plus and minus 5 G in three orthogonal directions. Reliability demonstration and acceptance tests required prolonged vibration at specified parameters to prove operating capabilities of the equipment. Shock testing involved 15-G and 30-G 11-msec shocks. The electrohydraulic multihead shaker system is described along with monitoring and control equipment. T.M.

A73-33141 # **Inlet duct sonic fatigue induced by the multiple pure tones of a high bypass ratio turbofan.** R. N. Hancock (Vought Aeronautics Co., Dallas, Tex.). In: Realism in environmental testing and control; Proceedings of the Nineteenth Annual Technical Meeting, Anaheim, Calif., April 2-5, 1973.
Mount Prospect, Ill., Institute of Environmental Sciences, 1973, p. 313-319. 7 refs.

Requirements for the redesign of an engine inlet duct to withstand sonic fatigue prompted the measurement of the duct acoustic environment forward of a 6.2 bypass ratio turbofan. Several axial and circumferential positions were utilized to characterize the noise incident on the internal nacelle structure. The paper briefly relates these data to other measurements from a .75 bypass ratio fan. Overall levels on the order of 175 dB, and Multiple Pure Tone (MPT) narrow band levels of 157 dB, near 1 KHz, were encountered. Maxima were found to coincide with a fan tip relative Mach number of 1.20. These measurements are summarized, including wave form, harmonic content and amplitude for various duct locations and fan operating conditions. Simulation of the MPT levels was outside the capabilities of the VAC Acoustics Laboratory, and a shaker test procedure was devised to test redesigned duct components to withstand sonic fatigue. This procedure, duplicating high frequency modal response, is discussed. (Author)

A73-33144 # **MIL-STD-810 industry opinion.** E. A. Meeder, Jr. (Bendix Corp., Navigation and Control Div., Teterboro, N.J.). In: Realism in environmental testing and control; Proceedings of the Nineteenth Annual Technical Meeting, Anaheim, Calif., April 2-5, 1973. Mount Prospect, Ill., Institute of Environmental Sciences, 1973, p. 380-383.

The uniform environmental test methods established by MIL-STD-810, as revised in June 1967, are critically examined with respect to their ability to determine the resistance of equipment to the effects of natural and induced environments peculiar to military operations. Some basic inadequacies and misapplications are pointed out. A planned continuous revision and specific test method improvements are recommended. M.V.E.

A73-33145 # **Lightning simulation testing in aerospace.** D. W. Clifford (McDonnell Aircraft Engineering Laboratories, St. Louis, Mo.). In: Realism in environmental testing and control; Proceedings of the Nineteenth Annual Technical Meeting, Anaheim, Calif., April 2-5, 1973. Mount Prospect, Ill., Institute of Environmental Sciences, 1973, p. 388-396. 24 refs.

Review of lightning damage mechanisms and of techniques used for simulating lightning strikes. The special features of the average lightning flash are described, as well as damage mechanisms resulting from high voltage, high peak current, high charge transfer, and induced coupling effects. A number of simulation techniques are then summarized, including techniques for generating high voltage, simulating high peak current, unipolar testing, high charge transfer simulation, swept-stroke simulation, and induced voltage testing. It is shown that high-current and high-coulomb pulses can be produced easily with energy storage capacitor banks to match the peak magnitudes and pulse widths of natural lightning current pulses. High-voltage and field phenomena such as attachment points and dielectric effects can be studied by the use of high-voltage impulse generators. A.B.K.

A73-33170 * # **Aspects of investigating STOL noise using large-scale wind-tunnel models.** M. D. Falarski, P. T. Soderman (U.S. Army, Air Mobility Research and Development Laboratory, Fort Eustis, Va.), and D. G. Koenig (NASA, Ames Research Center, Moffett Field, Calif.). *(Canadian Aeronautics and Space Institute, Annual General Meeting, Toronto, Canada, May 18, 19, 1973.) Canadian Aeronautics and Space Journal*, vol. 19, Feb. 1973, p. 61-69. 8 refs.

The applicability of the NASA Ames 40- by 80-foot wind tunnel for acoustic research on STOL concepts has been investigated. The acoustic characteristics of the wind-tunnel test section have been studied with calibrated acoustic sources. Acoustic characteristics of several large-scale STOL models have been studied in both the free-field and wind-tunnel acoustic environments. The results of these studies indicate that the acoustic characteristics of large-scale STOL models can be measured in the wind tunnel if the test section acoustic environment and model acoustic similitude are taken into consideration. The reverberant field of the test section must be determined with an acoustically similar noise source. A directional microphone, a phased array of microphones, and extrapolation of near-field data to far-field are some of the techniques being explored as possible solutions to the directivity loss in a reverberant field. The model sound pressure levels must be of sufficient magnitude to be distinguishible from the wind-tunnel background noise. (Author)

A73-33176 **Anglo-American Aeronautical Conference, 13th, London, England, June 4-8, 1973, Proceedings.** Conference sponsored by the Royal Aeronautical Society, American Institute of Aeronautics and Astronautics, and Canadian Aeronautics and Space Institute. London, Royal Aeronautical Society, 1973. 329 p.

Topics discussed include the role of air transportation in Canada, the transfer between surface and air transport, an upgraded third-generation ATC system, a prediction of the appropriate aircraft fleet for British Airways in the 1980s, problems in the selection of a new airport for the Toronto area, the present state of operations in the Concorde project, the use of large aircraft for moving liquid and gaseous fossil fuels from the Arctic region, a determination of the types of aircraft required to meet the needs of the short-haul market, the use of helicopters for performing environmentally sensitive operations, and the feasibility of a proposed small automated fixed-wing rotorcraft for both ground and airborne transportation of individuals. A.B.K.

A73-33177 # **The place of aviation in the Canadian transportation spectrum.** M. E. Kieran (Kates, Peat, Marwick and Co., Toronto, Canada) and M. Brenckmann (Transportation Development Agency, Canada). In: Anglo-American Aeronautical Conference, 13th, London, England, June 4-8, 1973, Proceedings.
London, Royal Aeronautical Society, 1973. 19 p.

Brief review of the development of the various transportation modes in Canada, focusing, in particular, on the growing role of air transportation. The growth in investment in transportation facilities is outlined, transportation facilities and activities are described, and the share of activities by transportation modes is noted. An evaluation is then made of air transportation in Canada, focusing on such factors as traffic density, marketing trends, and short-haul passenger transport (including a STOL demonstration service between Ottawa and Montreal). A study is made of the role of regional air carriers engaged in three types of service, noting the need for these sometimes unprofitable routes as a purely social service. Finally, some specialty air services, including exploration and prospecting, are discussed. A.B.K.

A73-33178 # **The airport as an interface.** K. B. Walter (British Airports Authority, London, England). In: Anglo-American Aeronautical Conference, 13th, London, England, June 4-8, 1973, Proceedings. London, Royal Aeronautical Society, 1973. 15 p.

Review of the current situation at existing airports in the London area insofar as the interface between surface and air transport is concerned. A number of elements involved in surface/air transfer are discussed, including surface access to the airport, check-in and ticketing on departure, baggage handling, walking distances, aircraft boarding, and security. Improvements which could be made at existing airports and those which could be introduced at the proposed Maplin airport are noted. A.B.K.

A73-33179 # **Developments in the management and utilization of airspace.** G. E. Lundquist (FAA, Washington, D.C.). In: Anglo-American Aeronautical Conference, 13th, London, England,

June 4-8, 1973, Proceedings. London, Royal Aeronautical Society, 1973. 12 p.

Description of a major program launched by the FAA to improve its air traffic control system. An upgraded third-generation ATC system is described which is intended to enhance the capabilities of the present ARTS III and NAS Stage A systems and includes such features as a discrete address beacon system, an electronic voice switching system, a microwave landing system, and aeronautical satellites. The possibility of incorporating intermittent positive control in the upgraded third-generation ATC system, once the discrete address beacon system is complete, is considered. The potential of area navigation and practical means for implementing it in the national airspace system are evaluated. A.B.K.

A73-33180 # **The aeroplane in the transport system - What sort of aeroplanes should the airlines want in the eighties.** S. F. Wheatcroft (British Airways Board, London, England). In: Anglo-American Aeronautical Conference, 13th, London, England, June 4-8, 1973, Proceedings. London, Royal Aeronautical Society, 1973. 11 p.

Development of a pattern of aircraft requirements for British Airways in the 1980s decade. The current pattern of world air traffic is reviewed, factors influencing future traffic growth are noted, and marketing developments of the next decade tending to inhibit the development of conventional short-haul air transport are evaluated. An attempt is made to forecast the likely world air traffic pattern in the 1980s and on this basis to draw conclusions regarding the choosing of an aircraft fleet. It is concluded that British Airways' operations in 1988 will call for nine different types of supersonic passenger aircraft. It is believed that in 1988 64% of British Airways' total passenger traffic will be carried in aircraft considerably larger than the Boeing 747. A.B.K.

A73-33181 # **Unsiting a major airport - A Canadian snafu.** I. M. Hamer. In: Anglo-American Aeronautical Conference, 13th, London, England, June 4-8, 1973, Proceedings. London, Royal Aeronautical Society, 1973. 19 p. 42 refs.

Review of the various decisions leading to the selection of a new airport for the Toronto area. Four areas of primary concern to the Province of Ontario in choosing the site for a second Toronto International Airport are cited. It is shown how government decisions moved from merely expanding the existing Malton airport, to the possible construction of two new airports, and then finally settling on one new site northeast of Toronto (At Pickering). However, owing to strong resistance on the part of local residents, the future of the projected new airport is in doubt, and the very need for it is being questioned. A.B.K.

A73-33182 # **Concorde operations.** W. J. Strang (British Aircraft Corp., Ltd., Filton, Bristol, England). In: Anglo-American Aeronautical Conference, 13th, London, England, June 4-8, 1973, Proceedings. London, Royal Aeronautical Society, 1973. 26 p.

Review of the Concorde project status, operations, and related problems of ecological concern. Four examples are cited which illustrate the mixture of conventional and innovative elements in the Concorde. The impact of parameters peculiar to the Concorde on wind-tunnel, structural, systems, and flight testing is demonstrated. The handling operations of Concorde prototypes during visits on five continents are discussed, as well as the general compatibility of Concorde with current ATC procedure and requirements, fuel reserves and fuel reserve policy, and airfield operations. Ecological areas with which Concorde interacts are cited, including community noise, sonic boom, low-altitude atmospheric pollution, high-altitude atmospheric pollution, and cosmic radiation effects. A.B.K.

A73-33183 # **A resource carrying aircraft for remote regions.** V. H. Atrill. In: Anglo-American Aeronautical Conference, 13th, London, England, June 4-8, 1973, Proceedings. London, Royal Aeronautical Society, 1973. 12 p.

Consideration of the possibility of using very large aircraft for the first-leg movement of liquid and gaseous fossil fuels from the Canadian and American Arctic. The known liquid and gaseous fossil fuel resource situation in the Canadian and American Arctic is briefly summarized, and the pipeline proposals actively being promoted are cited. In view of the heavy expenditures for these pipelines, a very large resource-carrying aircraft for first-leg movements is proposed which has a payload of close to 1200 tons for a mission of 500 nautical miles. It is claimed that these vehicles can operate in the Arctic 18 to 18.5 hours per day. They will cruise at about 400 knots. Their estimated cost is eighty million dollars per aircraft. A.B.K.

A73-33184 # **Short haul traffic - Matching the design to the market.** A. S. Watson (Hawker Siddeley Aviation, Ltd., Kingston on Thames, Surrey, England). In: Anglo-American Aeronautical Conference, 13th, London, England, June 4-8, 1973, Proceedings. London, Royal Aeronautical Society, 1973. 15 p.

Consideration of the patterns of development of the short-haul market, and determination of the types of aircraft required to meet the predicted needs. It is shown that on major high-density routes growth will be met by much bigger aircraft, there will be more direct flights on less dense routes bypassing 'hub airports,' and a proliferation will take place in feeder routes using 'bus-stop' techniques. It is concluded that three distinctive types of aircraft are required - namely, very large aircraft for use on the predominantly leisure routes and on the densest intermetropolitan routes, exceptionally quiet aircraft of intermediate size to increase service frequencies and route coverage within the main line systems, and a jet feederliner which can generally operate profitably within standard fare structures. A.B.K.

A73-33185 # **Rotary wing economics in a time of changing social values.** J. A. McKenna (United Aircraft Corp., Sikorsky Aircraft Div., Stratford, Conn.). In: Anglo-American Aeronautical Conference, 13th, London, England, June 4-8, 1973, Proceedings. London, Royal Aeronautical Society, 1973. 9 p.

Review of some of the ecological advantages of using helicopters for carrying out logging operations, passenger transport, and offshore oil exploration and production. It is shown that rotary-wing aircraft have provided access to critical lumber resources without causing a harmful environmental impact on the forests. Another advantage of the helicopter is that its use for short-haul air transportation will save land that would otherwise be wasted on large airports. Finally, the economic advantage of using helicopters for offshore oil production and transportation (particularly in the North Sea) to avoid undue dependence on Middle East sources is stressed. A.B.K.

A73-33186 # **The Independently Targeted Vehicle.** O. L. L. Fitzwilliams (Westland Helicopters, Ltd., Yeovil, Somerset, England). In: Anglo-American Aeronautical Conference, 13th, London, England, June 4-8, 1973, Proceedings. London, Royal Aeronautical Society, 1973. 50 p.

Consideration of the feasibility of developing a small automated vehicle for both ground and airborne transportation of individuals not possessing piloting skills. The vehicle is assumed to be a rotorcraft of about 2500 lb gross weight in the general class of fixed-wing tilt rotors, with two small prop-rotors laterally disposed. It carries two occupants and some baggage over a stage length of 500 miles. The functions of the collision-avoidance system required for a network of such independently targeted vehicles (ITVs) are outlined, and the capacity of the ITV traffic system is estimated. A brief description is given of the vehicle itself, emphasizing its main and auxiliary controls. Market models of the vehicle are developed for the years 1974 to 2001 and the years beyond 2001. Finally, the credibility of the ITV system is discussed. A.B.K.

A73-33187 # **Towards simplification of avionics systems.** J. G. Wright. In: Anglo-American Aeronautical Conference, 13th, London, England, June 4-8, 1973, Proceedings. London, Royal Aeronautical Society, 1973. 23 p.

The possibility of reducing the cost, quantity, and complexity of avionics systems components is explored, and some approaches likely to make simplifications possible are pointed out. Special attention is given to the identification of areas that hold a potential for simplification. M.V.E.

A73-33188 # **Impact of advanced technology on jet aircraft.** C. F. Newberry, R. B. Holloway, G. E. Bergmann, and M. D. Nelsen (Boeing Co., Wichita, Kan.). In: Anglo-American Aeronautical Conference, 13th, London, England, June 4-8, 1973, Proceedings. London, Royal Aeronautical Society, 1973. 15 p. 63 refs.

Discussion of some of the possible future directions that jet aircraft design is likely to take under the influence of some recent technology developments. The effects upon aircraft design of four technology advance areas, in particular, are considered, namely: flight controls technology, jet engine noise suppression, supercritical aerodynamics, and composite structures. M.V.E.

A73-33189 # **Social aspects of the variable-pitch fan.** J. G. Keenan (Dowty Rotol, Ltd., Gloucester, England). In: Anglo-American Aeronautical Conference, 13th, London, England, June 4-8, 1973, Proceedings. London, Royal Aeronautical Society, 1973. 19 p. 10 refs.

Discussion of the merits of the variable-pitch fan in turbofan jet aircraft, particularly in STOL jet aircraft. It is shown that, with a variable pitch fan, fan blade operation remains at high efficiency throughout the flight envelope, a built-in thrust reverser is provided at no extra cost or weight, engine handling is improved, and a considerable noise reduction becomes possible. M.V.E.

A73-33190 # **The expanding role for high bypass propulsion.** G. Rosen (United Aircraft Corp., Hamilton Standard Div., Windsor Locks, Conn.). In: Anglo-American Aeronautical Conference, 13th, London, England, June 4-8, 1973, Proceedings. London, Royal Aeronautical Society, 1973. 16 p.

Discussion of potential uses of high-bypass fan engines in various types of aircraft, covering military transport aircraft, super-quiet forward area reconnaissance aircraft, close-support attack aircraft, carrier-based transport aircraft, compound helicopters, high-speed ASW surface effect ships, and arctic amphibious surface effect vehicles. It is shown that the lower the speed of the aircraft and the higher the requirements in noise reduction, the higher should be the bypass ratio for optimal aircraft performance. The potential benefits from very high bypass propulsion are analyzed in detail for individual types of aircraft. V.Z.

A73-33191 # **The changing environment and propulsion.** L. G. Dawson and T. D. Sills (Rolls-Royce, Ltd., Derby, England). In: Anglo-American Aeronautical Conference, 13th, London, England, June 4-8, 1973, Proceedings. London, Royal Aeronautical Society, 1973. 22 p. 13 refs.

Various sources of aircraft-related noise generation are discussed in the context of a changing environment and advanced propulsion. Airport noise and airframe noise and their effects on powerplant evolution are considered, covering powerplant installation, STOL, externally blown flap, augmentor wing, and boosters. The noise-unrelated pollution problems created by aviation are believed to be manageable by further advances in aviation technology. The topics also include the distribution, availability and demand of natural fuels in civil aviation and the impact of mounting environmental pressures on the further development of civil aviation. V.Z.

A73-33192 # **The future for STOL.** R. E. Hage and M. D. Marks (Douglas Aircraft Co., Long Beach, Calif.). In: Anglo-American Aeronautical Conference, 13th, London, England, June 4-8, 1973, Proceedings. London, Royal Aeronautical Society, 1973. 6 p.

It is shown that currently ongoing STOL research and development activities are yielding results which could in the foreseeable future bring about a viable short-haul STOL system. In addition to closing the gap on operational costs and fare levels between conventional and short takeoff and landing aircraft, this system is also likely to meet the stringent environmental requirements that the air transport industry will have to observe. M.V.E.

A73-33193 # **Social and economic implications of V/STOL.** R. H. Miller (MIT, Cambridge, Mass.). In: Anglo-American Aeronautical Conference, 13th, London, England, June 4-8, 1973, Proceedings. London, Royal Aeronautical Society, 1973. 18 p.

The factors which determine the quality of air service in short haul air operations under 200 miles stage length are discussed. Among the qualities by which a transportation system is judged are cost, trip time, convenience, and comfort. The time which the passenger judges in determining quality of service is total time, made up of block time of the vehicle in transit, wait time, and access and egress time to the terminal. Some fairly simple analyses serve to show the interrelation between various conflicting requirements for quality of service represented by the time and cost factors. Air travel should always offer several times the travel speed per unit of energy than ground transportation systems. F.R.L.

A73-33201 **Flight Simulation Symposium, 2nd, London, England, May 16, 17, 1973, Proceedings.** Symposium sponsored by the Royal Aeronautical Society. London, Royal Aeronautical Society, 1973. 185 p.

The papers discuss the use of specific behavioral objectives in simulator development, optimizing the use of the flight simulator, total simulation, the development of visual systems for flight simulation, the simulator as a tool for avionics research, the contribution of integrated product support to the uptime of simulators, and the contribution of the simulator industry to military training requirements. V/STOL research simulation, a flight research program to define VTOL visual simulator requirements, flight simulation in helicopter and V/STOL research, BOAC experience and usage of flight simulators, and pilot opinion on simulation are considered. F.R.L.

A73-33202 # **The use of Specific Behavioral Objectives in simulator and curriculum development and other simulator uses.** W. L. Thomas (United Air Lines, Inc., Denver, Colo.). In: Flight Simulation Symposium, 2nd, London, England, May 16, 17, 1973, Proceedings. London, Royal Aeronautical Society, 1973. 10 p.

The Specific Behavior Objective (SBO) concept, as part of a systems approach to flight training, has been given considerable attention within the industry. This approach to the development of new programs and to the redevelopment of existing programs details the objectives the training program must achieve, and serves as a valuable and highly effective resource for determining evaluation criteria. Progress made in adapting simulators and the programs to FAA requirements is discussed. Application of the SBO concept can cut down on the simulator program by eliminating those things about flying that a pilot can already accomplish in a proficient manner. Of major importance are the things application of the SBO concept might do to the design of simulators. Some of the difficulties most likely to be encountered in the simulator phase of training are discussed. F.R.L.

A73-33203 # **Optimising the use of the flight simulator.** W. A. Wooden and J. D. Cowell (British Overseas Airways Corp., London Airport, Hounslow, Middx., England). In: Flight Simulation

Symposium, 2nd, London, England, May 16, 17, 1973, Proceedings. London, Royal Aeronautical Society, 1973. 14 p.

Consideration is given to airline type conversion and continuation training and checking. In order to optimize the use of the flight simulator it is considered that more formal arrangements for the training of airline instructor/examiners should be set up. There should be exploitation of the quite different and advantageous environment of the flight simulator for initial type conversion courses by the introduction of programmed learning, automated demonstration, and maneuver replay. There should be increased use of systems rigs, part-task trainers, and photographic models. For the purpose of continuation check/training all possible steps should be taken to provide total flight environment simulation. F.R.L.

A73-33204 # **Total simulation - A near future goal.** W. P. Moran (American Airlines, Inc., New York, N.Y.). In: Flight Simulation Symposium, 2nd, London, England, May 16, 17, 1973, Proceedings. London, Royal Aeronautical Society, 1973. 8 p.

Visual simulation has contributed greatly to a more safe, efficient, and economical method of training commercial airline crew members. The training has been to the proficiency level required to fly larger, faster, more complex aircraft. The ATA and IATA goal of total simulation in airline flying training is considered to be now attainable. Although there are still some desired refinements to modern digital simulators and present day visual systems, it is considered that the present realism and fidelity permits complete training transfer. That transfer, however, is greatly dependent on how effectively the simulator is used and maintained. F.R.L.

A73-33205 # **The development of visual systems for flight simulation.** A. M. Spooner (Redifon Flight Simulation, Ltd., Crawley, Sussex, England). In: Flight Simulation Symposium, 2nd, London, England, May 16, 17, 1973, Proceedings. London, Royal Aeronautical Society, 1973. 19 p. 11 refs.

Alternative methods of generating the visual images are reviewed, and methods of presenting them to the pilot are described. The three main visual simulation methods, all capable of giving a colored display with a visual angle about 50 deg wide are closed circuit television/physical model (CCTV), cine film, and computer generated image (CGI). CCTV systems have been developed over the last 10 years, and the latest designs are fairly well optimized. Visual systems using cine film are more compact and may be cheaper than CCTV, but the envelope of possible flight paths is restricted. CGI systems divide into the simple night-only visual system and the very much more complex version capable of presenting a daytime scene. F.R.L.

A73-33206 # **The simulator as a tool for avionics research.** F. S. Stringer (Ministry of Defence, London, England). In: Flight Simulation Symposium, 2nd, London, England, May 16, 17, 1973, Proceedings. London, Royal Aeronautical Society, 1973. 9 p.

The observations here are designed to stimulate the avionics system or ergonics designer to a correct application of simulation to give a cost-effective method of providing an end product which will be a solution to a particular problem with a minimum of in-service modification. It is important that the interrelationship between the aircraft and the avionics system and the man-machine interface should be understood as thoroughly as possible before very expensive decisions are taken to build a prototype system into an aircraft. Much of this preliminary examination of design parameters and total performance envelope can be predicted by simulation. However, the cost of simulation can be high. F.R.L.

A73-33208 # **The simulator industry and its contribution to military training requirements.** M. A. B. Collin (RAF, London, England). In: Flight Simulation Symposium, 2nd, London, England, May 16, 17, 1973, Proceedings. London, Royal Aeronautical Society, 1973. 8 p.

The Royal Air Force has, over the last five to seven years, supplemented a significant percentage of their pilot and other crew member training with the use of complex full mission flight simulators. Since the beginning of 1970 the Service has seen the progressive introduction of flight simulators for the Phantom, Buccaneer and Harrier aircraft, and other crew trainers for air electronic operators and navigators. Full mission flight simulator training is reviewed, and the need for flight simulators is discussed, as well as some revisions in the simulator policy. F.R.L.

A73-33209 # **V/STOL research simulation at HSA.** D. K. Mendela and R. E. Sawtell (Hatfield Polytechnic, Hatfield, Herts., England). In: Flight Simulation Symposium, 2nd, London, England, May 16, 17, 1973, Proceedings. London, Royal Aeronautical Society, 1973. 35 p. 10 refs.

Flight simulation trials of VTOL and STOL aircraft projects carried out on a fixed base simulator are described. Typical results achieved on the simulator are quoted for lift fan VTOL and STOL aircraft. Improvements are noted in aircraft handling and performance together with a reduction in pilot workload due to the introduction of autostabilization, electronic head-up displays and specific flight deck controls. Some limitations of the fixed base simulator are shown. The new four degrees of freedom moving-base simulator, supported by the Honeywell H632 digital computer which was installed recently at HSA, Hatfield, is described. (Author)

A73-33210 # **A flight research program to define VTOL visual simulator requirements.** R. J. Milelli, W. A. Keane, and W. J. Kenneally (U.S. Army, Electronics Command, Fort Monmouth, N.J.). In: Flight Simulation Symposium, 2nd, London, England, May 16, 17, 1973, Proceedings. London, Royal Aeronautical Society, 1973. 11 p.

During 1972, the U.S. Army Avionics Laboratory developed and flew a unique airborne test helicopter designated as the Research Aircraft for the Visual Environment (RAVE) to obtain comparative data on pilot performance under both direct visual and TV mediated imagery. TV imagery was presented on infinity collimated displays and was variable with respect to both field of view and resolution. Comparative performance for both direct and TV mediated systems was obtained for a wide spectrum of airmobile maneuvers in a confined tactical area as well as terrain following and terrain avoidance over a tactical terrain course. (Author)

A73-33211 # **Flight simulation in helicopter and V/STOL research.** T. Wilcock and B. N. Tomlinson (Royal Aircraft Establishment, Bedford, England). In: Flight Simulation Symposium, 2nd, London, England, May 16, 17, 1973, Proceedings. London, Royal Aeronautical Society, 1973. 20 p. 12 refs.

The flight simulator of the Aerodynamics Flight Division, RAE Bedford, has for over a decade been used for research into aircraft handling policies, and the emphasis is directed toward this particular area of helicopter and V/STOL research. Those aspects are considered first in which the requirements for effective simulation differ from those of conventional aircraft, both in terms of the mathematical model of the vehicle being simulated and the methods of displaying the vehicle's characteristics and behavior to the pilot. The Aerodynamics Flight Division simulator is then described, and a number of simulations of V/STOL aircraft performed on the simulator during the last decade are discussed, including a report on a current program of STOL simulations. F.R.L.

A73-33212 # **BOAC experience and usage of flight simulators.** P. Brentnall and M. R. Jenkins (British Overseas Airways Corp., London Airport, Hounslow, Middx., England). In: Flight Simulation Symposium, 2nd, London, England, May 16, 17, 1973, Proceedings. London, Royal Aeronautical Society, 1973. 8 p.

Following a review of BOAC's experiences with various simulators which they have operated since their advent, particular reference

is made to the 747 flight simulator. BOAC called, broadly, for a digital computer with a four-axis motion system, significant improvements in the visual system, something new in the area of the instructor's console, and far closer tolerances in performance than had been asked for previously. An external track recorder station was installed, complete with a weather broadcast system to provide prerecorded weather and automatic terminal information service information on the voice channel of the appropriate terminal VOR stations. The three main subdivisions of usage are type conversion training, low weather minima training, and recurrent practice and checking. F.R.L.

A73-33215 Region of existence of frictional noise and experimental verifications (Domaine d'existence de bruits de frottement et vérifications expérimentales). J.-M. Tatraux-Paro, J.-C. Chezeaux, and W. Bismuth (CNRS, Centre de Recherches Physiques, Marseille, France). *Acustica*, vol. 28, May 1973, p. 272-278. 11 refs. In French.

The range of existence, the frequencies, and the amplitudes of friction vibrations are studied in terms of the slip velocity. The experimental results for three types of tires slipping on an iron track are studied. The range of existence and the frequency and amplitude of the oscillations of a Stoker model slipping against different types of friction track are studied in terms of the slip velocity. Experimental and theoretical results show that the Stoker model accounts for the process generating the friction vibrations for low slip velocities. (Author)

A73-33265 Experimental results in the case of the Nonweiler wave-rider in the subsonic, transonic, and supersonic range (Experimentelle Ergebnisse zum Nonweiler-Wellenreiter im Unterschall-, Transschall- und Überschallbereich). U. Ganzer (Berlin, Technische Universität, Berlin, West Germany). *Zeitschrift für Flugwissenschaften*, vol. 21, May 1973, p. 153-159. 11 refs. In German.

Pressure distributions were measured on the surface of a Nonweiler caret wing at free-stream Mach numbers of 0.2 to 4.0. The experimentally determined pressure distributions at the upper side, the lower side and at the base are compared with the values calculated by various theoretical methods in the subsonic and supersonic regimes. Furthermore, the aerodynamic coefficients of the caret wing, such as lift, drag and aerodynamic efficiency as determined from the pressure distributions are presented. (Author)

A73-33267 Turbulent boundary layer on a yawed wing. N. V. C. Swamy (Indian Institute of Technology, Madras, India). *Zeitschrift für Flugwissenschaften*, vol. 21, May 1973, p. 163-166. 11 refs.

Results of a three-dimensional turbulent boundary layer developing on the suction side of a yawed wing kept in a uniform flow are described. This extends the author's earlier work (1971) on a yawed flat plate. The results are discussed in terms of several proposed semiempirical methods. F.R.L.

A73-33382 # Combined environmental test and testing installations (Kombinierte Umweltprüfung und Prüfanlagen). R. Sundermann (Brabender Realtest GmbH, Duisburg, West Germany). In: Problems and methods of simulating the environment; Annual Meeting, Karlsruhe, West Germany, September 27-29, 1972, Reports. Berghausen bei Karlsruhe, Institut für Chemie der Treib- und Explosivstoffe, 1973, p. 115-134. In German.

Environmental test chambers are used to reproduce the climatic conditions existing anywhere on earth or in the atmosphere as a basis for exposing components to be tested to their future environment while subjecting these components to the tests which are significant for a determination of the functional component suitability. A testing installation for studying under varying climatic conditions the mechanical characteristics of materials for aeronautical and astronautical uses is discussed. Investigations at temperatures from -80 C to +250 C and environmental pressures from 760 to 0.001 torr are possible. G.R.

A73-33410 Nonlinear filter evaluation for estimating vehicle position and velocity using satellites. S. G. Wilson (Boeing Co., Seattle, Wash.). *IEEE Transactions on Aerospace and Electronic Systems*, vol. AES-9, Jan. 1973, p. 65-75. 8 refs. U.S. Department of Transportation Contract No. FA69WA-2109.

A73-33416 Winter simulation conference, San Francisco, Calif., January 17-19, 1973, Proceedings. Conference sponsored by ACM, AIIE, IEEE, SHARE, SCi, and TIMS. Edited by A. C. Hoggatt (California, University, Berkeley, Calif.). New York, Institute of Electrical and Electronics Engineers, Inc., 1973. 908 p. $15.

Topics discussed include the role of simulation in project development, behavior and learning models, simulation methodology, and aerospace applications of simulation, including the real-time simulation of a multiple-element defensive test environment, computer simulation of the interactions between surface-to-air missile systems and aircraft in a nonjamming environment and over flat terrain, and the design and use of a simulator of some of the newly automated safety separation functions for terminal air traffic control. Also discussed are languages used for simulation and the problem of maintenance and reliability. A.B.K.

A73-33419 # Simulation in the design of automated air traffic control functions. P. D. Flanagan, J. B. Currier, K. E. Willis. In: Winter Simulation Conference, San Francisco, Calif., January 17-19, 1973, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1973, p. 449-462.

Description of the design and use of a simulator of some of the newly automated safety separation functions for terminal air traffic control (ATC). The program was used not only for analysis and design of these functions but also as a testbed for the logic actually implemented in the Knoxville, Tennessee terminal. Imbedded in the program is an emulator of the Goodyear Aerospace Corporation STARAN IV Associative Processor used at Knoxville. The three major ATC functions simulated are: (1) advanced midair conflict prediction and evaluation, (2) conflict resolution maneuver generation, and (3) automated voice advisory message generation and scheduling. Author)

A73-33422 Methods for estimating drag polars of subsonic airplanes. J. Roskam (Kansas, University, Lawrence, Kan.). Lawrence, Kan., Roskam Aviation and Engineering Corp., 1971. 90 p. 6 refs. $4.50.

The purpose of this text is to present methods for computing drag polars of conventional airplanes at Mach numbers below 1.0. The word conventional is to be interpreted such that airplanes with highly swept, low aspect ratio wings are excluded. Two methods are presented. First a very fast preliminary design method for estimating drag polars at low Mach numbers. Second a more elaborate (and also more accurate) method for estimating drag polars over the entire range below M = 1.0. The intent is that the first method be used in the very first stages of preliminary design studies of new airplane designs. The second method can be used to obtain more detailed and accurate drag data for an airplane design once its configuration is more or less determined. (Author)

A73-33423 Methods for estimating stability and control derivatives of conventional subsonic airplanes. J. Roskam (Kansas, University, Lawrence, Kan.). Lawrence, Kan., Roskam Aviation and Engineering Corp., 1971, 110 p. 7 refs. $5.50.

This text provides methods for computing numbers of stability and control derivatives for conventional, tail-aft airplanes in subsonic flight. Such methods are particularly valuable when doing parametric

or preliminary design studies of stability and control characteristics of airplanes. The methods allow students to come up with estimated stability characteristics of their own design within a reasonable period of time and with reasonable accuracy. The methods presented apply to most jet airplane configurations with power-on or power-off, because power effects on the aerodynamic derivatives are small. F.R.L.

A73-33477 **Reliability of aerospace fluidic controls.** J. M. Mix (AiResearch Manufacturing Co., Los Angeles, Calif.). *Fluidics Quarterly*, vol. 5, Jan. 1973, p. 96-109.

Discussion of aerospace fluidic control system designs developed by the Company under a fluidic technology program initiated in the early 1960's. The systems covered include a load control system, a fluidic temperature sensor, a pneumatic actuator for thrust reverser, the Lockheed S-3A pressure regulating valve, the Concorde SST fluidic speed control system of thrust reverser, the APU surge control valve of the B-1 aircraft, an engine thrust reverser speed and torque control system, and various filter designs. Test data are given to demonstrate the reliability of fluidic control modules in aerospace control applications. V.Z.

A73-33478 **Hydrofluidic component and system reliability.** L. J. Banaszak (Honeywell, Inc., Minneapolis, Minn.). *Fluidics Quarterly*, vol. 5, Jan. 1973, p. 110-120. Grant No. DAAJ02-67-C-0003.

Reliability/life test results are evaluated for hydrofluidic control components and systems in helicopter applications. Failure criteria for rate sensors, amplifiers, bellows and trim control are given. Life limiting characteristics of hydrofluidic components are shown to exceed greatly 3000 hr of operating time. It is also concluded that catastrophic failures are not inherent in hydrofluidic components and that their replacement lifetimes most probably far exceed the lifetimes of their intended applications. Effective corrective measures were developed and supplemented for all hydrofluidic drift-type failure modes encountered during the test program. V.Z.

A73-33480 * # **Effect of rotor design tip speed on aerodynamic performance of a model VTOL lift fan under static and crossflow conditions.** N. O. Stockman, I. J. Loeffler, and S. Lieblein (NASA, Lewis Research Center, VTOL Propulsion Branch, Cleveland, Ohio). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Washington, D.C., Apr. 8-12, 1973, Paper 73-GT-2.* 8 p. 9 refs. Members, $1.00; nonmembers, $3.00.

A73-33481 # **Investigation of the aerodynamic performance of small axial turbines.** J. S. Ewen, F. W. Huber, and J. P. Mitchell (United Aircraft Corp., Pratt and Whitney Aircraft Div., West Palm Beach, Fla.). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Washington, D.C., Apr. 8-12, 1973, Paper 73-GT-3.* 7 p. 9 refs. Members, $1.00; nonmembers, $3.00.

This paper describes results of an experimental investigation of small axial turbine performance characteristics. Included are test data on the effects of the following design variables on small turbine aerodynamic efficiency: blade height, vane endwall contouring, blade reaction, blade tip clearance, stage work, and vane and blade airfoil row solidity. In addition, the effects of vane, blade, and disk cooling air injection on turbine efficiency are presented. The turbines evaluated were single stage, low aspect ratio configurations sized for airflows of 3.63 kg/sec or less and designed for inlet temperatures in the 2200-to-2500 deg F range. The efficiency data presented in the paper cover both design and off-design velocity and pressure ratios. These data illustrate that relatively high efficiencies can be obtained in small, low aspect ratio axial turbines with an optimum design. (Author)

A73-33483 # **Reduction of nitrogen oxide emissions from a gas turbine by fuel modifications.** H. Shaw (Esso Government Research Laboratory, Linden, N.J.). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Washington, D.C., Apr. 8-12, 1973, Paper 73-GT-5.* 8 p. 21 refs. Members, $1.00; nonmembers, $3.00. Contract No. F33615-71-C-1575.

A broad experimental program was undertaken to assess the feasibility of reducing NOx from aircraft gas turbine engines by fuel modifications (additives and/or treatments). The modifications were selected without regard to practical limitations in order not to obscure potentially useful approaches. The Esso high-pressure can-nular combustor was used to simulate the characteristic emissions of gas turbines. Approximately 70 fuel modifications were tested using Jet A as the base fuel. None of the investigated additives was fully acceptable because of the relatively low NOx reduction that was obtained even with high additive treat rates. The experimental work was carried out at an overall air to fuel ratio of around 50 and at a pressure of 48 psig. The exhaust gas composition was typical of the latest aircraft turbine engines with the exception of the carbon monoxide levels which were too high. (Author)

A73-33484 # **Small turbomachinery compressor and fan aerodynamics.** R. C. Pampreen (AiResearch Manufacturing Company of America, Phoenix, Ariz.). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Washington, D.C., Apr. 8-12, 1973, Paper 73-GT-6.* 6 p. 9 refs. Members, $1.00; nonmembers, $3.00.

This paper discusses aerodynamic considerations in the design of small turbomachinery axial and centrifugal compressors and fans. Test results are presented to show the effect of scaling on compressor performance. Correlations are presented which relate compressor efficiency to Reynolds number and clearance. It is shown that clearance effects are more prominent when scaling designs, and Reynolds number effects are more prominent as density is lowered. (Author)

A73-33485 # **Dynamic gas temperature measurements in a gas turbine transition duct exit.** R. R. Dils (United Aircraft Materials Engineering and Research Laboratory, Middletown, Conn.). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Washington, D.C., Apr. 8-12, 1973, Paper 73-GT-7.* 13 p. 42 refs. Members, $1.00; nonmembers, $3.00.

Wide bandwidth gas temperature measurements in the transition duct exit of a gas turbine show that large gas temperature fluctuations occur at any point in the duct exit. The temperature fluctuations increase with engine thrust level, exceeding 1000 deg F at takeoff. Probabilistic and spectral analyses of the data indicate that the gas temperature fluctuations are due to nonaxial displacements of partially mixed secondary air jet zones in the transition duct exit. The jet zones are driven by the combustion processes in the forward sections of the main burner. The combustion processes regeneratively and nonlinearly amplify the longitudinal resonant acoustic pressure modes of the diffuser duct and the main burner and generate periodic velocity fluctuations in the combustion products leaving the forward sections of the main burner. Surface temperature waves induced at the leading edge of the first-stage turbine nozzle guide vanes by the main burner exhaust gases are also obtained from the data. (Author)

A73-33487 # **Compressible flow theories for airfoil cascades.** J. P. Gostelow (Science Research Council, Turbomachinery Laboratory, Cambridge, England). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Washington, D.C., Apr. 8-12, 1973, Paper 73-GT-9.* 12 p. 68 refs. Members, $1.00; nonmembers, $3.00.

Solutions to the direct problem of subsonic flow calculation for cascades are firstly reviewed and the existing techniques are classified into series, iterative, matrix, and streamline curvature solutions. Most techniques appear to be successful when the peak velocity remains subsonic. Some solutions to the design problem are reviewed but results from these require further verification. Purely supersonic cascade flows, although rare, offer no particular difficulties but the regime of greatest current activity involves transonic or mixed flows. Where both subsonic and supersonic flows exist various new techniques offer great promise. (Author)

A73-33488 * # **The use of a finite difference technique to predict cascade, stator, and rotor deviation angles and optimum angles of attack.** P. R. Dodge (AiResearch Manufacturing Company of Arizona, Phoenix, Ariz.). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Washington, D.C., Apr. 8-12, 1973, Paper 73-GT-10.* 6 p. 11 refs. Members, $1.00; nonmembers, $3.00. Contract No. NAS3-15324.

A73-33489 # **Low emissions combustion for the regenerative gas turbine. I - Theoretical and design considerations.** W. R. Wade, P. I. Shen, C. W. Owens, and A. F. McLean (Ford Motor Co., Dearborn, Mich.). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Washington, D.C., Apr. 8-12, 1973, Paper 73-GT-11.* 17 p. 38 refs. Members, $1.00; nonmembers, $3.00.

A73-33490 # **Low emissions combustion for the regenerative gas turbine. II - Experimental techniques, results, and assessment.** N. A. Azelborn, W. R. Wade, J. R. Secord, and A. F. McLean (Ford Motor Co., Dearborn, Mich.). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Washington, D.C., Apr. 8-12, 1973, Paper 73-GT-12.* 7 p. Members, $1.00; nonmembers, $3.00.

A73-33492 # **On the unsteady supersonic cascade with a subsonic leading edge - An exact first order theory. I.** M. Kurosaka (General Electric Co., Schenectady, N.Y.). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Washington, D.C., Apr. 8-12, 1973, Paper 73-GT-15.* 10 p. 11 refs. Members, $1.00; nonmembers, $3.00.

A73-33493 # **On the unsteady supersonic cascade with a subsonic leading edge - An exact first order theory. II.** M. Kurosaka (General Electric Co., Schenectady, N.Y.). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Washington, D.C., Apr. 8-12, 1973, Paper 73-GT-16.* 9 p. 6 refs. Members, $1.00; nonmembers, $3.00. Research sponsored by the General Electric Co.

A73-33494 # **A contribution to the theoretical and experimental examination of the flow through plane supersonic deceleration cascades and supersonic compressor rotors.** H. Simon (Rheinisch-Westfälische Technische Hochschule, Aachen, West Germany). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Washington, D.C., Apr. 8-12, 1973, Paper 73-GT-17.* 11 p. 12 refs. Members, $1.00; nonmembers, $3.00.

A73-33495 # **Effectiveness and heat transfer with full-coverage film cooling.** D. E. Metzger (Arizona State University, Tempe, Ariz.), D. I. Takeuchi, and P. A. Kuenstler. *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Washington, D.C., Apr. 8-12, 1973, Paper 73-GT-18.* 5 p. 13 refs. Members, $1.00; nonmembers, $3.00.

The paper presents experimental results for performance of full-coverage film cooled surfaces. Effectiveness and heat transfer are measured on plane surfaces with discrete injection through the surface at an array of points into a turbulent mainstream boundary layer. The injection is normal to the surface, through circular holes arranged in both in-line and staggered patterns with 4.8 hole diameters used for both the row-to-row spacing and the hole-to-hole spacing within a single row. Both the film and mainstream fluids are air, and property differences are kept small throughout the study. Uniform injection over the entire array at film-to-mainstream velocity ratios of 0.1 and 0.2 with a uniform wall temperature boundary condition are covered. Results are compared with predictions using superposition of available single hole local effectiveness values. (Author)

A73-33496 * # **Control of turbofan lift engines for VTOL aircraft.** J. F. Sellers and J. R. Szuch (NASA, Lewis Research Center, Dynamics and Controls Branch, Cleveland, Ohio). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Washington, D.C., Apr. 8-12, 1973, Paper 73-GT-20.* 11 p. 9 refs. Members, $1.00; nonmembers, $3.00.

This paper presents the results of an analytical study of the dynamics and control of turbofan lift engines, and proposes methods of meeting the response requirements imposed by the VTOL aircraft application. Two types of lift fan engines are discussed: the integral and remote. The integral engine is a conventional two-spool, high bypass ratio turbofan designed for low noise and short length. The remote engine employs a gas generator and a lift fan which are separated by a duct, and which need not be coaxial. For the integral engine, a control system design is presented which satisfies the VTOL response requirements. For the remote engine, two unconventional methods of control involving flow transfer between lift units are discussed. (Author)

A73-33497 # **Interface effects between a moving supersonic blade cascade and a downstream diffuser cascade.** J. Fabri, J. Reboux, and F. Hirsinger (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Washington, D.C., Apr. 8-12, 1973, Paper 73-GT-23.* 6 p. 10 refs. Members, $1.00; nonmembers, $3.00.

A73-33498 * # **Propulsion system for research VTOL transports.** L. W. Gertsma (NASA, Lewis Research Center, Cleveland, Ohio) and S. Zigan (General Electric Co., Cincinnati, Ohio). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Washington, D.C., Apr. 8-12, 1973, Paper 73-GT-24.* 8 p. 8 refs. Members, $1.00; nonmembers, $3.00.

In anticipation of an eventual VTOL requirement for civil aviation, NASA has been conducting studies directed toward determining and developing the technology required for a commercial VTOL transport. The commercial transport configurations of such a VTOL transport are briefly reviewed, the propulsion system specifications and components developed by the engine study contractor are presented and described, and methods for using the lift-propulsion system for aircraft attitude control are discussed. (Author)

A73-33499 # **Newkirk effect - Thermally induced dynamic instability of high-speed rotors.** A. D. Dimarogonas (Lehigh University, Bethlehem, Pa.). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Washington, D.C., Apr. 8-12, 1973, Paper 73-GT-26.* 11 p. 6 refs. Members, $1.00; nonmembers, $3.00.

The Newkirk effect is the vibration change due to thermal distortion of a rotor caused by rubbing on stationary components. The static bow due to an arbitrary heat input can be found from a convolution integral of a source bow function and a heat function. Utilizing the dynamic response of the system, the resulting dynamic bow was computed. This dynamic bow controls the generated heat and the associated heat function. The resulting model can be described by a complex integral equation which can be transformed into two nonlinear differential equations. The stability and the modes of these equations have been studied. The equations themselves were solved with numerical methods. Three modes of the Newkirk effect were discovered: spiraling, oscillating, and constant modes. It was found that critical speeds only indirectly influence the modes. The important factor is still the dynamic characteristics of the system in the form of a phase angle. (Author)

A73-33500 * # **Aerodynamic study of a turbine designed for a small low-cost turbofan engine.** M. G. Kofskey and W. J. Nusbaum (NASA, Lewis Research Center, Cleveland, Ohio). *American Society of Mechanical Engineers, Gas Turbine Conference and Products*

Show, Washington, D.C., Apr. 8-12, 1973, Paper 73-GT-29. 11 p. 5 refs. Members, $1.00; nonmembers, $3.00.

A73-33501 # **Upstream attenuation and quasi-steady rotor lift fluctuations in asymmetric flows in axial compressors.** E. M. Greitzer (United Aircraft Corp., Pratt and Whitney Aircraft Div., East Hartford, Conn.). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Washington, D.C., Apr. 8-12, 1973, Paper 73-GT-30.* 10 p. 8 refs. Members, $1.00; nonmembers, $3.00.

A73-33503 # **Lift and measurements in an aerofoil in unsteady flow.** D. W. Holmes (Science Research Council, Turbomachinery Laboratory, Cambridge, England). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Washington, D.C., Apr. 8-12, 1973, Paper 73-GT-41.* 12 p. 12 refs. Members, $1.00; nonmembers, $3.00. Research supported by Rolls Royce, Ltd.

A wind tunnel is described which is capable of producing both 'transverse' and 'streamwise' gusts. An account is given of the lift and pressure fluctuations measured on an isolated airfoil tested in the tunnel. The response to a transverse gust compares well with Kemp's (1952) theory, although the pressure distribution is not as predicted. The results suggest that the wake behavior and, in particular, the existence of a separation region can in practice seriously affect the validity of applying the now classical unsteady vortex theory. (Author)

A73-33504 # **Remanufacture of jet engine compressor components.** M. Weinstein (Chromalloy American Corp., San Antonio, Tex.). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Washington, D.C., Apr. 8-12, 1973, Paper 73-GT-43.* 8 p. Members, $1.00; nonmembers, $3.00.

A description of the various mechanical operations employed in the remanufacture of gas turbine engine compressor components such as blading, rotor disks and spacer, vane shroud assemblies, and air seals are given. The operations described include tungsten inert gas, plasma needle arc and electron beam welding, furnace and torch brazing, glass bead and shot peening, magnetic particle and ultrasonic inspection, plasma spray and diffusion coating. Emphasis is given to the effect of these operations on the mechanical integrity of the engine component. For example, the effect of welding, brazing, peening, and diffusion coating on the high-cycle fatigue strength of compressor stator and rotor components is discussed. The effect of repair operations on jet engine compressor performance is also considered. (Author)

A73-33505 # **Repair of turbine blades and vanes.** D. S. Duvall and J. R. Doyle (Pratt and Whitney Aircraft Materials Engineering and Research Laboratory, Middletown, Conn.). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Washington, D.C., Apr. 8-12, 1973, Paper 73-GT-44.* 14 p. Members, $1.00; nonmembers, $3.00.

Fusion-weld repair of turbine components made from high-strength nickel-base superalloys is complicated by the relatively poor weldability of these materials. In turbine vanes constructed of cast Waspaloy (a superalloy of moderate strength), service-induced damage can be repaired by careful gas-tungsten-arc welding procedures without significant incidence of weldment cracking. Weld repair of the higher strength vane alloy Inco 713 requires the use of special techniques such as dissimilar weld filler alloys and/or unique preheating methods to produce crack-free repair welds. (Author)

A73-33507 # **Transient analysis of ceramic vanes for heavy duty gas turbines.** R. T. Schaller and T. J. Rahaim (Westinghouse Electric Corp., Lester, Pa.). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Washington, D.C., Apr. 8-12, 1973, Paper 73-GT-46.* 9 p. 12 refs. Members, $1.00; nonmembers, $3.00.

A transient analysis of thermal stresses in ceramic stationary vanes is presented. The application of ceramics to gas turbines represents an alternate approach for designers to increase operating temperatures. Highly dense silicon carbide and silicon nitride vanes are analyzed for application in a heavy duty gas turbine. The most severe thermal loading condition for this turbine is imposed on the vanes. The purpose of this paper is to present the effect of ceramic material, vane size, air foil, cross-sectional geometry, and gas inlet temperature on the thermal response of ceramic vanes. (Author)

A73-33509 # **Gas turbine vibration limits - A fundamental view.** G. A. Ludwig and O. D. Erdmann (General Electric Co., Gas Turbine Products Div., Schenectady, N.Y.). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Washington, D.C., Apr. 8-12, 1973, Paper 73-GT-48.* 6 p. Members, $1.00; nonmembers, $3.00.

An attempt is made to categorize the vibration response characteristics of several types of rotating machinery, with specific emphasis on industrial type gas turbines. Absolute and relative motions and units of measurement are discussed, and a vibration 'standard' is proposed that has been successfully applied to a large family of industrial gas turbines. M.V.E.

A73-33510 # **Transonic flow through a turbine stator treated as an axisymmetric problem.** H. J. Schröder and P. Schuster (Motoren- und Turbinen-Union München GmbH, Munich, West Germany). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Washington, D.C., Apr. 8-12, 1973, Paper 73-GT-51.* 12 p. 6 refs. Members, $1.00; nonmembers, $3.00.

A73-33512 # **A wake and an eddy in a rotating, radial-flow passage. I - Experimental observations.** J. Moore (GE Research and Development Center, Schenectady, N.Y.). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Washington, D.C., Apr. 8-12, 1973, Paper 73-GT-57.* 8 p. 11 refs. Members, $1.00; nonmembers, $3.00. NSF Grant No. GK-74922.

A73-33515 * # **Experimental evaluation of the effects of a blunt leading edge on the performance of a transonic rotor.** L. Reid and D. C. Urasek (NASA, Lewis Flight Center, Cleveland, Ohio). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Washington, D.C., Apr. 8-12, 1973, Paper 73-GT-60.* 6 p. Members, $1.00; nonmembers, $3.00.

A73-33516 # **Hot isostatic pressing of titanium alloys for turbine engine components.** G. H. Harth (Battelle Columbus Laboratories, Columbus, Ohio). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Washington, D.C., Apr. 8-12, 1973, Paper 73-GT-63.* 5 p. 7 refs. Members, $1.00; nonmembers, $3.00.

A73-33517 # **Design considerations for supersonic V/STOL aircraft.** D. Migdal, R. Cea, and R. McNiece (Grumman Aerospace Corp., Bethpage, N.Y.). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Washington, D.C., Apr. 8-12, 1973, Paper 73-GT-65.* 12 p. Members, $1.00; nonmembers, $3.00.

Postulating the requirement for one supersonic V/STOL aircraft to perform a variety of potentially useful military missions, several design options were explored: the effects on aircraft size/performance of cruise engine bypass and operating pressure ratios; the use of afterburning cruise engines for V/STOL; and the resulting surface temperature/velocity properties. It was concluded that a moderate bypass ratio (0.8) was near optimum for the supersonic missions and a high bypass ratio (2.5) is desirable for the subsonic

missions. The use of afterburning during V/STOL can yield significant reductions in aircraft gross weight and may not require unreasonably large danger areas for a steel deck. (Author)

A73-33518 # **Conceptual study of high performance V/STOL fighters.** P. G. Kappus and A. O. Kohn (General Electric Co., Advanced Military Combat Systems, Cincinnati, Ohio). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Washington, D.C., Apr. 8-12, 1973, Paper 73-GT-66.* 19 p. Members, $1.00; nonmembers, $3.00.

A simplified, conceptual study has been conducted to identify the effect of a variety of conceptual approaches on the design of VTOL interceptor type fighter aircraft with high supersonic speed capability and high levels of excess power at subsonic and supersonic combat conditions. The study assumes advanced technology in aircraft and propulsion systems consistent with an IOC (Initial Operational Capability) in the early to mid 1980's. Included are designs using augmented lift/cruise engines. Also evaluated are tilt pod and nose hanger configurations. All configurations are designed for identical mission range/payload requirements. Specific design problems encountered in the various configurations are discussed, with special attention paid to the problems of balance and attitude control in the lift mode. (Author)

A73-33519 # **Compound ejector thrust augmenter development.** L. W. Throndson (North American Rockwell Corp., Aircraft Div., Columbus, Ohio). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Washington, D.C., Apr. 8-12, 1973, Paper 73-GT-67.* 10 p. 14 refs. Members, $1.00; nonmembers, $3.00.

The basic simplicity of ejectors provides an advantageous form of engine thrust augmentation for V/STOL aircraft. Application requires careful internal aerodynamics development to provide high augmentation ratios in compact, short length, ejector installations. Development of the compound ejector through rig and wind tunnel tests is described wherein Coanda flow and improved central primary flow injection are combined. Several methods of reducing ejector volume are employed through increased mixing and diffusion rates while directing attention to loss sources such as inlet blockage. (Author)

A73-33521 # **Lift engine bleed flow management for a V/STOL fighter reaction control system.** C. N. Webster (Vought Aeronautics Co., Dallas, Tex.). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Washington, D.C., Apr. 8-12, 1973, Paper 73-GT-70.* 11 p. Members, $1.00; nonmembers, $3.00.

A73-33522 # **V/STOL airframe/propulsion integration problem areas.** D. Sutliff (General Dynamics Corp., Convair Aerospace Div., San Diego, Calif.). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Washington, D.C., Apr. 8-12, 1973, Paper 73-GT-76.* 11 p. Members, $1.00; nonmembers, $3.00.

The integration of V/STOL airframe and propulsion systems requires consideration of problems not experienced in conventional aircraft. These problems are discussed in terms of several propulsion arrangements of lift jets and vectored cruise engines. Thrust requirements are compared for the propulsion arrangements and the exhaust flow pattern, and its interference and reingestion effects developed in ground proximity, are reviewed. Selected design problems involving store and landing gear location and the use of lift jets for emergency cruise are discussed. Finally, a comparison is made of the weight and costs of the aircraft, each using a different propulsion arrangement. (Author)

A73-33523 # **Performance of jet V/STOL tactical aircraft nozzles.** E. H. Miller (Grumman Aerospace Corp., Bethpage, N.Y.). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Washington, D.C., Apr. 8-12, 1973, Paper 73-GT-77.* 11 p. 5 refs. Members, $1.00; nonmembers, $3.00.

V/STOL aircraft impose stringent requirements on exhaust nozzles. In many cases, this type nozzle must provide a high level of thrust for liftoff and maintain it while vectoring. Grumman ran a test program to optimize V/STOL nozzle designs and obtain a basic understanding of the complicated exhaust nozzle flow process. The program made use of fiberglass models which were 1/6.5 scale of representative fighter designs. Tests were run statically with cold air. The configurations examined were cut-off plug, single bearing swivel-tee plenum, single bearing swivel-scroll plenum, and flap nozzle. The effects of number of vanes, Mach number, and distortion were examined. (Author)

A73-33524 # **Pressure measurements on the rotating blades of an axial-flow compressor.** M. R. Sexton, W. F. O'Brien, Jr., and H. L. Moses (Virginia Polytechnic Institute and State University, Blacksburg, Va.). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Washington, D.C., Apr. 8-12, 1973, Paper 73-GT-79.* 7 p. 11 refs. Members, $1.00; nonmembers, $3.00. Navy-supported research. Project SQUID.

A73-33525 # **Turbulence downstream of stationary and rotating cascades.** R. Kiock (Institut für Aerodynamik, Braunschweig, West Germany). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Washington, D.C., Apr. 8-12, 1973, Paper 73-GT-80.* 13 p. 18 refs. Members, $1.00; nonmembers, $3.00.

In a compressor, the inflow turbulence to the different stages determines the blade boundary layer behavior, especially at low Reynolds numbers as they occur in jet engines. Therefore, the knowledge of the turbulence quantities in a compressor is very important for compressor research and design. Some investigations of turbulence parameters behind stationary and rotating cascades are described. Velocity fluctuations were detected in a frequency range from 20 to 30,000 Hz by a hot-wire probe. Starting with a plane decelerating cascade, the stationary and instationary quantities are evaluated downstream of the cascade and transferred to overall values representing certain mean values along one blade spacing. (Author)

A73-33526 # **A current turbine engine maintenance program and the experience and logic upon which it is based.** F. S. Nowlan (United Air Lines, Inc., San Francisco International Airport, Calif.). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Washington, D.C., Apr. 8-12, 1973, Paper 73-GT-81.* 18 p. 6 refs. Members, $1.00; nonmembers, $3.00.

A73-33527 # **Inviscid flow through a cascade of thick, cambered airfoils. I - Incompressible flow.** D. A. Frith (Department of Supply, Aeronautical Research Laboratories, Melbourne, Australia). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Washington, D.C., Apr. 8-12, 1973, Paper 73-GT-84.* 7 p. Members, $1.00; nonmembers, $3.00.

A73-33528 # **Inviscid flow through a cascade of thick, cambered airfoils. II - Compressible flow.** D. A. Frith (Department of Supply, Aeronautical Research Laboratories, Melbourne, Australia). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Washington, D.C., Apr. 8-12, 1973, Paper 73-GT-85.* 6 p. Members, $1.00; nonmembers, $3.00.

A73-33529 # **Comparative analysis of turbine loss parameters.** R. T. Timm (Wisconsin Public Service Commission, Madison, Wis.) and N. H. Beachley (Wisconsin, University, Madison, Wis.). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Washington, D.C., Apr. 8-12, 1973, Paper*

73-GT-91. 10 p. 7 refs. Members, $1.00; nonmembers, $3.00.

Prediction of axial flow turbine performance requires accurate loss parameters. Ainley and Mathieson's loss data have been widely used in the field for a number of years. This set of data is compared with a composite set consisting primarily of loss parameters from a study made recently by Balje and Binsley. Turbine performance calculations using computerized three-dimensional techniques have been performed for a wide range of turbine configurations and operating conditions, using both sets of loss data. Little significant difference is found in the results obtained by using either approach. (Author)

A73-33530 # **Nondestructive inspection method for jet engine turbine blades.** I. R. Kraska (General American Transportation Corp., Niles, Ill.) and W. L. Berndt (USAF, Oklahoma Air Material Area, Tinker AFB, Okla.). *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, Washington, D.C., Apr. 8-12, 1973, Paper 73-GT-92*. 11 p. Members, $1.00; nonmembers, $3.00.

A73-33536 # **Pollution of the upper atmosphere revisited.** W. W. Kellogg (National Center for Atmospheric Research, Boulder, Colo.). *American Institute of Aeronautics and Astronautics and American Meteorological Society, International Conference on the Environmental Impact of Aerospace Operations in the High Atmosphere, Denver, Colo., June 11-13, 1973, AIAA Paper 73-492*. 5 p. 10 refs. Members, $1.50; nonmembers, $2.00.

Since the upper atmosphere is so tenuous and since contaminants introduced there can have a long residence time, the possibility of modifying it by human intervention has been raised a number of times in the past. In the early 1960's very large booster rockets, then only on the drawing board, caused some concern in this regard, but it was not until 1970 that widespread attention was drawn to the effects of high flying aircraft on the stratosphere. This has reopened the question of polluting the upper atmosphere. We will review what we know now in the light of what we think we will need to know in order to predict the environmental effects of advancing aerospace technology. (Author)

A73-33546 # **Concentration of OH and NO in YJ93-GE-3 engine exhausts measured in situ by narrow-line UV absorption.** W. K. McGregor, B. L. Seiber, and J. D. Few (ARO, Inc., Arnold Engineering Development Center, Arnold Air Force Station, Tenn.). *American Institute of Aeronautics and Astronautics and American Meteorological Society, International Conference on the Environmental Impact of Aerospace Operations in the High Atmosphere, Denver, Colo., June 11-13, 1973, AIAA Paper 73-506*. 12 p. 18 refs. Members, $1.50; nonmembers, $2.00. Research sponsored by the U.S. Department of Transportation.

A73-33548 # **The WB-57F aircraft as an instrument platform.** T. J. Kelly (USAF, McClellan AFB, Calif.). *American Institute of Aeronautics and Astronautics and American Meteorological Society, International Conference on the Environmental Impact of Aerospace Operations in the High Atmosphere, Denver, Colo., June 11-13, 1973, AIAA Paper 73-510*. 3 p. Members, $1.50; nonmembers, $2.00.

The WB-57F, a highly modified version of the Martin B-57 Canberra light bomber, was designed for use in high altitude air sampling in conjunction with nuclear testing in the atmosphere. Although the aircraft can still accomplish nuclear sampling, its unique design permits it to carry a wide variety of instrument packages with which to study the upper atmosphere. A general description of the aircraft is presented, including range, altitude, and speed. A detailed description of the payload capability of the aircraft is given. Size, instrument package weight limit, available power, and environmental conditions of the various equipment stations are discussed. (Author)

A73-33562 # **A three-dimensional stratospheric point-source tracer experiment and its implications for dispersion of effluent from a fleet of supersonic aircraft.** J. D. Mahlman (NOAA, Geophysical Fluid Dynamics Laboratory, Princeton, N.J.). *American Institute of Aeronautics and Astronautics and American Meteorological Society, International Conference on the Environmental Impact of Aerospace Operations in the High Atmosphere, Denver, Colo., June 11-13, 1973, AIAA Paper 73-528*. 6 p. 15 refs. Members, $1.50; nonmembers, $2.00. AEC-supported research.

A73-33563 # **A general circulation model of stratospheric ozone.** D. M. Cunnold, F. N. Alyea, N. A. Phillips, and R. G. Prinn (MIT, Cambridge, Mass.). *American Institute of Aeronautics and Astronautics and American Meteorological Society, International Conference on the Environmental Impact of Aerospace Operations in the High Atmosphere, Denver, Colo., June 11-13, 1973, AIAA Paper 73-529*. 8 p. 36 refs. Members, $1.50; nonmembers, $2.00. Contract No. AT(11-1)-2249.

This paper reports on a numerical model being developed with the ultimate objective of assessing the effects of SST operations on the atmospheric ozone distribution. The model is quasi-geostrophic and is being solved in the spectral domain using 79 spherical harmonics and 26 vertical levels between the ground and 70 km. The heating of the stratosphere by ozone is explicitly treated in the model and the ozone prediction equation includes the Chapman reactions and the catalytic reaction with nitric oxide. The model is initially being used in an attempt to simulate the seasonal variations of the unperturbed global ozone distribution. (Author)

A73-33565 # **Dispersion of exhaust plumes in the stratosphere.** J. J. Walton (California, University, Livermore, Calif.). *American Institute of Aeronautics and Astronautics and American Meteorological Society, International Conference on the Environmental Impact of Aerospace Operations in the High Atmosphere, Denver, Colo., June 11-13, 1973, AIAA Paper 73-532*. 5 p. 6 refs. Members, $1.50; nonmembers, $2.00. Research sponsored by the U.S. Department of Transportation and AEC.

Because of the continued passage of aircraft over specific areas of the earth, local regions of high concentration may be expected to appear and be sustained. This problem is enhanced since early time dispersion occurs at a slower rate than predicted using global-scale diffusion coefficients. For this reason, using the superposition of nonreactive plumes being dispersed by scale-dependent diffusion, the characteristic concentration growth curves and profiles of such a flight corridor have been obtained. A linear relation was found between maximum concentration and flight frequency while only a weak dependence on corridor dimension was observed. As a specific example, a flight corridor 400 km in the horizontal by 3 km in the vertical with a flight frequency of 180 round trips per day was considered. Maximum corridor concentration rose to approximately 10% of that of a single plume at the end of the wake-dispersion regime with concentrations dropping to 1/e of this maximum in 1800 km and 2.8 km in the horizontal and vertical respectively. (Author)

A73-33566 # **Subsonic jet aircraft contribution to NOx in the stratospheric ozone layer - 1968 to 1990.** H. B. Levine (Virginia Polytechnic Institute and State University, Blacksburg, Va.). *American Institute of Aeronautics and Astronautics and American Meteorological Society, International Conference on the Environmental Impact of Aerospace Operations in the High Atmosphere, Denver, Colo., June 11-13, 1973, AIAA Paper 73-534*. 5 p. 8 refs. Members, $1.50; nonmembers, $2.00.

A73-33567 * # **Preliminary estimates of the fate of SST exhaust materials using a coupled diffusion/chemistry model.** G. R. Hilst and C. Donaldson (Aeronautical Research Associates of Princeton, Inc., Princeton, N.J.). *American Institute of Aeronautics and Astronautics and American Meteorological Society, International Conference on the Environmental Impact of Aerospace Operations in*

the High Atmosphere, Denver, Colo., June 11-13, 1973, AIAA Paper 73-535. 6 p. 7 refs. Members, $1.50; nonmembers, $2.00. Contracts No. NAS1-11433; No. NAS1-11873.

A73-33569 * # **A model for studying the effects of injecting contaminants into the stratosphere and mesosphere.** R. C. Whitten (NASA, Ames Research Center, Moffett Field, Calif.) and R. P. Turco (NASA, Ames Research Center, Moffett Field; R & D Associates, Santa Monica, Calif.). *American Institute of Aeronautics and Astronautics and American Meteorological Society, International Conference on the Environmental Impact of Aerospace Operations in the High Atmosphere, Denver, Colo., June 11-13, 1973, AIAA Paper 73-539.* 10 p. 73 refs. Members, $1.50; nonmembers, $2.00.

A73-33601 **Annual Reliability and Maintainability Symposium, Philadelphia, Pa., January 23-25, 1973, Proceedings.** Symposium sponsored by IEEE, AIAA, AIIE, ASME, ASM, ASQC, and IES. New York, Institute of Electrical and Electronics Engineers, Inc. (Annals of Assurance Sciences. Volume 6, No. 1), 1973. 657 p. $10.00.

Topics discussed include mathematical modeling, effectiveness and acceptance testing, Aegis weapon system reliability, mechanical reliability, parts reliability, logistics, airborne vs ground checkout tradeoffs, reliability methods for material engineering, safety, cost modeling, atomic energy, and computer applications. Also discussed are sequential probability ratio tests, accelerated testing of guided missiles, failure rate functions, product liability prevention, failure analysis of unequal size samples, and system engineering aspects of the man-machine interface.

A.B.K.

A73-33605 **The role of testing in achieving aerospace systems effectiveness.** A. M. Smith (General Electric Co., Philadelphia, Pa.) and T. D. Matteson (United Air Lines, Inc., San Francisco, Calif.). In: Annual Reliability and Maintainability Symposium, Philadelphia, Pa., January 23-25, 1973, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1973, p. 36-41.

The findings of a study of the relationship between testing and the achievement of effectiveness in aerospace systems are summarized. The study was conducted by the AIAA Systems Effectiveness and Safety Technical Committee and covered various aspects of test program requirements, philosophy and experience with spacecraft, launch vehicles, DOD aircraft, and commercial aircraft. The conclusion is that acceptance tests play a less-than-dominant role in the achievement of systems effectiveness. V.Z.

A73-33622 **Analysis of early failures in unequal size samples.** R. A. Heller and A. S. Heller (Virginia Polytechnic Institute and State University, Blacksburg, Va.). In: Annual Reliability and Maintainability Symposium, Philadelphia, Pa., January 23-25, 1973, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1973, p. 198-202. 6 refs. Contract No. F33615-72-C-2111.

Combined analytic and graphic methods, based on the extreme value theory and order statistics, are used as a basis for sampling tests on specimen populations with unequal-size members in quality control applications. A nonparametric method is described for using the first and second failures in unequal-size samples for the estimation of the population distribution function in the detection of weak members in a specimen population. This testing technique is characterized as effective in quality control applications for structural and mechanical integrity of materials when widely different samples sizes are used. V.Z.

A73-33627 **Increase reliability of operational systems /IROS/.** E. D. Hendricks (USAF, Logistics Command, McClellan AFB, Calif.) and A. K. Olsen (USAF, Quality Management Div., Kelly AFB, Tex.). In: Annual Reliability and Maintainability Symposium, Philadelphia, Pa., January 23-25, 1973, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1973, p. 250-259. 6 refs.

This paper describes the development and implementation of the Air Force Increase Reliability of Operational Systems (IROS) Program. Explanations of purpose and program direction, along with a sketch of the program history, are given. Activities of the Air Force Logistics Command's Reliability/IROS Working Group have resulted in the application of computerized math models which interface with Air Force data systems to establish resource allocation priorities in the areas of reliability, logistic support cost, operational availability, and system safety. Multiple discipline teams at both the working and management levels are utilized to assure effectiveness. Economic resource allocations and cost effective system modifications are achieved through the IROS concept as applied to operational systems. (Author)

A73-33631 **Operational readiness and maintenance testing of the B-1 strategic bomber.** J. E. Ogden and F. P. Cavanaugh (North American Rockwell Corp., Los Angeles, Calif.). In: Annual Reliability and Maintainability Symposium, Philadelphia, Pa., January 23-25, 1973, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1973, p. 293-297.

The implementation of new concepts in aircraft testing led to the development of the Central Integrated Test Subsystem (CITS). The CITS is an onboard aircraft subsystem utilizing a dedicated computer to read and assess the condition of all airborne subsystems. This provides the aircrew with continuous information regarding the status of the subsystems as a basis for the isolation of failures to a line replaceable unit. The CITS in its relationship to the B-1 and its maintainability is discussed, giving particular attention to cost tradeoffs between the CITS and all levels of aerospace ground equipment. G.R.

A73-33634 **Concept and system of the versatile avionic shop test /VAST/ system.** O. L. Eichna, Jr. (PRD Electronics, Inc., Syosset, N.Y.). In: Annual Reliability and Maintainability Symposium, Philadelphia, Pa., January 23-25, 1973, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1973, p. 313-317.

Review of the conceptual history, development, capabilities, and applications of the versatile avionic shop test (VAST) system. A study in the late 1950s of the problems associated with the maintenance of airborne electronic systems in the carrier environment (lacking shop work space, sufficient capable technical personnel, and maintenance equipment support) led to recognition of the need for built-in test equipment in aircraft to isolate failures to a weapon replaceable assembly and for standardized test systems making possible further fault isolation and repair in the maintenance shop. The VAST system design developments described are shown to have achieved their original goals. The system is currently used by aircraft personnel for supporting several A-7E electronics, and by Grumman, Lockheed, and LTV in the development of test programs for the F-14A, E-2C, and S-3A, respectively. M.V.E.

A73-33641 **Integrated reliability and safety analysis of the DC-10 all-weather landing system.** K. L. Peterson and R. S. Babin (Douglas Aircraft Co., Long Beach, Calif.). In: Annual Reliability and Maintainability Symposium, Philadelphia, Pa., January 23-25, 1973, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1973, p. 403-409.

The Douglas DC-10 airplane has an all-weather landing (AWL) capability, which permits automatic landings under zero-visibility weather conditions. An exhaustive reliability and safety analysis of the DC-10 AWL System showed conclusively that the safety of such landings, despite any concurrent system failures, is extremely high - higher, in fact, than that of conventional, visual landings under the pilot's control - and that government regulatory agencies' safety

criteria are fully met. The system analysis combined several common reliability analysis techniques with extensive modeling of system performance. (Author)

A73-33648 **Some economic aspects of aviation safety.** H. W. Wynholds (Lockheed Missiles and Space Co., Inc., Sunnyvale, Calif.). In: Annual Reliability and Maintainability Symposium, Philadelphia, Pa., January 23-25, 1973, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1973, p. 484-490. 23 refs.

This paper represents an initial attempt at addressing the fundamental issues of safety and regulation by constructing a simplified model of an industry that produces a single service (transportation) for which the cost of production and the value of the service are precisely known. It is shown that a fundamental logical problem requiring societal value judgments must be solved in order to determine the necessity for regulation and, if any is imposed, the type of regulation that is socially optimal. This result suggests that considerable care will be required in order to arrive at an optimal social policy in more complex problems, such as those presented by the interaction of the regulated airlines and the relatively unregulated aircraft manufacturers. It also suggests that highly simplified models may be useful in delineating some of the issues in these more complex and realistic problems of safety and regulation. (Author)

A73-33653 **Model to make Army decisions.** L. Neri (U.S. Army, Reliability and Maintainability Div., St. Louis, Mo.) and H. Wiebe (Missouri, University, Rolla, Mo.). In: Annual Reliability and Maintainability Symposium, Philadelphia, Pa., January 23-25, 1973, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1973, p. 554-557. 11 refs.

The Engineering management decision technique currently in use by the Army's Aviation Project Engineers, to determine which Equipment Improvement Recommendation or EIR case should be evaluated first, has been studied and a computer program designed to perform this function. Four significant parameters - reliability, availability, total annual inventory cost and total annual cost to live with the problem - have been developed and used to accomplish this. The objective of this study was to computerize the manual and mental process and evaluation of the EIRs relative to the four parameters and arrive at the decision as to which EIR has the highest priority. (Author)

A73-33654 **DC9-30 refrigeration system diagnosis by computer.** J. Albert (Eastern Air Lines, Inc., Miami, Fla.). In: Annual Reliability and Maintainability Symposium, Philadelphia, Pa., January 23-25, 1973, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1973, p. 558-563. 6 refs.

A novel method of quickly diagnosing DC9-30 refrigeration problems is presented. Readily obtainable steady state data are substituted in mathematical models relating to component performance, and the results compared to prescribed operating limits by computer for instantaneous diagnosis. In addition, hot day conditions are mathematically simulated and potential system problems predicted to provide preventative maintenance. An 'on condition' maintenance programme based on these concepts has been implemented, resulting in significant reduction in maintenance costs and increased system reliability. This instantaneous diagnostic approach to aircraft maintenance practices is believed to be the first of its type in the airline industry. (Author)

A73-33681 # **Moving-frame analysis of jet noise.** W. T. Chu (Southern California, University, Los Angeles, Calif.). *Acoustical Society of America, Journal*, vol. 53, May 1973, p. 1439, 1440. 9 refs. U.S. Department of Transportation Grant No. OS-00002.

A spectral representation is used as a basis for deriving a moving-frame formulation for jet noise by a simple mathematical procedure. Essential in this procedure is a spectral density function of the farfield acoustic pressure given as the Fourier cosine transform of a farfield acoustic pressure autocorrelation function. V.Z.

A73-33736 # **The experimental Kiebitz system.** W. Göller. *Dornier-Post* (English Edition), no. 2, 1973, p. 14, 15.

The feasibility of an automatically stabilized tethered rotor platform is demonstrated by the Dornier 'Kiebitz' system. The system uses the rotor and propulsion units of the Do 32 one-man helicopter, while the flight controls blade-pitch-control servo motors are taken from the Do 32-D helicopter drone. By using real-time transmission of sensor data, the platform can serve for communications, reconnaissance, and ECM purposes. It avoids the need for costly guidance systems, and is practically immune to jamming. V.P.

A73-33750 **Criteria regarding the predetermination of the laminar-turbulent boundary layer transition in the case of flows about body contours (Kriterien zur Voraubestimmung des laminar-turbulenten Grenzschichtumschlags an umströmten Körperkonturen).** P. Thiede(Berlin, Technische Universität, Berlin, West Germany). *VDI-Z Fortschrift-Berichte, Reihe 7 - Strömungstechnik*, no. 31, Dec. 1972. 43 p. 57 refs. In German. Research supported by the Deutsche Forschungsgemeinschaft.

In the case of a smooth surface and a flow subjected to few disturbing effects, the laminar-turbulent boundary layer transition takes place in three phases, including the primary instability of the laminar boundary layer, the beginning disturbance in the instable laminar boundary layer, and the origin and expansion of the turbulence. Reliable criteria on the basis of the stability theory regarding the primary instability of the compressible laminar boundary layer are available. The path length required for the origination of the disturbance cannot be determined theoretically. A criterion regarding the occurrence of the disturbance of general validity is derived on the basis of an empirical relation between the disturbance origin and the beginning of the transition. The criterion takes into account the effect of the pressure gradient and the Reynolds number. G.R.

A73-33944 **The propagation and attenuation of sound in lined ducts containing uniform or 'plug' flow.** B. J. Tester (Southampton, University, Southampton, England). *Journal of Sound and Vibration*, vol. 28, May 22, 1973, p. 151-203. 44 refs. Research supported by the British Aircraft Corp.

This paper is concerned with a theoretical analysis of the inviscid, perturbed or acoustic field, at a particular frequency, in an infinite, two-dimensional duct of constant cross-section in which the fluid properties, other than the mean axial velocity, are constant; one duct wall has a uniform, locally reacting, frequency dependent wall impedance, the other wall is rigid. The perturbed duct field due to an infinite, uniform line source, or the two-dimensional Green's function, is formally derived for uniform or plug flow in the duct, and is expressed as an infinite sum of non-orthogonal modes. The optimization of modal, axial attenuation rates is examined in some detail. Under certain conditions it is found that not necessarily all the Green's function modes in plug flow decay away from the source. (Author)

A73-33963 # **Calculation of flows past wings without thickness in the presence of developing vortex sheets (Calcul d'écoulements autour d'ailes sans épaisseur avec nappes tourbillonnaires évolutives).** C. Rehbach (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *La Recherche Aérospatiale*, Mar.-Apr. 1973, p. 53-61. 10 refs. In French.

A73-33964 # **Conditions of rotating stall suppression in axial compressors (Conditions de suppression du décollement tournant dans les compresseurs axiaux).** Y. Le Bot (ONERA, Châtillon-

sous-Bagneux, Hauts-de-Seine, France). *La Recherche Aérospatiale*, Mar.-Apr. 1973, p. 63-69. 12 refs. In French.

The rotating stall unsteady regime is particularly dangerous for the mechanical resistance of compressors. The theoretical analysis of the stability conditions of rotating stall in an isolated rotor of an axial compressor shows that this regime can be avoided when the ratio between the flow axial velocity and the entrainment velocity of the row at mid-height is near unity at the adaptation point, the exact value of this ratio depending on the blade geometry. This conclusion is directly applicable to by-pass turbojet fans, and gives an indication on the evolution to be sought for multistage axial compressors.

(Author)

A73-33986 **Hyfil limited - The manufacture of Hyfil carbon fibre.** I. Whitney (BTR Reinforced Plastics, Ltd., Uxbridge, Middx., England). *Composites*, vol. 4, May 1973, p. 101-104.

The need in the aircraft industry for materials with high strength and stiffness combined with low density led to the development of Hyfil carbon fibres within Rolls Royce Limited. The production plant, first built to satisfy a large internal demand for preimpregnated broad sheet, led to the development of an on line 'prepreg' process. The plant has since been modified to allow other carbon fibre products to be produced to meet the needs of the market.

(Author)

A73-34015 **Study of unsteady potential flows - Application to the case of a turbomachine stage (Etude des écoulements instationnaires à potentiel - Application au cas d'un étage de turbomachine).** J. Corniglion and T. S. Luu (CNRS, Paris, France). *Entropie*, vol. 9, Mar.-Apr. 1973, p. 17-23. 13 refs. In French.

Development of a method of studying a plane, unsteady, irrotational flow of an ideal incompressible fluid through a turbomachine stage. In particular, a study is made of the unsteady flow resulting from the interaction between a stationary grid and a moving grid. For this purpose, the method of singularities is employed, the solution scheme chosen being that of a constant mean global circulation around the profiles as the moving grid passes the stationary grid. The results obtained show the influence of a number of parameters on the investigated unsteady forces. Among these parameters are the distance between the grids, the angle at which the profiles are adjusted relative to the grid front, the relative thickness, and the relative pitch of the blades. A.B.K.

A73-34029 **Spherical debris - Its occurrence, formation and significance in rolling contact fatigue.** D. Scott and G. H. Mills (National Engineering Laboratory, East Kilbride, Scotland). *Wear*, vol. 24, May 1973, p. 235-242. 12 refs.

Scanning electron microscopical investigation of fracture surfaces and lubricant debris has revealed that spherical debris is a characteristic feature associated with rolling contact fatigue. It is formed by deformation processes within propagating fatigue cracks. Its detection is suggested as a diagnostic aid for the indication of distress in critical rolling mechanisms. (Author)

A73-34040 **Hamilton Standard and its Q-Fan concept.** *Interavia*, vol. 28, June 1973, p. 641-643.

Description of the design concept, structural considerations, demonstration tests, and market prospects of Q-Fan (quiet-fan) jet engines being developed by Hamilton Standard (a subsidiary of United Aircraft Corporation) to meet the expected stringent noise and thrust requirements of future STOL aircraft. The concept is based on the efficiency which can be obtained from a single-stage geared fan powered by a conventional turbine engine. The large, slow-rotating, variable-pitch fan contributes to thrust in the same manner as in conventional fan engines by accelerating the air drawn through the fan and then diverting it around the engine. Bypass ratios are far higher, however, ranging from 10:1 to 15:1 for high subsonic aircraft to 25:1 to 30:1 for low-speed general aviation applications. The fan can produce twice the thrust of a conventional first-stage fan, and noise reduction is effected by reducing both the number of blades and the tip speed. T.M.

A73-34041 **Designing to a price - The Westinghouse WX radar family.** H. B. Smith (Westinghouse Defense and Electronic Systems Center, Baltimore, Md.). *Interavia*, vol. 28, June 1973, p. 652, 653.

Description of design policies and decisions adopted in the development of a new family of modular air-to-air and air-to-ground fire control radars meeting requirements of high reliability and easy maintainability under fixed purchase-price limits. Factors ensuring simple low-cost design include limitation of part quantity and unit complexity, incorporation of many system functions in the software rather than in the system components, and the application of modularity and commonality in every possible area. Specific features of individual radar models comprising the family are outlined. T.M.

A73-34042 **Boron composites - Status in the USA.** W. D. Dittmer and P. R. Hoffman (Avco Corp., Avco Systems Div., Lowell, Mass.). *Interavia*, vol. 28, June 1973, p. 654-656.

The first-generation applications in aircraft have proven boron epoxy composites as effective, predictable, and reliable for highly loaded structural components over the temperature range from -67 to +350 F. The newer boron composite applications are directed toward wing structures for high-performance aircraft, selectively reinforced components for transport aircraft, and blades for turbine engines. In addition, new boron composite forms with an increased temperature capability are being developed for even wider applications. Details of the boron filament production process are described along with properties of boron epoxy composites and examples of typical applications. T.M.

A73-34046 # **An initial estimate of aircraft emissions in the stratosphere in 1990.** A. J. Broderick (U.S. Department of Transportation, Transportation Systems Center, Cambridge, Mass.), J. M. English (California, University, Los Angeles, Calif.), and A. K. Forney (FAA, Washington, D.C.). *American Institute of Aeronautics and Astronautics and American Meteorological Society, International Conference on the Environmental Impact of Aerospace Operations in the High Atmosphere, Denver, Colo., June 11-13, 1973, AIAA Paper 73-508.* 10 p. 15 refs. Members, $1.50; nonmembers, $2.00. Research supported by the U.S. Department of Transportation.

The projected demand for air transportation is considered together with the available flight systems, engine emission characteristics, emission reduction technology, emission variations in flight, and service characteristics. The estimate of aircraft emissions presented is intended to provide an early approximation of a reasonable upper bound. It is suggested that the estimate is used as a basis for estimating climatic and other effects of high-altitude aircraft operations until a more accurate estimate becomes available. G.R.

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STAR ENTRIES

N73-23995# Aeronautical Research Council, London (England).
[RESEARCH PROGRESS ON AERODYNAMIC HEATING, AIRFOILS, WINGS, AND AIRCRAFT DURING 1960, VOLUME 1] Technical Report, 1960
HMSO 1972 775 p refs
Avail: NTIS HC $40.75; HMSO £ 18; PHI $69.77

Research projects involving aerodynamics, aerodynamic heating, air flow, boundary layer flow, and heat transfer are discussed. Emphasis is placed on investigations of pressure distribution and flow characteristics of various airfoils and wing planforms under subsonic and supersonic flight conditions. Structural analyses of airframes to show the effects of flutter, thermal stresses, and fatigue are reported. The stability and control characteristics of helicopters and swept wing aircraft are described.

N73-23996 Ministry of Aviation, London (England).
MEASUREMENT OF AERODYNAMIC HEATING ON THE NOSE OF A DELTA AIRCRAFT AT SPEEDS UP TO M EQUALS 1.65
J. E. Nethaway and O. P. Nicholas *In* ARC Res. Progr. on Aerodyn. Heating, Airfoils, Wings, and Aircraft during 1960, Vol. 1 1972 p 1-12 ref Supersedes RAE-TN-Aero-2693; ARC-22617
(ARC-R/M-3280; RAE-TN-Aero-2693; ARC-22617)

Skin temperature measurements recorded during a climb and level-flight acceleration at 40,000 feet, at speeds up to M = 1.65 are presented. The temperatures were measured at 27 points on the skin of the aircraft nose, on a diaphragm forming part of the nose internal structure and inside the nose. Measurements were first made with the skin clean, and then with it painted. Comparison with estimates of boundary-layer temperature shows that during accelerations of about 0.3 meters/minute the skin temperature lagged behind the estimated value by about 5 C, for the clean skin, and by about 9 C for the painted skin. The maximum skin temperature reached was about 100 C above ambient. Agreement between measured and calculated skin temperatures was good. Author

N73-24000 Ministry of Aviation, London (England).
THE PRESSURE DISTRIBUTION ON TWO DIMENSIONAL WINGS NEAR THE GROUND
J. A. Bagley *In* ARC Res. Progr. on Aerodyn. Heating, Airfoils, Wings, and Aircraft during 1960, Vol. 1 1972 p 79-118 refs Supersedes RAE-Aero-2625; ARC-22060

(ARC-R/M-3238; RAE-Aero-2625; ARC-22060)

A method of calculating the pressure distribution in incompressible flow on two-dimensional airfoils of arbitrary section at moderate distances from the ground is developed. Comparisons with an exact potential-flow solution, and with measurements on a 10 percent thick airfoil of RAE 101 section, provide a satisfactory verification of the adequacy of method. It is shown that it is necessary to take account of the boundary layer on the airfoil in the calculations. Author

N73-24001 National Physical Lab., Teddington (England). Aerodynamics Div.
PRESSURE DISTRIBUTION AND SURFACE FLOW ON 5 PERCENT AND 9 PERCENT THICK WINGS AND CURVED TIP AND 60 DEG SWEEPBACK
H. C. Garner and D. E. Walshe *In* ARC Res. Progr. on Aerodyn. Heating, Airfoils, Wings, and Aircraft during 1960, Vol. 1 1972 p 119-212 refs Supersedes ARC-20982; ARC-21562

(ARC-R/M-3244; ARC-20982; ARC-21562)

Extensive tables are given of pressure coefficients measured at Reynolds numbers from 1.3 x one million to 3.9 x one million on two half-models of identical planform with 5 percent RAE 101 and 9 percent RAE 101 streamwise sections. The planform of aspect ratio 3.899 has a straight trailing edge with 60 deg of sweepback, constant chord over most of the span and a parabolic outer portion of the leading edge curving to a pointed tip. The overall wing characteristics are obtained from integrated normal pressures and are compared with lifting-surface theory. The low-speed experimental pressure distributions and surface oil-flow patterns are analysed and discussed in relation to the onset of separation and the distinct vortex flows that develop at high incidence. Series of contrasting upper-surface isobars illustrate some features of the different stalling processes of the two wings. The direct influence of the main vortex on local surface pressures is assessed in general terms. A fuller appraisal of secondary surface flow is obtained from the oil patterns, observations in water and measurements of high suction near the trailing edge. Author

N73-24002 Ministry of Aviation, London (England).
PROPERTIES OF A TWO PARAMETER FAMILY OF THIN CONICALLY CAMBERED DELTA WINGS BY SLENDER BODY THEORY
J. C. Cooke *In* ARC Res. Progr. on Aerodyn. Heating, Airfoils, Wings, and Aircraft during 1960, Vol. 1 1972 p 213-247 refs Supersedes RAE-TN-Aero-2698; ARC-22327

(ARC-R/M-3249; RAE-TN-Aero-2698; ARC-22327)

Slender theory with exact boundary conditions is used to calculate the flow past a thin conically cambered delta wing. The spanwise camber-line consists of a straight central part with two drooping pieces at the sides, the points of junction being termed the shoulders. The shape is not given at the start but is the result of a series of conformal transformations. Attention is concentrated on flow which is attached at the leading edge. Incidence and lift and drag coefficients are worked out for this condition. It is found that, for a given lift coefficient, moving the shoulder outboard reduces the droop and droop angle required and also reduces the error introduced by neglecting second order terms. For low lift coefficients the lowest drag is obtained with shoulder position well outboard, but for high lift coefficients least drag is obtained when the shoulder position is along the center-line and the camber-line reduces to a circular arc. Author

N73-24003 National Physical Lab., Teddington (England). Aerodynamics Div.
A STUDY OF THE EFFECT OF LEADING EDGE MODIFICATIONS ON THE FLOW OVER A 50-DEG SWEPTBACK WING AT TRANSONIC SPEEDS
E. W. E. Rogers, C. J. Berry, and J. E. G. Townsend *In* ARC Res. Progr. on Aerodyn. Heating, Airfoils, Wings, and Aircraft during 1960, Vol. 1 1972 p 249-328 refs Supersedes ARC-21987
(ARC-R/M-3270; ARC-21987)

A wind tunnel investigation has been made of the effects of leading-edge modifications on the flow and forces on an untapered wing of 50 deg leading-edge sweep, at stream Mach numbers between 0.60 and 1.20. Seven leading-edge profiles were tested, ranging from a drooped extension of 18 percent of the chord of the basic sharp-nosed section to a round-nosed section with a leading-edge radius of 1.0 percent of the basic chord. Leading-edge droop was found to increase the wing drag near zero lift but to reduce appreciably the lift-dependent drag component, except at the highest test Mach numbers. Droop also increased the lift coefficient at which leading-edge separation

occurred on the upper surface at moderate subsonic speeds, but in addition reduced the Mach number for transonic flow attachment. The appearance of the forward shock (but not the rear shock) is considerably delayed when the leading edge is drooped. With the undrooped sections an increase in leading-edge radius was accompanied by successively earlier appearances of the forward shock, and hence the outboard shock with its attendant separation. The conditions at which the rear shock first appeared changed only slowly as the section was changed. The variations in wing flow pattern as the leading edge is modified are discussed and related to measured changes in the wing lift and drag. Author

N73-24004 National Physical Lab., Teddington (England). Aerodynamics Div.
THE FLOW PATTERN ON A TAPERED SWEPTBACK WING AT MACH NUMBERS BETWEEN 0.6 AND 1.6, PART 1. EXPERIMENTS WITH A TAPERED SWEPTBACK WING OF WARREN 12 PLANFORM AT MACH NUMBERS BETWEEN 0.6 AND 1.6, PART 2 **c02**
I. M. Hall and E. W. E. Rogers *In* ARC Res. Progr. on Aerodyn. Heating, Airfoils, Wings, and Aircraft during 1960, Vol. 1 1972 p 329-487 refs Supersedes ARC-19691; ARC-22050

(ARC-R/M-3271; ARC-19691; ARC-22050)
The development of the flow pattern on a swept wing with incidence and stream Mach number is described. The wing, of aspect ratio 2.828, taper ratio 0.333 and leading-edge sweep 53.5 deg, was tested at Mach numbers between 0.6 and 1.6 at incidences up to about 12 deg. The test Reynolds number varied with Mach number, being typically 2.3 x one million at Mach = 1.0. Boundary-layer transition was fixed by a roughness band at the leading edge. It is shown that the flow pattern at moderate incidences develops smoothly from a subsonic type involving leading-edge separation to a supersonic type where the flow is attached near the leading edge and with shock-induced separation further aft. The formation and movement of the shock-wave system and the vortices near the wing surface are briefly discussed. Author

N73-24005 Ministry of Aviation, London (England).
FREE FLIGHT MEASUREMENTS OF THE TRANSONIC ROLL DAMPING CHARACTERISTICS OF THREE RELATED WINGS OF ASPECT RATIO 2.83
K. J. Turner and G. K. Hunt *In* ARC Res. Progr. on Aerodyn. Heating Airfoils, Wings, and Aircraft during 1960, Vol. 1 1972 p 489-500 refs Supersedes RAE-TN-Aero-2683, ARC-22117

(ARC-R/M-3274; RAE-TN-Aero-2683; ARC-22117)
Measurements of the roll-damping derivative of three wing planforms were made by the free-flight roll-balance technique over the Mach number range 0.7 to 1.4. The wings were all of RAE 102 section, 7.5 percent thickness to chord and aspect ratio 2.83 but varied in sweep and taper ratio. The two wings of taper ratio 0.33 showed little loss of damping in the transonic region but the 50 deg delta wing suffered a 50 percent loss of damping at Mach = 0.96. The results have been compared with simple theoretical estimates and the effects of aero-elasticity have been computed. Author

N73-24006 Aeronautical Research Council, London (England).
SOME APPLICATIONS OF NOT-SO-SLENDER WING THEORY TO WINGS WITH CURVED LEADING EDGES
L. C. Squire *In its* Res. Progr. on Aerodyn. Heating, Airfoils, Wings, and Aircraft during 1960, Vol. 1 1972 p 501-524 refs Supersedes RAE-TN-Aero-2703; ARC-22437

(ARC-R/M-3278; RAE-TN-Aero-2703; ARC-22437)
An extension of slender-wing theory, has been applied to some problems concerned with the properties of slender, lifting, wings with curved leading edges at supersonic speeds. Two particular problems are considered. These are the calculation of the change in lift, aerodynamic center, and load distribution on uncambered wings as the Mach number increases above M = 1.0 and the calculation of the camber shape to produce a given load distribution at a given Mach number. Where possible the results are compared with linear theory and with experimental results, and the limitations of the extension are discussed. Author

N73-24007 Aeronautical Research Council, London (England).
TRANSONIC TUNNEL TESTS ON A 6 PERCENT THICK, WARPED 55 DEG SWEPTBACK WING MODEL
A. B. Haines and J. C. M. Jones *In its* Res. Progr. on Aerodyn. Heating, Airfoils, Wings, and Aircraft during 1960, Vol. 1 1972 p 525-564 refs Supersedes ARA-25; ARC-22466

(ARC-R/M-3385, ARA-25; ARC-22466)
Wind tunnel tests have been made on a model having a 6 percent thick, 55 deg sweptback wing with a warp distribution designed to give a constant spanwise C sub L distribution and a triangular chordwise load at C sub L = 0.15, M = 1.2. The wing-body junction was designed according to supersonic area rule for this Mach number. The results can be considered as encouraging. Subcritical-type flow is maintained over most of the wing under the design conditions. The margins in both Mach number at the design C sub L and C sub L at the design Mach number before the start of any serious supercritical increase in drag or before the appearance of any significant shock-induced separations are of the order of 0.05. Major changes in the pitching-moment characteristics are even further delayed. At subsonic speeds and low C sub L, K is near 1.2 while at the design conditions, the approximate value from the experimental results is K = 1.55 as compared with a theoretical prediction of K = 1.33. The results suggest that it is unlikely that there was a sizeable sweep factor on the wing skin-friction drag through no firm conclusion can be drawn about this. Author

N73-24008 National Physical Lab., Teddington (England). Aerodynamics Div.
AN INVESTIGATION OF THE FLOW ABOUT A PLANE HALF WING OF CROPPED DELTA PLANFORM AND 6 PERCENT SYMMETRICAL SECTION AT STREAM MACH NUMBERS BETWEEN 0.8 AND 1.41
E. W. E. Rogers, I. M. Hall, and C. J. Berry *In* ARC Res. Progr. on Aerodyn. Heating, Airfoils, Wings, and Aircraft during 1960, Vol. 1 1972 p 565-652 refs Supersedes ARC-22191

(ARC-R/M-3286; ARC-22191)
A study has been made of the flow development over the wing as the incidence and stream Mach number vary and this is illustrated by surface pressure distributions and oil-flow patterns. The growth and movement of the two main surface shocks (the rear and forward shocks) is discussed, and conditions for slow separation through these shocks are considered. For the rear shock, which has little sweep, these conditions are similar to those for shock-induced separation on two-dimensional airfoils. The forward shock is comparatively highly swept and separation seems to correspond to two rather different but simultaneously-attained conditions, one related to the component Mach number normal to the shock front and the other to the position of the reattachment line. The flow in the region between the leading edge and the forward shock is shown to have certain characteristics analogous to those found upstream of the shock on two-dimensional airfoils. To the rear of the forward shock, but ahead of the rear shock, the flow at low supersonic speeds resembles in some respects that about a simple cone. Author

N73-24009 Imperial Coll. of Science and Technology, London (England). Dept. of Aeronautics.
EXPERIMENTS ON A DELTA WING WITH JET ASSISTED LIFT
W. H. Melbourne *In* ARC Res. Progr. on Aerodyn. Heating, Airfoils, Wings, and Aircraft during 1960, Vol. 1 1972 p 653-700 refs Supersedes ARC-21968; Rept-101

(ARC-R/M-3288; ARC-21968; Rept-101)
The effect of blowing a jet stream, simulating conventional jet engines, downwards from the lower surface of a slender

delta wing (aspect ratio unity), for the purpose of obtaining additional lift at take-off and landing was examined. Initial experiments investigated a spanwise jet sheet blown respectively from 70, 80 and 90 percent of the mid-chord from the apex, and a trailing-edge jet flap. It was found that a spanwise jet flown forward of the trailing edge was inefficient in providing lift. A flow investigation showed that this was associated with a region of the low pressure behind the jet and a strong vortex at the outer edge of the jet. Further experiments were then carried out using a narrow chordwise jet sheet and a concentrated group of jets on the wing center-line, to avoid the adverse effects of the spanwise jet. The concentrated jets proved far more efficient than the other two arrangements. Author

N73-24010 Royal Aircraft Establishment, Farnborough (England).
A CONTRIBUTION TO THE THEORY OF AIRCRAFT RESPONSE IN ROLLING MANOEUVRES INCLUDING INERTIA CROSS COUPLING EFFECTS
H. H. B. M. Thomas and P. Price *In* ARC Res. Progr. on Aerodyn. Heating, Airfoils, Wings, and Aircraft during 1960, Vol. 1 1972 p 701-762 refs Supersedes RAE-Aero-2634; ARC-22301
(ARC-R/M-3349; RAE-Aero-2634; ARC-22301)

The problem of calculating the response of an aircraft in rolling maneuvers when the mass distribution of the aircraft is such that the inertia terms in the equations of motion effect a cross-coupling of the usual lateral and longitudinal motions is considered. Solutions are outlined to two formulations of this problem: (1) response to a given applied aileron and (2) response corresponding to a specified time history of rate of roll. Detailed calculations are made only for the first of these, and the results compare favourably with digital-computer solutions. Possible simplifications to the method of calculation are discussed.
Author

N73-24011# Aeronautical Research Council, London (England).
[RESEARCH ON AERODYNAMIC CHARACTERISTICS AND CONTROL, BOUNDARY LAYERS, AND INSTRUMENTS DURING 1960, VOLUME 2] Technical Report, 1960
HMSO 1972 783 p refs
Avail: NTIS HC $41.25; HMSO £19; 1 PHI $75.07

Research projects in aerodynamic subjects are discussed. The topics reported include the following: (1) boundary layer flow, (2) heat transfer during aerodynamic heating, (3) effects of atmospheric turbulence on aerodynamic loads, (4) lateral stability characteristics of delta wings, (5) structural analysis of airframes for optimum design, and (6) performance of slotted transonic wind tunnel working section.

N73-24014 Cambridge Univ. (England). Engineering Lab.
THE ANALYSIS OF BLADE VIBRATION DUE TO RANDOM EXCITATION
D. S. Whitehead *In* ARC Res. on Aerodyn. Characteristics and Control, Boundary Layers, and Instruments during 1960, Vol. 2 1972 p 833-848 refs Previously issued as ARC-22119

(ARC-R/M-3253; ARC-22119)

The experimental measurement of the power spectra of waveforms derived from vibrating blades in axial compressors under running conditions was conducted. This enables the damping factor of the blades to be found, and these damping factors agree reasonably well with theoretical estimates of the aerodynamic damping. There is no significant decrease in the damping factor when the blades stall. Theoretical estimations of the length of data which has to be examined to get accurate measurements of the rms amplitude and the power spectrum are included. The amount of data required is much greater for the power spectrum, but even for the rms amplitude it is surprisingly long. A theoretical prediction of the effect of variations of air density and blade material density under otherwise similar conditions is presented.
Author

N73-24015 Cambridge Univ. (England). Dept. of Engineering.
FORCE AND MOMENT COEFFICIENTS FOR VIBRATING AEROFOILS IN CASCADE
D. S. Whitehead *In* ARC Res. on Aerodyn. Characteristics and Control, Boundary Layers, and Instruments during 1960, Vol. 2 1972 p 849-885 refs Previously issued as ARC-22133

(ARC-R/M-3254; ARC-22133)

A method is given for calculating the aerodynamic forces and moments acting on installed vibrating cascade blades. The forces and moments due to both bending and torsional vibration are calculated. Wakes from periodic obstructions far upstream which move relative to the cascade in question are analyzed. Tables of the force and moment coefficients for two space/chord ratios are presented. The coefficients can be used to predict the occurrence of pure torsional or coupled flutter and the vibration induced by periodic disturbance in the flow. Author

N73-24017 Ministry of Aviation, London (England).
BEHAVIOUR OF SKIN FATIGUE CRACKS AT THE CORNERS OF WINDOWS IN A COMET 1 FUSELAGE

R. J. Atkinson, W. J. Winkworth, and G. M. Norris *In* ARC Res. on Aerodyn. Characteristics and Control, Boundary Layers, and Instruments during 1960, Vol. 2 1972 p 929-963 refs Previously issued as RAE-R-STRUCT-257; ARC-22270

(ARC-R/M-3248; RAE-STRUCT-257; ARC-22270)

Fatigue tests on a Comet 1 aircraft pressure cabin subjected to operational pressure cycles are described. Cracks at window corners are the main subject of investigation. Results are compared with earlier experiments on other Comet 1 aircraft pressure cabins. Conclusions are reached that appeared to have some general significance. Author

N73-24018 Ministry of Aviation, London (England).
A NOTE ON FLUTTER OF ASYMMETRIC CONTROLS

E. G. Broadbent and E. V. Hartley *In* ARC Res. on Aerodyn. Characteristics and Control, Boundary Layers, and Instruments during 1960, Vol. 2 1972 p 965-974 refs Previously issued as RAE-TN-STRUCT-278; ARC-22084

(ARC-R/M-3256; RAE-TN-STRUCT-278; ARC-22084)

Methods for approximating an aircraft with an asymmetric elevator control for the purpose of flutter calculations are discussed. Two examples of asymmetric controls that are common in practice are described. Four calculations for an asymmetric tail are developed for the following modes: (1) symmetric modes, (2) antisymmetric modes, (3) the same modes as (1) but for only half the aircraft, and (4) the same modes as (2) for only half the aircraft. Author

N73-24019 National Physical Lab., Teddington (England). Aerodynamics Div.
CALCULATION OF STABILITY DERIVATIVES FOR TAPERED WINGS OF HEXAGONAL PLANFORM OSCILLATING IN A SUPERSONIC STREAM
Doris E. Lehrian *In* ARC Res. on Aerodyn. Characteristics and Control, Boundary Layers, and Instruments during 1960, Vol. 2 1972 p 975-1020 refs Previously issued as ARC-22186

(ARC-R/M-3298; ARC-22186)

The aerodynamic loading is formulated for a family of symmetrically tapered wings describing simple harmonic pitching oscillations of low frequency in supersonic flow. The planforms have supersonic leading and trailing edges of constant sweep, the variable parameters being the angle of rake of the side edges and the ratio of span to root chord. For Mach numbers up to 2.4 the investigation covers supersonic and subsonic side edge which act as leading edges, streamwise tips or trailing edges. The lift and moment are evaluated to first order in frequency on the basis of linearized thin-wing theory. In the case of subsonic trailing side edges, it is more convenient to obtain the total forces by use of the reverse-flow theorem. The theoretical values of the pitching-moment derivatives are compared with experimental results obtained on half-wing models with alternative pitching axes and a basic 5 percent double-wedge section. An estimate of thickness effect is calculated by applying two-dimensional aerofoil theory on a strip-theory basis. When corrected for

thickness the theoretical values are in good agreement with the experimental derivatives for Mach numbers greater than 1.6.
Author

N73-24022 Ministry of Aviation, London (England).
THE LONGITUDINAL STABILITY AND CONTROL OF THE TANDEM-ROTOR HELICOPTER, PART 1. THE LATERAL STABILITY AND CONTROL OF THE TANDEM-ROTOR HELICOPTER, PART 2
A. R. S. Bramwell *In* ARC Res. on Aerodyn. Characteristics and Control, Boundary Layers, and Instruments during 1960, Vol. 2 1972 p 1113-1211 refs Previously issued as RAE-NAVAL-3;ARC-21943;RAE-NAVAL-4; ARC-21918

(ARC-R/M-3223; RAE-NAVAL-3; ARC-21943; RAE-NAVAL-4; ARC-21918)

A simple method of calculating downwash interference is presented and comparison of theoretical and flight test trim curves indicates that the method is reasonably accurate. Since the stability of the tandem-rotor helicopter depends largely on small differences between the thrusts of the front and rear rotors it is necessary to calculate the rotor thrust derivatives far more accurately than for the single-rotor helicopter. The downwash interference causes a reversal of stick position with speed for part of the speed range with an associated divergence in the dynamic stability. This may be eliminated by choosing a suitable value of swash-plate dihedral angle. If, in addition, a suitable differential delta-three hinge angle is applied the tandem-rotor helicopter appears to be stable over the whole speed range except at hovering and very low speeds.
Author

N73-24027 Ministry of Aviation, London (England).
FLIGHT TESTS TO INVESTIGATE THE DYNAMIC LATERAL-STABILITY CHARACTERISTICS OF A 45-DEG DELTA, CROPPED TO GIVE THREE ASPECT RATIOS
J. E. Nethaway and J. Clark *In* ARC Res. on Aerodyn. Characteristics and Control, Boundary Layers, and Instruments during 1960, Vol. 2 1972 p 1319-1335 refs Previously issued as RAE-TN-Aero-2671; ARC-21990

(ARC-R/M-3243; RAE-TN-Aero-2671; ARC-21990)

Flight test to determine the dynamic lateral-stability characteristics of the Boulton-Paul 3A aircraft, have been made at aspect ratios 3.8, 3.0 and 2.3. They showed that the changes in damping, period and phase angle were not large when the aspect ratio was varied, but the roll to yaw ratio increased considerably as aspect ratio was reduced. The comparison between the characteristics measured in flight, and those estimated, is generally fair. Agreement is closest over the range of lift coefficient 0.25 to 0.45.
Author

N73-24028 Aeronautical Research Council, London (England).
A THEORETICAL INVESTIGATION OF THE LONGITUDINAL STABILITY, CONTROL AND RESPONSE CHARACTERISTICS OF JET-FLAP AIRCRAFT, PARTS 1 AND 2
A. S. Taylor *In its* Res. on Aerodyn. Characteristics and Control, Boundary Layers, and Instruments during 1960, Vol. 2 1972 p 1337-1436 refs Previously issued as RAE-Aero-2600; RAE-TN-Aero-2670; ARC-19925; ARC-21867

(ARC-R/M-3272; RAE-Aero-2600; RAE-TN-Aero-2670; ARC-19925; ARC-21867)

A theoretical analysis of the stability, control, and response characteristics of jet flap aircraft is presented. The restrictions imposed by the use of two dimensional theoretical lift and moment data as the basis of tractable stability and control analyses are examined. Considerations of trim, static stability, and quasi-steady maneuverability are discussed to show effects of jet controls as compared with tail controls. The mathematical theory and mathematical models which support the aerodynamic responses are developed. Graphs and tables of aerodynamic characteristics are included.
Author

N73-24030 Ministry of Aviation, London (England).
THERMAL STRESSES NEAR THE ROOTS OF RECTANGULAR WINGS
G. G. Pope *In* ARC Res. on Aerodyn. Characteristics and Control, Boundary Layers, and Instruments during 1960, Vol. 2 1972 p 1477-1494 refs Previously issued as RAE-STRUCT-254; ARC-22143

(ARC-R/M-3236; RAE-STRUCT-254; ARC-22143)

A continuous solution is derived for the stress distribution in a simple wing surface represented by a uniformly reinforced strip bounded by equal constant area edge members, when the sections in the airstream experience a uniform temperature rise. The section shielded by the fuselage is assumed to remain at a constant temperature. This analysis, which takes into account the bending, shear and direct stiffness of the edge members, is used to evaluate the shear stress distribution in a specific strip used as an example. The stress distribution in this same specimen strip is also calculated by the Argyris matrix force method assuming a finite spanwise temperature gradient at the edges of the fuselage, both for a constant chordwise temperature and for a parabolic chordwise temperature variation in the airstream.
Author

N73-24033*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
OVERALL AND BLADE-ELEMENT PERFORMANCE OF A MULTIPLE-CIRCULAR-ARC BLADED TRANSONIC COMPRESSOR ROTOR WITH TIP SPEED OF 1375 FEET PER SECOND
George Kovich and Lonnie Reid Washington May 1973 86 p refs
(NASA-TM-X-2697; E-7155) Avail: NTIS HC $3.00 CSCL 20D

The design and experimental performance of a 20-inch-diameter multiple-circular-arc bladed axial-flow transonic compressor rotor is presented. Radial surveys of the flow conditions were made. At design speed the peak efficiency was 0.882 and occurred at a weight flow of 64.0 pounds per second. At this point the total-pressure and total-temperature ratios were 1.79 and 1.205, respectively. The stall margin at design speed was 8 percent based on weight flows and total-pressure ratios at experimental peak efficiency and near stall. The measured stall margin was 20 percent at design weight flow and speed.
Author

N73-24035*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
AERODYNAMIC EFFECTS OF FIVE LIFT-FAN POD ARRANGEMENTS ON AN UNPOWERED V/STOL TRANSPORT MODEL
James L. Thomas, Danny R. Hoad (Army Air Mobility R and D Lab., Fort Eustis, Va.), and Delwin R. Croom Washington Jun. 1973 64 p refs
(NASA-TN-D-7199; L-8754) Avail: NTIS HC $3.00 CSCL 01A

An investigation was conducted in the Langley V/STOL tunnel to determine the effect of longitudinally oriented wing-mounted pods on the longitudinal and lateral aerodynamic characteristics in the cruise flight condition of a high-wing V/STOL transport model. Five pod arrangements were tested - three configurations with in-line pods at 20, 40, or 60 percent semispan and two split pod configurations with rear pods at 20 percent semispan and front pods at 40 or 60 percent semispan. In general, addition of the pods to the model decreased the stability, increased the lift-curve slope, and alleviated the abrupt stall of the basic model. The configuration with pods at 20 percent semispan had an abrupt instability at 10 deg angle of attack. All the configurations had lateral stability at sideslip angles from 5 to -5 deg. Very little difference in results existed between the configurations with pods at 40 and 60 percent semispan. Of the split pod configurations, the configuration with front pods at 40 percent semispan offered the best trimmed lift and lift-induced drag characteristics at high angles of attack. The configuration with in-line pods at 40 or 60 percent semispan provided the best cruise characteristics of all the pod configurations.
Author

N73-24036*# General Motors Corp., Indianapolis, Ind. Detroit Diesel Allison Div.
DESIGN AND EXPERIMENTAL RESULTS FOR A TURBINE WITH JET FLAP STATOR AND JET FLAP
James L. Bettner and Jerry O. Blessing Washington NASA May 1973 165 p refs
(Contract NAS3-14303)
(NASA-CR-2244; EDR-7389) Avail: NTIS HC $3.00 CSCL 01C

The overall performance and detailed stator performance of a negative hub reaction turbine design featuring a moderately low solidity jet flap stator and a jet flap rotor were determined. Testing was conducted over a range of turbine expansion ratios at design speed. At each expansion ratio, the stator jet flow and rotor jet flow ranged up to about 7 and 8 percent, respectively, of the turbine inlet flow. The performance of the jet flap stator/jet flap rotor turbine was compared with that of a turbine which used the same jet flap rotor and a conventional, high solidity plan stator. The effect on performance of increased axial spacing between the jet stator and rotor was also investigated. Author

N73-24037*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
LOCAL FLOW MEASUREMENTS AT THE INLET SPIKE TIP OF A MACH 3 SUPERSONIC CRUISE AIRPLANE
Harold J. Johnson and Earl J. Montoya Washington May 1973 42 p refs
(NASA-TN-D-6987; H-722) Avail: NTIS HC $3.00 CSCL 01C

The flow field at the left inlet spike tip of a YF-12A airplane was examined using at 26 deg included angle conical flow sensor to obtain measurements at free-stream Mach numbers from 1.6 to 3.0. Local flow angularity, Mach number, impact pressure, and mass flow were determined and compared with free-stream values. Local flow changes occurred at the same time as free-stream changes. The local flow usually approached the spike centerline from the upper outboard side because of spike cant and toe-in. Free-stream Mach number influenced the local flow angularity: as Mach number increased above 2.2, local angle of attack increased and local sideslip angle decreased. Local Mach number was generally 3 percent less than free-stream Mach number. Impact-pressure ratio and mass flow ratio increased as free-stream Mach number increased above 2.2, indicating a beneficial forebody compression effect. No degradation of the spike tip instrumentation was observed after more than 40 flights in the high-speed thermal environment encountered by the airplane. The sensor is rugged, simple, and sensitive to small flow changes. It can provide accurate imputs necessary to control an inlet. Author

N73-24040# Air Vehicle Corp., San Diego, Calif.
AN EXACT METHOD OF DESIGNING AIRFOILS WITH GIVEN VELOCITY DISTRIBUTION IN INCOMPRESSIBLE FLOW: AN EXTENSION OF THE LIGHTHILL AND ARLINGER METHODS Final Report, 15 Jun. - 15 Dec. 1972
T. Strand Dec. 1972 81 p
(Contract N00600-71-C-0709)
(AD-757813) Avail: NTIS CSCL 20/4

The inverse problem of airfoil theory, i.e., from a given surface velocity distribution determine the airfoil shape, is solved by conformal mapping procedures. The method is based upon prior works by Arlinger, which in turn is an extension of Lighthill's basic development. It involves the use of least squares and Lagrangian multipliers to modify the prescribed velocity distribution along a portion of the lower surface of the airfoil, thus ensuring that the modifications required for profile closure are minimized. The method developed should be of particular importance for calculating the shapes of new types of airfoils with high design lift coefficients. (Author Modified Abstract) GRA

N73-24041 Purdue Univ., Lafayette, Ind.
DESIGN OF STABILITY AUGMENTATION SYSTEMS FOR DECOUPLING AIRCRAFT RESPONSES Ph.D. Thesis
Rhall Edward Pope 1972 166 p
Avail: Univ. Microfilms Order No. 72-30960

During the landing phase of flight, STOL aircraft exhibit undesirable coupled response in both the longitudinal and lateral-directional modes of flight. There is also a need for stability augmentation for these aircraft due to low longitudinal and directional dynamic stability and low static longitudinal stability. Application of Gilbert's decoupling procedure is proposed to eliminate the undesirable coupling effects and to develop a simpler method of designing a stability augmentation system. Five decoupled configurations were investigated. In the longitudinal mode, pitch response controlled by longitudinal stick was decoupled, first, from angle of attack, second, from flight path angle, and third from airspeed all of which were controlled by throttle. In the lateral directional mode, roll response controlled by lateral stick was decoupled first from yaw, and second from sideslip which were both controlled by rudder pedals.
Dissert. Abstr.

N73-24042# Advisory Group for Aerospace Research and Development, Paris (France).
AIRCRAFT PERFORMANCE: PREDICTION METHODS AND OPTIMIZATION
J. Williams, ed. Mar. 1973 345 p refs In ENGLISH and partly in FRENCH
(AGARD-LS-56) Avail: NTIS HC $19.25

The development and application of aircraft performance prediction methods are developed. The methods are applied to subsonic and supersonic aircraft. The basic topics discussed include: (1) range and radius capabilities, (2) takeoff and landing operations, and (3) aircraft maneuvers. Problems of aerodynamic prediction, aircraft mass estimation, and engine selection are included. Parametric and optimization techniques for aircraft design synthesis are reported.

N73-24043 Ministry of Defence, London (England). Project Performance Analysis Section.
RANGE AND RADIUS-OF-ACTION PERFORMANCE PREDICTION FOR TRANSPORT AND COMBAT AIRCRAFT
Robert K. Page *In* AGARD Aircraft Performance: Prediction Methods and Optimization Mar. 1973 32 p refs

Numerical methods for determining the range and radius of action performance of transport and combat aircraft are presented. The data required for the prediction process are explained. Conditions which govern the choice of method to be used are analyzed. The following parameters are examined to show the effect on aircraft range: (1) optimum cruising speeds, (2) cruise height schedules and integrated range, (3) effect of various aircraft and engine characteristics. Mathematical models are included to support the theoretical concepts and tables of data are provided to show application of data. Author

N73-24044 Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.
AIRFIELD PERFORMANCE PREDICTION METHODS FOR TRANSPORT AND COMBAT AIRCRAFT
John Williams *In* AGARD Aircraft Performance: Prediction Methods and Optimization Mar. 1973 56 p refs

Methods for evaluating and predicting the airfield performance of turbojet and turbofan aircraft operating in conventional and short takeoff modes are developed. Airfield performance parameters include: (1) accelerating and decelerating ground run, (2) rotation to liftoff and from touchdown, (3) airborne flare, up and out, and (4) climb and descent approach. The aircraft configurations to which the data apply are described. The factors involved in airfield performance prediction are formulated separately for takeoff and landing operations. The sensitivity of airfield performance comparisons to the specific choice of technical and operational assumptions is illustrated. Author

N73-24045 Dornier-Werke G.m.b.H., Friedrichshafen (West Germany). Flight Mechanics Dept.
FLIGHT MANOEUVRE AND CLIMB PERFORMANCE PREDICTION
Heribert Friedel *In* AGARD Aircraft Performance: Prediction Methods and Optimization Mar. 1973 51 p

Methods for predicting aircraft flight maneuver and climb performance are presented. The methods are based on the equations of motion in a vertical and in a horizontal plane. The problems concerning the point performance values are explained. The relationship between excess power and load factor and their influence on climb and turn performance are discussed. Methods for evaluating the Mach-dependent performance values and the related optimum values are reported. Author

N73-24046 Service Technique Aeronautique, Paris (France).
THE ESTIMATION OF AERODYNAMIC COEFFICIENTS NECESSARY FOR PERFORMANCE CALCULATIONS
C. Lievens *In* AGARD Aircraft Performance: Prediction Methods and Optimization Mar. 1973 28 p In FRENCH

Aerodynamic coefficients are used to study the performance of scale and wind tunnel models of transport aircraft. Data cover fuselage reactions, boundary layer evolution, and differences in results for the two models. Particular attention was given to the effects of boundary layer flow separation, boundary layer evolution, boundary layer reaction near flight and attack edge, and shock wave interaction with the boundary layer.
Transl. by E.H.W.

N73-24047 Service Technique Aeronautique, Paris (France).
AIRCRAFT MASS
C. Vivier and P. Cormier *In* AGARD Aircraft Performance: Prediction Methods and Optimization Mar. 1973 21 p In FRENCH
A study was made of methods used to estimate aircraft mass and the effects of that mass on the aircraft performance.
Transl. by E.H.W.

N73-24048* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ENGINE SELECTION FOR TRANSPORT AND COMBAT AIRCRAFT
James F. Dugan, Jr. *In* AGARD Aircraft Performance: Prediction Methods and Optimization Mar. 1973 55 p refs

CSCL 21A
The procedures for selecting engines for transport and combat aircraft during the design process are presented. The types of aircraft considered are: (1) a long haul conventional takeoff and landing transport, (2) a short haul vertical takeoff and landing transport, (3) a long range supersonic transport, and (4) a fighter aircraft. The influence of aircraft noise considerations on engine selection is examined. The aerodynamic characteristics of supercritical wings and their effect on engine selection are reported. Author

N73-24049 Boeing Co., Seattle, Wash. Commercial Airplane Div.
PARAMETRIC AND OPTIMISATION TECHNIQUES FOR AIRPLANE DESIGN SYNTHESIS
Richard E. Wallace *In* AGARD Aircraft Performance: Prediction Methods and Optimization Mar. 1973 57 p refs

Aircraft design synthesis for various conditions of performance and load carrying capacity is discussed. The subjects presented are: (1) parametric evaluation techniques, (2) optimization evaluation techniques, and (3) computerized airplane design synthesis. Charts are developed to show the elements of synthesis, principal lines of data flow for aircraft design, propulsion parameters, aerodynamic parameters, and optimization methods. Author

N73-24050 Societe Nationale Industrielle Aerospatiale, Paris (France).
DISCREPANCY BETWEEN APPROVAL AND MODERNISM
G. Dumas *In* AGARD Aircraft Performance: Prediction Methods and Optimization Mar. 1973 3 p

The characteristics of aircraft flight manuals and their formats for presentation of information are discussed. A specific example of the take-off performance chart is developed. Discrepancies in performance data which arise from different methods of compiling and computing the information are cited. A diagram of a typical takeoff chart to show the interrelationships of outside air temperature, flap setting, aircraft weight, speed ratio, runway slope, and wind velocity and their effect on takeoff distance is included. Author

N73-24051 Technische Hogeschool, Delft (Netherlands).
AN ANALYTICAL EXPRESSION FOR THE BALANCED FIELD LENGTH
E. Torenbeek *In* AGARD Aircraft Performance: Prediction Methods and Optization Mar. 1973 8 p refs

A tractable analytical expression for the balanced field length of a civil aircraft to be used in parametric design studies is presented. It is demonstrated that in the project design stage, a detailed solution of the equations of motion and the graphical-numerical processes for the definition of the decision point can be avoided without serious loss of accuracy. Mathematical models are prepared to show the method for analyzing aircraft takeoff performance. Diagrams are included to show the phases of takeoff which influence the aircraft performance and forces exerted on the aircraft during the takeoff phases. Author

N73-24052 Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
SUPPLEMENTARY NOTE TO FLIGHT MANOEUVRE AND CLIMB PERFORMANCE PREDICTION
P. Foerster *In* AGARD Aircraft Performance: Prediction Methods and Optimization Mar. 1973 8 p

A numerical analysis of the minimum time climbing procedure for aircraft is presented. The procedure is defined as the locus of all tangent points of the constant energy lines and the constant specific excess power lines on the performance chart. In a similar manner, the minimum fuel climbing procedure is defined by a locus of all tangent points of the constant energy maneuverability index lines and the constant specific energy lines. Specific application of the methods to a typical subsonic aircraft is analyzed. Author

N73-24053 Hawker Siddeley Aviation, Ltd., Brough (England).
MINIMUM TIME TRAJECTORY COMPUTATION: DEVELOPMENT OF THE BALAKRISHNAN METHOD
P. Middleton *In* AGARD Aircraft Performance: Prediction Methods and Optimization Mar. 1973 6 p ref

The development of a computer program for determining minimum time trajectory for aircraft flight is discussed. In the method discussed, the state and control variables are considered at a number of discrete points and a path through the matrix of these values is computed for the solution. The gradient method of computation in which the equations of motion are integrated at each iteration is described. Mathematical models and graphs are included to support the theoretical considerations. Author

N73-24054 Royal Aircraft Establishment, Farnborough (England).
REVIEW OF TWO METHODS OF OPTIMIZING AIRCRAFT DESIGN
D. L. I. Kirkpatrick *In* AGARD Aircraft Performance: Prediction Methods and Optimization Mar. 1973 p 14

Two methods of optimizing aircraft design are discussed. One is an analytical method of optimizing three of the principal

design variables of a subsonic swept wing jet transport aircraft and demonstrated how optimum design is affected by changes in mission requirements, operational constraints, and assumed design changes. The other method uses an aircraft design program coupled with the multivariate analysis technique to optimize 15 aircraft design variables using equations to represent the aerodynamic characteristics of the wing and high-lift devices, the masses of all the various aircraft components, and the engine performance. Author

N73-24055# Tampere Univ. of Technology, (Finland).
OPTIMAL DOLPHIN SOARING AS A VARIATIONAL PROBLEM
Risto Arho 1972 17 p refs
(ME-68; ISBN-951-666-016-9) Avail: NTIS HC $3.00

A technique for improving sailplane performance during cross country flight is described. The technique is called dolphin motion and consists of pulling up in lift and diving through down, with no thermal circling. The technique is especially effective in cloudstreet flying, enabling long distances to be covered in straight line flight. The problem of minimum flight time in dolphin soaring is discussed and the minium flight time problem is solved numerically by the calculus of variations. Author

N73-24056# National Aeronautical Lab., Bangalore (India).
THE EFFECT OF AERODYNAMIC LAG ON THE BENDING RESPONSE OF WINGS AT SUPERSONIC SPEEDS
B. R. Somashekar Nov. 1971 25 p refs
(NAL-TN-36) Avail: NTIS HC $3.25

The effect of aerodynamic lag on the bending response of wings in supersonic flow conditions is reported. The possibility of approximately representing the lag function by simple functions, which facilitate aeroelastic analysis, is examined. Laplace transform techniques are used for obtaining the response solution and the method is applicable to any Mach number. It is shown that the lag is important in response to calculations which may be used for estimating transient loads due to gusts or maneuvers. Author

N73-24057*# Teledyne Ryan Aeronautical Co., San Diego, Calif.
FEASIBILITY STUDY OF MODIFICATIONS TO BQM-34E DRONE FOR NASA RESEARCH APPLICATIONS
H. A. James 27 Dec. 1972 201 p refs
(Contract NAS1-11758)
(NASA-CR-112323; ASTM-72-40) Avail: NTIS HC $12.25 CSCL 01C

The feasibility of modifying an existing supersonic drone into a free-flight research vehicle is examined. Appropriate structural and control system modifications, reliability and operational considerations, and ROM costs indicate that the BQM-34E drone is indeed suitable as a NASA research vehicle. Author

N73-24058*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AERODYNAMIC CHARACTERISTICS OF A 55 DEG CLIPPED-DELTA-WING ORBITER MODEL AT MACH NUMBERS FROM 1.60 TO 4.63
A. B. Blair, Jr. and Josephine Grow Washington May 1973 96 p ref
(NASA-TM-X-2748; L-8732) Avail: NTIS HC $3.00 CSCL 01C

Wind tunnel tests to determine the supersonic aerodynamic characteristics of a delta wing space shuttle orbiter model were conducted. The model was tested at Mach numbers from 1.60 to 4.63, at nominal angles of attack from minus 2 degrees to plus 30 degrees, nominal sideslip angles of minus 4 degrees to plus 10 degrees, and Reynolds numbers from 1.8 to 2.5 times one million per foot. Author

N73-24059*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NOISE TESTS OF A MIXER NOZZLE-EXTERNALLY BLOWN FLAP SYSTEM
Jack H. Goodykoontz, Robert G. Dorsch, and Donald E. Groesbeck Washington May 1973 56 p refs
(NASA-TN-D-7236; E-7288) Avail: NTIS HC $3.00 CSCL 01C

Noise tests were conducted on a large scale model of an externally blown flap lift augmentation system, employing a mixer nozzle. The mixer nozzle consisted of seven flow passages with a total equivalent diameter of 40 centimeters. With the flaps in the 30 - 60 deg setting, the noise level below the wing was less with the mixer nozzle than when a standard circular nozzle was used. At the 10 - 20 deg flap setting, the noise levels were about the same when either nozzle was used. With retracted flaps, the noise level was higher when the mixer nozzle was used. Author

N73-24060*# Scripta Technica, Inc., Washington, D.C.
FLIGHT OF AIRCRAFT WITH PARTIAL AND UNBALANCED THRUST
M. L. Gallay NASA Apr. 1973 176 p refs Transl. into ENGLISH of the book "Polet Samoleta s Nepolnoy i Nesimmetrichnoy Tyagoy" Moscow, Mashinostroyeniye Press, 1970
(Contract NASw-2036)
(NASA-TT-F-734) Avail: NTIS HC $3.00 CSCL 01C

The problem of aircraft operation under conditions of unbalanced thrust following the failure of an engine on a multi-engine aircraft is examined. The dynamics of the divergent motion of the aircraft immediately after engine failure are analyzed. Emphasis is placed on the condition of an engine located outside the plane of symmetry of the aircraft. The effects on the steady flight regime, execution of maneuvers, and pilot handling are investigated. Specific examples are included to clarify the theoretical considerations. Author

N73-24061*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
A MANUAL CONTROL THEORY ANALYSIS OF VERTICAL SITUATION DISPLAYS FOR STOL AIRCRAFT Final Report
Sheldon Baron and William H. Levison Apr. 1973 179 p refs
(Contract NAS2-6652)
(NASA-CR-114620; BBN-2484) Avail: NTIS HC $11.00 CSCL 01C

Pilot-vehicle-display systems theory is applied to the analysis of proposed vertical situation displays for manual control in approach-to-landing of a STOL aircraft. The effects of display variables on pilot workload and on total closed-loop system performance was calculated using an optimal-control model for the human operator. The steep approach of an augmentor wing jet STOL aircraft was analyzed. Both random turbulence and mean-wind shears were considered. Linearized perturbation equations were used to describe longitudinal and lateral dynamics of the aircraft. The basic display configuration was one that abstracted the essential status information (including glide-slope and localizer errors) of an EADI display. Proposed flight director displays for both longitudinal and lateral control were also investigated. Author

N73-24062*# Boeing Commercial Airplane Co., Seattle, Wash.
APPROACH PATH CONTROL FOR POWERED-LIFT STOL AIRCRAFT
D. J. Clymer and C. C. Flora Apr. 1973 100 p refs
(Contract NAS2-6344)
(NASA-CR-114574; D6-60222) Avail: NTIS HC $7.00 CSCL 01C

A flight control system concept is defined for approach flightpath control of an augmentor wing (or similar) powered-lift STOL configuration. The proposed STOL control concept produces aircraft transient and steady-state control responses that are familiar to pilots of conventional jet transports, and has potential for good handling qualities ratings in all approach and landing phases. The effects of trailing-edge rate limits, real-engine dynamics, and atmospheric turbulence are considered in the study. A general discussion of STOL handling qualities problems and piloting techniques is included. Author

N73-24063*# Boeing Co., Philadelphia, Pa. Vertol Div.
A COMPENDIUM OF STATIC AND CRUISE TEST RESULTS FROM A SERIES OF TESTS ON 13 FT DIAMETER LOW DISC LOADING ROTORS
Virgil H. Soule and R. D. Clark 27 Mar. 1973 138 p refs (Contract NAS2-6784)
(NASA-CR-114625; D160-10021-1) Avail: NTIS HC $9.00 CSCL 01C

The results are presented of tests conducted on a series of 13 foot rotors with various blade twists during the time period from 1969 to 1972. The tests were accomplished at AFAPL Wright-Patterson Air Force Base, Ohio and the ONERA 8-meter tunnel at Modane, France. Both static and cruise performance data are presented. Author

N73-24064# National Transportation Safety Board, Washington, D.C.
AIRCRAFT ACCIDENT REPORTS: BRIEF FORMAT, US CIVIL AVIATION
23 Mar. 1973 511 p
(NTSB-BA-73-2) Avail: NTIS HC $27.75

Selected aircraft accident reports concerning U.S. civil aviation accidents occurring during calendar year 1972 are presented. Reports are submitted on 894 accidents. The facts, conditions, circumstances, and probable cause for each accident are reported. Additional statistical information is tabulated by type of accident, phase of operation, kind of flying, injury index, aircraft damage, conditions of light, pilot certificate, injuries, and causal factors. Author

N73-24065*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
APPLICATION OF SONIC-BOOM MINIMIZATION CONCEPTS IN SUPERSONIC TRANSPORT DESIGN
Harry W. Carlson, Raymond L. Barger, and Robert J. Mack Washington Jun. 1973 59 p refs
(NASA-TN-D-7218; L-8767) Avail: NTIS HC $3.00 CSCL 20A

The applicability of sonic boom minimization concepts in the design of large supersonic transport airplanes capable of a 2500-nautical-mile range at a cruise Mach number of 2.7 is considered. Aerodynamics, weight and balance, and mission performance as well as sonic boom factors, have been taken into account. The results indicate that shock-strength nominal values of somewhat less than 48 newtons/sq m during cruise are within the realm of possibility. Because many of the design features are in direct contradiction to presently accepted design practices, further study of qualified airplane design teams is required to ascertain sonic boom shock strength levels actually attainable for practical supersonic transports. Author

N73-24066*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
LONGITUDINAL AERODYNAMIC PARAMETERS OF THE KESTREL AIRCRAFT (XV-6A) EXTRACTED FROM FLIGHT DATA
William T. Suit and James L. Williams Washington Jun. 1973 42 p refs
(NASA-TN-D-7296; L-8703) Avail: NTIS HC $3.00 CSCL 01B

Flight-test data have been used to extract the longitudinal aerodynamic parameters of a vectored-thrust aircraft. The results show that deflecting the thrust past 15 has an effect on the pitching-moment derivatives and tends to reduce the static stability. The trend toward reduction in the longitudinal stability also been noted by the pilots conducting the flight tests. Author

N73-24067# General Accounting Office, Washington, D.C.
IN FLIGHT ESCAPE SYSTEMS FOR HELICOPTERS SHOULD BE DEVELOPED TO PREVENT FATALITIES Report to the Congress by the Comptroller General of the United States
Elmer B. Staats 12 Jun. 1973 33 p
(B-177166) Avail: NTIS HC $3.75

An investigation was conducted to determine the current status of escape systems for helicopter flight crews. The subjects discussed are: (1) need for helicopter in-flight escape systems, (2) development of capsule in-flight escape system, and (3) development of individual in-flight escape system. Author

N73-24068# National Transportation Safety Board, Washington, D.C.
AIRCRAFT ACCIDENT REPORT: TRANS WORLD AIRLINES, INCORPORATED, BOEING 707-331C, N788TW, JOHN F. KENNEDY INTERNATIONAL AIRPORT, JAMAICA, NEW YORK, 12 DECEMBER 1972
2 May 1973 14 p
(NTSB-AAR-73-11) Avail: NTIS HC $3.00

An aircraft accident involving a Boeing 707 aircraft during an instrument landing system approach to the John F. Kennedy International Airport, New York, on 12 December, 1972 is reported. The probable cause of the accident was determined as failure of the pilot to maintain a safe descent path by external reference during the landing approach. Author

N73-24069*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NUCLEAR AIR CUSHION VEHICLES
John L. Anderson 1973 39 p refs Presented at the Am. Ordnance Assoc., Washington, D. C., 8-9 May 1973
(NASA-TM-X-68231; E-7442) Avail: NTIS HC $4.00 CSCL 01C

The state-of-the-art of the still-conceptual nuclear air cushion vehicle, particularly the nuclear powerplant, is identified. Using mission studies and cost estimates, some of the advantages of nuclear power for large air cushion vehicles are described. The technology studies on mobile nuclear powerplants and conceptual ACV systems/missions studies are summarized. Author

N73-24070*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ENGINE-OVER-THE-WING NOISE RESEARCH
Meyer Reshotko, Jack H. Goodykoontz, and Robert G. Dorsch 1973 23 p refs Proposed for presentation at 6th Fluid and Plasma Dyn. Conf., Palm Springs, Calif., 16-18 Jul. 1973; sponsored by AIAA
(NASA-TM-X-68246; E-7429) Avail: NTIS HC $3.25 CSCL 20A

Acoustic measurements for large model engine-over-the-wing (EOW) research configurations having both conventional and powered lift applications were taken for flap positions typical of takeoff and approach and at locations simulating flyover and sideline. The results indicate that the noise is shielded by the wing and redirected above it, making the EOW concept a prime contender for quiet aircraft. The large-scale noise data are in agreement with earlier small-model results. Below the wing, the EOW configuration is about 10 PNdb quieter than the engine-under-the-wing externally-blown-flap for powered lift, and up to 10 db quieter than the nozzle alone at high frequencies for conventional lift applications. Author

N73-24071*# Stanford Univ., Calif. Guidance and Control Lab.
SYNTHESIS OF HOVER AUTOPILOTS FOR ROTARY-WING VTOL AIRCRAFT
W. E. Hall and Arthur E. Bryson, Jr. Jun. 1972 31 p refs (Contract NAS2-5143)
(NASA-CR-132053; SUDAAR-446) Avail: NTIS HC $3.75 CSCL 01C

The practical situation is considered where imperfect information on only a few rotor and fuselage state variables is available. Filters are designed to estimate all the state variables from noisy measurements of fuselage pitch/roll angles and from noisy measurements of both fuselage and rotor pitch/roll angles. The mean square response of the vehicle to a very gusty, random wind is computed using various filter/controllers and is found

to be quite satisfactory although, of course, not so good as when one has perfect information (idealized case). The second part of the report considers precision hover over a point on the ground. A vehicle model without rotor dynamics is used and feedback signals in position and integral of position error are added. The mean square response of the vehicle to a very gusty, random wind is computed, assuming perfect information feedback, and is found to be excellent. The integral error feedback gives zero position error for a steady wind, and smaller position error for a random wind. Author

N73-24072*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
GUIDANCE FOR A TILT ROTOR VTOL AIRCRAFT DURING TAKEOFF AND LANDING
Narendra K. Gupta and Arthur E. Bryson, Jr. Dec. 1972 116 p refs
(Contract NAS2-5143)
(NASA-CR-132043; SUDAAR-448) Avail: NTIS HC$8.00 CSCL 01C

A perturbation guidance scheme is developed to keep a tilt-rotor VTOL aircraft close to a predetermined nominal flight path during take-off and landing. A simulation of the guidance scheme applied to the Bell Model 266 tilt-rotor VTOL gave satisfactory behavior in the presence of initial errors and wind disturbances. Author

N73-24073# Aeronautical Systems Div., Wright-Patterson AFB, Ohio.
A PROBLEM DEFINITION FOR THE EJECTOR FLAP STOL CONCEPT
Thomas A. Durham, Jr. Jun. 1972 29 p refs
(AD-758202; ASD/XR-72-26) Avail: NTIS CSCL 01/3

The report addresses the application of cold thrust augmentation - i.e., the ejector flap - to the STOL requirement. The approach is to examine the results of a preliminary analysis in light of new information which was not originally considered. The original preliminary analysis, examined the potential of this concept by modifying an existing aircraft design to accept an ejector flap mechanism. It was found that in addition to an increase in STOL performance, the device could also yield performance gains by leaving the ejector flap on during other flight modes, i.e., climb, loiter and cruise. The optimum ejector geometry was in the low area ratio, low thrust augmentation ratio region. This latter finding was in direct contrast to other ejector efforts of current interest. The conclusion drawn is that this concept will probably yield most benefit for STOL missions requiring extended loitering of climbing time. Ejector on operation does not look promising for high speed cruise. (Author Modified Abstract) GRA

N73-24074# Lockheed-California Co., Burbank.
ENGINEERING CRITERIA AND ANALYSIS METHODOLOGY FOR THE APPRAISAL OF POTENTIAL FRACTURE RESISTANT PRIMARY AIRCRAFT STRUCTURE Final Report, 15 Feb. 1971 - 15 Aug. 1972
John C. Ekvall, Thomas R. Brusset, Alan F. Liu, and Matthew Creager Wright-Patterson AFB, Ohio AFFDL Sep. 1972 328 p refs
(Contract F33615-71-C-1324; AF Proj. 1467)
(AD-757870; LR-52388; AFFDL-TR-72-80) Avail: NTIS CSCL 01/3

Design criteria and analysis procedures are presented such that a design system can be implemented to minimize the occurrence of major structural failures due to the presence of undetected damage. The design criteria define a flaw growth durability requirement and crack growth structural integrity requirements for three classes of inspectability of the structure; noninspectable, NDI in-service inspectable, and walk-around inspectable. Currently available crack growth and residual strength methods of analysis are presented which can be used to predict the remaining life and strength of damaged structure. To illustrate the use of the criteria and methods of analysis, a design study was conducted of the lower wing surface of a fighter/attack aircraft. The results of this study indicate that the structure could meet the design criteria with little or no weight penalty using 7075-T76 aluminum and annealed Ti-6Al-4V, and provided adequate inspection techniques and inspection frequencies are applied throughout the life of the aircraft. Author (GRA)

N73-24075# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.
NONLINEAR INTERACTION OF PANEL FLUTTER WITH HARMONIC FORCING EXCITATION
Ching-Chiang Kuo, Luigi Morino, and John Dugundji Dec. 1972 46 p refs
(Contract F44620-69-C-0091; AF Proj. 9782)
(AD-758264; ASRL-TR-159-5; AFOSR-73-0536TR) Avail: NTIS CSCL 01/3

The interaction characteristics of harmonic forcing excitation and panel flutter are studied analytically. Both linear and nonlinear solutions are investigated. Wide ranges of dynamic pressure and forcing frequency are covered such that subcritical responses (pure forced response), supercritical responses (forcing-flutter interaction), and the coexistence of both pure forced response and forcing-flutter interaction are studied. Results obtained by both harmonic balance and direct integration methods generally agree well. The technique developed here can be applied to other structural dynamics problems. Author (GRA)

N73-24076# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
SELECTION OF OPTIMAL STABILITY AUGMENTATION SYSTEM PARAMETERS FOR A HIGH PERFORMANCE AIRCRAFT USING PITCH PAPER PILOT M.S. Thesis
Robert P. Denaro and Garrison L. Greenleaf 17 Oct. 1972 114 p refs
(AD-757879; GGC/EE/73-3) Avail: NTIS CSCL 01/3

Pitch paper pilot is a computer program which yields pilot parameters for a pitch tracking task and predicts the pilot rating of the aircraft handling qualities. Using Pitch Paper Pilot, optimal SAS gains are selected for the fixed form Stability Augmentation System of a high performance aircraft with structural bending. This aircraft was described in the Design Challenge to the 1970 Joint Automatic Control Conference. The final augmented aircraft responses compared favorably with desired normal acceleration response envelopes. The pilot model in Pitch Paper Pilot is modified in this study to include pilot lag and remnant which results in greater rating accuracy, although a few cases still show room for improvement. Author (GRA)

N73-24077# Decision Science, Inc., San Diego, Calif.
PRINCIPLES OF DISPLAY AND CONTROL DESIGN OF REMOTELY PILOTED VEHICLES Semiannual Technical Report
Lawrence J. Fogal, Robert S. Gill, Michael L. Mout, Douglas G. Hulett, and Carl E. Englund 14 Feb. 1973 156 p refs
(Contract N00014-72-C-0196; NR Proj. 196-119)
(AD-757761; SATR-2) Avail: NTIS CSCL 01/3

Review of potential RPV mission assignments and the peculiar problems of RPV flight control lead to a preliminary experiment wherein the performance of Navy attack pilots, model aircraft pilots, and engineer non-pilots was compared on a simulated scenario using eight different display/control configurations (inside-out vs. outside-in, attitude display, predictive vs. non-predictive attitude display and position vs. rate control stick). Navy pilots demonstrated significantly better performance; however, no significant difference was found between inside-out and outside-in display (although almost all subjects, including Navy pilots, preferred the outside-in presentation). Attitude prediction was not found to be of value, and position control stick was significantly superior to the conventional rate stick. The Embedded Figures Test appears to be a useful indicator of expected performance. Analysis revealed that additional information is required for manual flight control. Specific problems of sensor control, diagnosis of ECM impact, and usage of autopilot

capability were identified. Suitable recommendations were identified. Suitable recommendations were made in this regard. Author (GRA)

N73-24078# Kaman Aircraft Corp., Bloomfield, Conn.
DESIGN STUDY OF EXPENDABLE MAIN ROTOR BLADES Final Report
Michael C. Frengley, Paul F. Maloney, and Carroll R. Akeley Oct. 1972 232 p refs
(Contract DAAJ02-71-C-0041; DA Proj. 1F1-62205-A-119)
(AD-758464; R-979; USAAMRDL-TR-72-48) Avail: NTIS CSCL 01/3

A design study is performed to determine the feasibility and cost advantages of expendable main rotor blades designed for the UH-1H helicopter. Technical feasibility, manufacturing cost, reliability, maintainability, and life-cycle costs were determined. Three concepts were projected to have life-cycle costs lower than those of the current blade. A blade of simplified all-aluminum construction is shown to have the lowest initial procurement cost, while one of stainless steel sheet and fiberglass has the lowest life-cycle cost. Author (GRA)

N73-24079# Bell Aerospace Co., Buffalo, N.Y.
A STUDY OF AIR CUSHION LANDING SYSTEMS FOR RECOVERY OF UNMANNED AIRCRAFT
John M. Ryken Wright-Patterson AFB, Ohio AFFDL Jul. 1972 141 p refs
(Contract F33615-72-C-1175; AF Proj. 1369)
(AD-758789; AFFDL-TR-72-87) Avail: NTIS CSCL 06/7

The report presents results of a concept feasibility and formulation study of Air Cushion Landing Systems for recovery of unmanned aircraft (Remotely Piloted Vehicles). A modified Ryan Model 147G drone or special purpose aircraft was investigated for possible use in a low cost flight test demonstration of air cushion landing gear concepts on an existing unmanned aircraft. Recovery by horizontal landing on an air cushion landing system is compared with recovery with a mid-air recovery system. Author (GRA)

N73-24080# Illinois Inst. of Tech., Chicago. Dept. of Mechanics, Mechanical and Aerospace Engineering.
V/STOL ORIENTED AERODYNAMIC STUDIES Progress Report, 1 Oct. 1971 - 30 Sep. 1972
Mark V. Morkovin, Z. Lavan, A. A. Fejer, H. M. Nagib, J. L. Way, and T. P. Torda Sep. 1972 60 p refs
(Contract F44620-69-C-0022; AF Proj. 9560; Proj. Themis)
(AD-758899; THEMIS-IIT-TR-R-72-9; AFOSR-73-0590TR) Avail: NTIS CSCL 01/3

Besides refinements of 71 results, the following advances are noteworthy. A modular approach to complex flow phenomena was developed and illustrated for flows around protuberances and for control of free-stream turbulence. A new, multiply linear and nonlinear mechanism of transition downstream of isolated roughness elements was documented in detail. The previously developed technique for high-Reynolds number simulation was applied to wind-tunnel simulation of atmospheric boundary layers. Adaption of a small water tunnel led to detailed comparisons of two-dimensional unsteady separation and stall phenomena over airfoils oscillating in pitch, airfoils with oscillating flaps, and inclined fixed airfoils in periodically surging streams. Response of flows with locally separated pockets to periodic modulation of the free stream was documented. (Author Modified Abstract) GRA

N73-24081# Naval Postgraduate School, Monterey, Calif.
THE DESIGN AND DEVELOPMENT OF A NON-FLAPPING ROTOR SYSTEM UTILIZING INFLEXIBLE BLADES AND EMPLOYING A NEW ROTOR CONTROL MECHANISM M.S. Thesis
William Alfred Simmons Dec. 1972 72 p refs
(AD-758514) Avail: NTIS CSCL 01/3

The intent of this study was the design, development and preliminary testing of an inflexible blade, hingeless rotor system. A hingeless system was desired due to its advantage of augmented control power resulting from its ability to transfer bending moments across the hub. The inflexible blades offered the unconventional feature of reducing the magnitude of blade flap-wise flexing to substantially zero and of removing the resultant problems of rotor dynamics. These stiffer blades generally dictated the use of more compact rotors, i.e., of a smaller diameter and therefore of a higher disk loading. The control rotor was of unconventional design and utilized a relatively small, free-flapping rotor to convey cyclic commands to the main rotor blades and provide rolling trim with varying forward speed. The present study has yielded a simple, mechanical system that essentially satisfies the design criteria and shows sufficient promise to warrant further development and testing. Author (GRA)

N73-24185# Institute for Telecommunication Sciences, Boulder, Colo.
COMPATIBILITY MEASUREMENTS OF DIGITAL MSK AND VOICE TRANSMISSIONS Final Report, Apr. 1972 - Apr. 1973
J. R. Jurosher Apr. 1973 96 p refs
(Contract DOT-FA72WAI-268)
(FAA-RD-73-63) Avail: NTIS HC $6.75

A series of experimental tests to measure interference between digital and voice systems are described. The digital system consisted of a 2400 bit-per-second, minimum-shift-keyed modem whose 1.2 and 2.4 kHz tones were transmitted by amplitude modulation. Measurements were made showing the effects of digital interference on voice transmission, voice interference on digital transmission, and digital interference on digital transmission. The tests were conducted at VHF using a commercial aircraft receiver. Also described is an experiment to frequency multiplex the MSK signal for simultaneous transmission with voice. Circuitry was developed to frequency translate the 1.2 and 2.4 kHz tones of the digital system to 6.6 and 7.8 kHz, respectively. Measurements were then conducted to demonstrate feasibility. Author

N73-24186# Computer Sciences Corp., Falls Church, Va.
FAA COMMUNICATIONS SYSTEM DESCRIPTION (1973) Final Report on Phase 1
J. C. Hansen, E. M. Boseck, R. Weber, and R. Lorence Washington FAA Feb. 1973 477 p refs
(Contract DOT-FA72WA-3072)
(FAA-RD-73-36) Avail: NTIS HC $26.00

The current operational communications employed by the FAA in supporting the National Aviation System is described. The evolution of FAA communications is presented as well as a summary of the primary information transfer. Detailed descriptions of all the major communication systems and subsystems are included. The report covers air-ground, ground-ground (voice) and ground-ground (data) communications. Author

N73-24283# National Aerospace Lab., Tokyo (Japan).
SYSTEM DESIGN OF FACILITIES FOR VTOL FLYING TEST BED AT NATIONAL AEROSPACE LABORATORY
Naoto Takizawa, Akiyoshi Shibuya, Toshio Gawa, Hirotoshi Fujieda, Tadao Kai, Yoshito Miyamoto, Yoshikazu Tanabe, Kazuyuki Takeuchi, and Koichi Ono 1972 53 p refs In JAPANESE; ENGLISH summary
(NAL-TR-306) Avail: NTIS HC $4.75 CSCL 14B

Systems design and a general description of facilities for studying hovering vertical takeoff, and vertical landing of VTOL aircraft are given. The facilities are divided into the following four main groups: ground support facilities, constrained test rigs, measuring apparatuses and ground establishment. Ground support facilities are provided for the operation and maintenance of the FTB, including those for rework, supply, inspection, adjustment and experiment. Constrained test rigs for the safety of over-all preflight experiments contain a force test rig, a height control test rig, and attitude control test rig and tie down test rigs. Measuring apparatus for the collection of precious data on the first VTOL flights in Japan are arranged in combination with special wiring, telemetering and others. Ground establishments for large scale field experiments consist of buildings, a constrained test field, and a free flight test field. Author

N73-24266# National Aviation Facilities Experimental Center, Atlantic City, N.J.
INVESTIGATION OF SITE COVERAGE AND ASSOCIATED PROBLEMS AT THE O'HARE AIRPORT, CHICAGO, ILLINOIS, ENROUTE RADAR BEACON TEST SITE Interim Report, Sep. 1971 - Sep. 1972
George F. Spingler Apr. 1973 62 p
(FAA-RD-73-49; FAA-RD-73-38) Avail: NTIS HC $5.25

A temporary beacon test site was installed adjacent to the Chicago, Illinois, O'Hare Airport and operational tests were conducted to determine its suitability for possible use as a future enroute radar beacon site. Photographic data were collected using targets-of-opportunity flying within the coverage area of the test site. The data were analyzed to determine the extent of the radar beacon coverage and further scrutinized to uncover any anomolies which might derogate the operation of an enroute radar beacon site installed at the test location. Flight tests confirmed the originally suspected problem areas and provided additional justification for linking the anomolies to the vertical radiation pattern of the standard radar beacon directional antenna. Author

N73-24269# National Physical Lab., Teddington (England).
MEASUREMENT OF THE TIME-AVERAGE FORCES AND PITCHING MOMENTS ON A PROPOSED HELICOPTER LANDING PLATFORM FOR THE WOLF ROCK LIGHTHOUSE
C. F. Cowdrey and D. W. Bryer Mar. 1973 18 p refs
(Mar-Sci-R-106) Copyright. Avail: NTIS HC $3.00

Wind tunnel tests were conducted to determine the time-averaged aerodynamic forces and overturning moments on a model of a helicopter landing platform to be installed on the top of a lighthouse. The construction of the supporting framework and its attachment to the lighthouse are described. Visualization of the flow over the model did not reveal any unusual features which would have an adverse effect on the operation of helicopters from the full scale landing pad. A safe configuration of the landing pad is described. Author

N73-24271*# Virginia Univ., Charlottesville. Dept. of Engineering Science and Systems.
DEVELOPMENT OF A SUPERCONDUCTING ELECTROMAGNETIC SUSPENSION AND BALANCE SYSTEM FOR DYNAMIC STABILITY STUDIES Final Technical Report
Ricardo N. Zapata Feb. 1973 76 p refs
(Grant NGR-47-005-029)
(NASA-CR-132255; ESS-4009-101-73U) Avail: NTIS HC $6.00 CSCL 14B

A prototype facility comprising a superconducting magnetic suspension and balance and a supersonic wind tunnel was developed with the objectives of (1) establishing the feasibility of applying the 3-component magnetic balance concept to dynamic stability studies, and (2) investigating design concepts and parameters that are critical for extrapolation to large scale systems. Many important design and operational aspects are dictated by the cryogenic nature of this advanced technology facility. Results of initial tests demonstrate that superconductors can be utilized safely and efficiently for wind tunnel magnetic suspensions. Controlled one-dimensional support of a spherical model was achieved.

N73-24281# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
TWO-DIMENSIONAL AEROFOIL TEST FACILITY IN THE S3 BLOW-DOWN WIND-TUNNEL OF MODANE-AVRIEUX [DISPOSITIF D'ESSAIS DE PROFILS EN COURANT PLAN DANS LA SOUFFLERIE S3 DE MODANE-AVRIEUX]
Maurice Bazin Oct. 1972 17 p refs In FRENCH; ENGLISH summary
(ONERA-NT-203) Avail: NTIS HC $3.00

A device for two dimensional airfoil profile testing in the transonic test section of the blowdown wind tunnel S3 was designed and built. Airfoils up to 0.3 m chord length can be studied by pressure measurements up to 0.95 Mach, with stagnation pressure from 1.2 to 4.0 bars. The Reynolds number can be varied up to 15,000,000 at Mach 0.95. The main features of the device are outlined and its various components described, including a 0.78 x 0.56 m test section with horizontal perforated walls, rotating supports for angle of attack variations from -35 to +215 deg, mobile rake for wake pressure survey, models with wall pressure taps. The method and means for data acquisition are given along with the aerodynamic characteristics of the test device. The visualization methods are described, and improvements are suggested. ESRO

N73-24285# Army Engineer Waterways Experiment Station, Vicksburg, Miss.
CONDITION SURVEY, HUNTER AIRFIELD, SAVANNAH, GEORGIA
R. D. Jackson and P. J. Vedros Mar. 1972 36 p
(AD-757387; AEWES-Misc-Paper-S-72-8) Avail: NTIS CSCL 01/5

The purpose of this report is to present the results of an inspection performed at Hunter Army Airfield (HAAF) in March 1971. The inspection was limited to visual observations, and no tests were conducted on any of the pavement facilities. A layout of the airfield is given. (Author Modified Abstract) GRA

N73-24286# Army Foreign Science and Technology Center, Charlottesville, Va.
REPAIR OF UNPAVED RUNWAY
V. Ermolchuk 22 Dec. 1972 5 p Transl. into ENGLISH from Aviatsiya i Kosmonavtika (Moscow), no. 4, 1967 p 60-61
(AD-756806; FSTC-HT-23-2043-72) Avail: NTIS CSCL 01/5

The landing field is destroyed as one uses unpaved airfields. The runway surface should be packed down and the tracks closed up. Experience has shown that closing deep tracks with the 2-bladed plow sharply improves the productivity and quality of work. Expenditures of time and resources on repairing damaged portions of the landing field are reduced two to three times when employing the plow. It is especially effective on airfields where intensive flying is carried out. The tractor-mounted, 2-bladed plow is easy to use, simple in design and can be produced by repair workshops. GRA

N73-24302 University of Southern Calif., Los Angeles.
THE THREE-DIMENSIONAL STRUCTURE OF TRANSONIC FLOWS INVOLVING LIFT Ph.D. Thesis
Mohammed Mahmound Hafez 1972 90 p
Avail: Univ. Microfilms Order No. 72-27661

The problem of steady transonic flows over lifting configurations having a nonvanishing finite leading-edge sweep angle is formulated on the basis of an asymptotic theory. Numerical methods are developed to solve the reduced lifting problems in the thickness-dominated regime. The theory shows that the flow field consists of an inner region similar to that in the classical slender-body theory and an outer nonlinear region governed by the familiar transonic small disturbance equation in three dimensions. Depending on the relative contribution of the lateral forces, the scales and the symmetry property of the outer region vary and three regimes can be identified: (1) the thickness-dominated regime, (2) the intermediate regime, and (3) the lift-dominated regime. Dissert. Abstr.

N73-24312*# Lockheed-Georgia Co., Marietta.
HIGH SPEED FLOW PAST WINGS
Helge Norstrud Washington NASA Apr. 1973 97 p refs
(Contract NAS1-10665)
(NASA-CR-2246) Avail: NTIS HC $3.00 CSCL 20D

The analytical solution to the transonic small perturbation equation which describes steady compressible flow past finite wings at subsonic speeds can be expressed as a nonlinear integral equation with the perturbation velocity potential as the unknown function. This known formulation is substituted by a system of nonlinear algebraic equations to which various methods are applicable for its solution. Due to the presence of mathematical discontinuities in the flow solutions, however, a main computa-

tional difficulty was to ensure uniqueness of the solutions when local velocities on the wing exceeded the speed of sound. For continuous solutions this was achieved by embedding the algebraic system in a one-parameter operator homotopy in order to apply the method of parametric differentiation. The solution to the initial system of equations appears then as a solution to a Cauchy problem where the initial condition is related to the accompanying incompressible flow solution. In using this technique, however, a continuous dependence of the solution development on the initial data is lost when the solution reaches the minimum bifurcation point. A steepest descent iteration technique was therefore, added to the computational scheme for the calculation of discontinuous flow solutions. Results for purely subsonic flows and supersonic flows with and without compression shocks are given and compared with other available theoretical solutions.
Author

N73-24317*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
FLIGHT-MEASURED BASE PRESSURE COEFFICIENTS FOR THICK BOUNDARY-LAYER FLOW OVER AN AFT-FACING STEP FOR MACH NUMBERS FROM 0.4 TO 2.5
Sheryll A. Goecke Washington May 1973 33 p refs
(NASA-TN-D-7202; H-740) Avail: NTIS HC $3.00 CSCL 20D

A 0.56-inch thick aft-facing step was located 52.1 feet from the leading edge of the left wing of an XB-70 airplane. A boundary-layer rake at a mirror location on the right wing was used to obtain local flow properties. Reynolds numbers were near 10 to the 8th power, resulting in a relatively thick boundary-layer. The momentum thickness ranged from slightly thinner to slightly thicker than the step height. Surface static pressures forward of the step were obtained for Mach numbers near 0.9, 1.5, 2.0, and 2.4. The data were compared with thin boundary-layer results from flight and wind-tunnel experiments and semiempirical relationships. Significant differences were found between the thick and the thin boundary-layer data. Author

N73-24319*# Linguistic Systems, Inc., Cambridge, Mass.
THE KUTTA-JOUKOWSKY CONDITIONS IN THREE-DIMENSIONAL FLOW
Robert Legendre Washington NASA May 1973 24 p refs Transl. into ENGLISH from La Rech. Aerospatiale (French), no. 5, 1972 p 241-247
(Contract NASw-2482)
(NASA-TT-F-14918) Avail: NTIS HC $3.25

The Kutta-Joukowsky condition in three dimensional flow is discussed. The characteristics of the separation line along which a vortex sheet is attached on a wing are examined. From observations of the flow over marine propellers and delta wing models, a discussion is presented to improve the description of the flow over any wing and to provide a better basis for accurate calculations of the perfect fluid flow used as a reference.
Author

N73-24323*# Scientific Translation Service, Santa Barbara, Calif.
THE RECIRCULATION FLOW PATTERN OF A VTOL LIFTING ENGINE
E. Schwantes Washington NASA Jun. 1973 201 p refs Transl. into ENGLISH from the German report DLR-FB-72-50
(Contract NASw-2483)
(NASA-TT-F-14912; DLR-FB-72-50) Avail: NTIS HC $12.25 CSCL 20D

A method is developed to predict theoretically the increase of temperature due to wind recirculation in the inlet of a VTOL aircraft lift engine exhausting normally to the ground. A method for calculating the velocities in the recirculation flow is presented. The laws of spread of buoyant plumes is used to calculate the temperatures within the recirculated flow. The three regions of the propulsion jet are identified as: (1) the free jet, (2) the wall jet, and (3) the zone of separation of the wall jet from the ground due to wind effects and buoyancy forces. Author

N73-24329# Rhode Island Univ., Kingston. Dept. of Mechanical Engineering and Applied Mechanics.
RAPID ENGINEERING CALCULATION OF TWO-DIMENSIONAL TURBULENT SKIN FRICTION, SUPPLEMENT 1 Technical Report, 1 Jun. 1971 - 30 Jun. 1972
Frank M. White and George H. Christoph Nov. 1972 34 p refs
(Contract F33615-71-C-1585; AF Proj. 1426)
(AD-757872; AFFDL-TR-72-136-Suppl-1) Avail: NTIS CSCL 20/4

The report outlines the details for engineering use of White's two-dimensional theory of turbulent skin friction under arbitrary compressible flow conditions. The new method is not only simple but accurate. It is recommended for general use by engineering designers. The method concerns skin friction only. The report presents methods for hand or digital computer computation. Several examples are presented. (Author Modified Abstract)
GRA

N73-24334# Illinois Inst. of Tech., Chicago. Dept. of Mechanics Mechanical and Aerospace Engineering.
STARTING VORTEX, SEPARATION BUBBLE AND STALL: A NUMERICAL STUDY OF LAMINAR UNSTEADY FLOW AROUND AN AIRFOIL
Unmeel B. Mehta and Zalman Lavan Dec. 1972 275 p refs
(Contract F44620-69-C-0022; AF Proj. 9560)
(AD-758831; THEMIS-IIT-TR-R-72-11; AFOSR-73-0640TR)
Avail: NTIS CSCL 20/4

The stalling characteristics of an airfoil in laminar viscous incompressible fluid are investigated. The governing equations in terms of vorticity and stream function are solved utilizing an implicit finite difference scheme and point successive relaxation procedures. The development of the impulsively started flow, the initial generation of the circulation and the behavior of the forces at large time are studied with emphasis on the formation region. Following incipient separation, the lift increases due to enlargement of a separation bubble and intensification of the flow rotation in it. The extension of this bubble and beyond the trailing edge causes its rupture and brings about the stalling characteristics of the airfoil. The lift increases when attached clockwise bubbles grow and anti-clockwise bubbles are swept away and vice versa. (Author Modified Abstract)
GRA

N73-24341 Washington Univ., Seattle.
THE STRUCTURE AND DYNAMICS OF THE HORIZONAL ROLL VORTICES IN THE PLANETARY BOUNDARY LAYER Ph.D. Thesis
Margaret Anne Lemone 1972 144 p
Avail: Univ. Microfilms Order No. 72-28625

The wind and temperature fields of the planetary boundary layer are investigated during periods in which horizontal roll vortices are present. Measurements from a 444 meter tower and from inertially-stabilized aircraft indicate the rolls are maintained primarily by: (1) production of energy from the crossroll component of the mean PBL wind spiral (lateral instability), and (2) bouyancy. Although aircraft data indicate a systematic concentration of turbulence in the positive vertical velocity regions of rolls, the effect of turbulence on the roll energy budget seems small. Both tower and aircraft measurements indicate substantial heat flux by rolls. It is shown that including positive roll heat flux into Brown's equilibrium energy budget will lead to rolls of larger magnitude. Dissert. Abstr.

N73-24477# National Aerospace Lab., Tokyo (Japan).
EXPERIMENTS ON AIRSPEED CALIBRATION PROCEDURES
Jiro Koo, Toichi Oka, Yukichi Tsukano, Kenti Yazawa, and Takatsugu Ono 1973 19 p refs In JAPANESE; ENGLISH summary
(NAL-TR-298) Avail: NTIS

The position errors of airspeed measuring systems and the cause of such errors are reported. Flight tests were made on six procedures. These include trailing cone or bomb, tower, radar altimeter, speed course, swiveling pitot-static tube, and airplane pacing methods. Author

N73-24504# Army Foreign Science and Technology Center, Charlottesville, Va.
EXCERPT FROM PILOTING AND NAVIGATIONAL DEVICES
S. D. Danich 8 Nov. 1972 91 p Transl. into ENGLISH of the publ. "Elektropribornaye Oborudovaniye Samolete AN-24 "Transport" USSR, 1971 263 p
(AD-758751; FSTC-HT-23-2165-72) Avail: NTIS CSCL 01/4

A detailed description and technical data are presented of the instrument panel equipment installed on an aircraft which is quite varied in its purpose, operating principle and design. The entire complex of this equipment is designed for piloting and navigation of the aircraft day and night, under simple and difficult weather conditions, at all latitudes in both hemispheres of the Earth, at all flying altitudes of the An-24 aircraft.
Author (GRA)

N73-24524# National Aeronautical Lab., Bangalore (India).
TANGENT MILLING AND SPLINE APPROXIMATION TECHNIQUES IN MODEL MAKING
R. Sankar and S. Janardhan Apr. 1971 47 p
(NAL-TN-33) Avail: NTIS HC $4.50

Wings whose surfaces are developable, were milled on a jig-borer at the National Aeronautical Laboratory, Bangalore, employing tangential milling. In this process, the wing cross section is approximated by a polygon which can be smoothened by hand-finish. The polygonal approximation itself is such that each side of the polygon is a tangent to the aerofoil. The aerofoil is defined by a finite set of points got from experiments or otherwise. These points are joined smoothly by using spline approximation to achieve continuity of first and second derivatives. The splines and the settings of the jig-borer (for tangential milling) were obtained on the NAL Sirius computer. Each setting of the jig-borer consists of the cutter-height and two turnings of the turn-table, one about the latter's axis and the other about a fixed horizontal axis, so that the tangent plane coincides with the plane of milling. The two angles of rotation and the cutter-height depend upon the wing geometry besides some of the machine parameters. Author

N73-24537# Mechanical Technology, Inc., Latham, N.Y.
HIGH PERFORMANCE BEARING STUDY Technical Report, 5 Mar. 1971 - 5 Jun. 1972
Warren D. Waldron and William E. Young (Pratt and Whitney Aircraft, West Palm Beach, Fla.) Wright-Patterson AFB, Ohio AFAPL 15 Jul. 1972 206 p refs
(Contract F33615-71-C-1382; AF Proj. 3048)
(AD-757869; MTI-72TR26; AFAPL-TR-72-63) Avail: NTIS CSCL 13/9

A feasibility investigation was performed to identify the probable advantages, problem areas, and the degree of feasibility of applying air lubricated bearings to an advanced class of U.S. Air Force complex-cycle aircraft engines. Three P-WA engines incorporating wraparound ramjets for high-Mach number, high-altitude operation were used as vehicles for the evaluation. No significant engine performance, size or weight penalty associated with air-lubricated bearings when compared to conventional oil-lubricated, rolling-element bearings was found. Hydrodynamic type bearings were found to have better load capacity characteristics than hydrostatic or hybrid types. New methods of cooling both the journal and thrust bearing were conceived which reduced the quantity of cooling air required from the engine. (Author Modified Abstract) GRA

N73-24540# Boeing Co., Philadelphia, Pa. Vertol Div.
TEST RESULTS REPORT AND TECHNOLOGY DEVELOPMENT REPORT HLH/ATC COMPLIANT ROLLER BEARING DEVELOPMENT PROGRAM Final Report
Joseph W. Lenski, Jr. Nov. 1972 138 p refs
(Contract DAAJO1-71-C-0840(P40); DA Proj. 1X1-6303-D-156)
(AD-755535; USAAMRDL-TR-72-62) Avail: NTIS CSCL 13/9

The report presents the results of effort conducted between August 1971 and March 1972 to define criteria and to design, fabricate, and test compliant rollers to obtain the optimum detail roller profile for use in the HLH rotor transmission second-stage planetary system. Tests were performed between flat plates under HLH loading and misalignment conditions. Technical inspection and evaluation of the test results will be used for selecting the optimum compliant roller configuration for the HLH rotor transmission second-stage planetary system. Author (GRA)

N73-24611# Douglas Aircraft Co., Inc., Long Beach, Calif.
DEVELOPMENT OF A GRAPHITE HORIZONTAL STABILIZER Interim Technical Report, 1 Jul. - 31 Dec. 1972
George M. Lehman, D. M. Purdy, F. C. Allen, C. G. Dietz, and R. Teodosiadis Jan. 1973 125 p refs
(Contract N00156-70-C-1321)
(AD-758718; MDC-J5841) Avail: NTIS CSCL 11/4

The analysis, repair, and further static testing of the previously failed graphite horizontal stabilizer are described. The design, analysis, and development testing of redesign concepts to correct the understrength condition at the main pivot fitting joint are discussed. Finite element analyses of the joint region were conducted to quantify the interlaminar shears and bending moments induced in the laminated skin panel by secondary bending effects. The calculated interlaminar shear and tensile stresses were of the order of 5 to 10 percent of allowable stresses determined in quality control specimens. The failed static test article was repaired with bolted and bonded steel splice plates and additional static tests were conducted to verify the strengths of the three elevator hinge brackets and supporting structures. These tests successfully demonstrated the design integrity of the hinge brackets since loads in excess of design ultimate load (150 percent design limit load) were sustained in each case. Joint specimens were tested to evaluate two redesign concepts (i.e., bonded external scarf and internal stepped-lap titanium doublers) to correct the understrength condition at the pivot fitting joint. The latter concept was selected for further development because it eliminated design reliance on laminate properties in the immediate vicinity of the major bolted joint. (Author Modified Abstract) GRA

N73-24639# Calspan Corp., Buffalo, N.Y.
EXPERIMENTAL TEST OF FOG CLEARING BY GROUND-BASED HEATING: VISIBILITY, TEMPERATURE, AND FOG MICROPHYSICS
C. William Rogers, Eugene J. Mack, and Roland J. Pilie Dec. 1972 74 p refs
(Contract F19628-72-C-0160; AF Proj. 8620)
(AD-757897; CJ-5076-M-1; AFCRL-TR-73-0056; SR-1) Avail: NTIS CSCL 04/2

Experimental tests of fog clearing by a ground-based heating system were carried out in nighttime advection fog occurring at Vandenberg Air Force Base, California during July and August 1972. Horizontal visibility ranged from 400 to 1000 m at one meter above the ground, 100 to 200 m between the 1 and 30 m heights and 50 to 100 m between the 30 and 60 m heights; average liquid water contents were 0.08, 0.22 and 0.38 g/cubic meter at 1, 13, and 42 m heights, respectively. Extrapolating the results of these experiments to a similar system installed at an airport, it appears that the visibility improvement achieved would always be adequate to permit landings at category 2 and category 3a runways. The clearing would usually be inadequate for approaches to category 1 runways unless the quantity of heat used was significantly increased. (Author Modified Abstract) GRA

N73-24653*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A LOW-COST INERTIAL SMOOTHING SYSTEM FOR LANDING APPROACH GUIDANCE
Frank R. Niessen Washington Jun. 1973 32 p refs
(NASA-TN-D-7271; L-8763) Avail: NTIS HC $3.00 CSCL 17G

Accurate position and velocity information with low noise content for instrument approaches and landings is required for

both control and display applications. In a current VTOL automatic instrument approach and landing research program, radar-derived landing guidance position reference signals, which are noisy, have been mixed with acceleration information derived from low-cost onboard sensors to provide high-quality position and velocity information. An in-flight comparison of signal quality and accuracy has shown good agreement between the low-cost inertial smoothing system and an aided inertial navigation system. Furthermore, the low-cost inertial smoothing system has been proven to be satisfactory in control and display system applications for both automatic and pilot-in-the-loop instrument approaches and landings. Author

N73-24654# Federal Aviation Administration, Washington, D.C.
SUMMARY OF NEAR TERM ENGINEERING AND DEVELOPMENT PROGRAM PLANS FOR GROUND BASED SEPARATION ASSURANCE
Mar. 1973 25 p refs
(FAA-EM-73-7) Avail: NTIS HC $3.25

A description is given of several engineering and development (E and D) activities directly involved with the development of automation capabilities to aid the separation assurance function of the ground based air traffic control (ATC) system. Separation assurance capabilities for the operational NAS En Route Stage A System are being developed in E and D Program 12 - En Route Control. The analogous development work for terminal systems, ARTS 3 and ARTS 2, is being accomplished in Program 14 - Terminal/Tower Control. The initial design of future capabilities, such as Intermittent Positive control for Phase 2 of the Upgraded Third Generation ATC System (which depends upon the surveillance/ communications provided by the Discrete Address Beacon System), is being performed under E and D Program 01 - Systems. In addition to work on ground based separation assurance, a parallel E and D program is being conducted to determine the potential value of an independent airborne collision avoidance system as a safety backup in the event of ground system failures. Author

N73-24655# Transportation Systems Center, Cambridge, Mass. Airport Surface Traffic Control Program Office.
ENGINEERING AND DEVELOPMENT PROGRAM PLAN: AIRPORT SURFACE TRAFFIC CONTROL
Jul. 1972 162 p refs
(FAA-ED-08-1) Avail: NTIS HC $10.25

Background, requirements, system descriptions, task descriptions, activities, schedules, and funding levels are presented for the Airport Surface Traffic Control program for the years 1972 to 1979. Systems, subsystems, proposed concepts, and equipments are defined and specified in a system context and then designed, developed, tested, and evaluated for introduction, in modular fashion, into the existing airport environment. Modular structure of the system will permit system configurations to be tailored to the needs of the individual airport and will permit modular expansion of either capacity or function to meet the airport's needs as they evolve with time. Author

N73-24656# ITT Avionics, Nutley, N.J.
SYSTEM ANALYSIS OF TACAN AND DME FOR ADDITION OF DIGITAL DATA BROADCAST Final Technical Report
John B. Kennedy and Ira Ross Apr. 1973 88 p refs
(Contract DOT-FA72WA-3001)
(FAA-RD-73-2) Avail: NTIS HC $6.50

An engineering analysis is presented on the feasibility of modifying the existing Tacan/DME system to provide broadcast digital data for area navigation. The operational and system considerations indicate that the required data rate is realizable and can be added with minimal effect on existing services. Various types of signal structure, synchronization and modulation techniques are examined. A comparison of the resulting data systems on the basis of data performance, flexibility, and the cost-complexity of implementation is included. Author

N73-24657# Stanford Research Inst., Menlo Park, Calif.
THE AIR TRAFFIC CONTROLLER'S CONTRIBUTION TO ATC SYSTEM CAPACITY IN MANUAL AND AUTOMATED ENVIRONMENTS. VOLUME 3: TERMINAL OPERATIONS Interim Report, Jun. 1971 - Jan. 1973
R. S. Ratner and J. O. Williams Jan. 1973 63 p
(Contract DOT-FA70WA-2142; SRI Proj. 8181)
(FAA-RD-72-63-Vol-3; IR-2) Avail: NTIS HC $5.25

The adaptation of the Relative Capacity Estimation Process (RECEP) to terminal ATC operations, findings and implications for effective automation in the terminal areas, quantitative capacity estimates, and predictions for several levels of automation are reported. A comparison of the results obtained for terminal ATC operations with those obtained for the ATC operations is presented. Author

N73-24658# Defense Mapping Agency Aerospace Center, St. Louis, Mo. Technical Translation Branch.
COMPUTATION OF THE GEODETIC COORDINATES OF AN AIRCRAFT FROM TWO MEASURED DISTANCES AND ITS HEIGHT ABOVE THE SURFACE OF THE EARTH ELLIPSOID
K. A. Laping and L. V. Medvedev Dec. 1972 11 p Transl. into ENGLISH from Gedez. i Kartograf. (Moscow), no. 3, 1972 p 13-15
(AD-757541; DMAAC-TC-1888) Avail: NTIS CSCL 08/5

The paper discusses the computation of the geodetic coordinates of an aircraft from two measured distances and its height above the surface of the earth ellipsoid. The advantages of the suggested method of determination of an aircraft's coordinates are: it is not necessary to reduce the measured distances to the surface of the earth ellipsoid, it is not necessary to know the approximate geodetic coordinates of the aircraft, and the suggested formulas can be used advantageously in a computer. Author (GRA)

N73-24697# Lockheed Missiles and Space Co., Palo Alto, Calif.
HIGH-FREQUENCY SPECTUM DOMAIN OF TURBULENT JET NOISE
V. A. Krasilnikov and R. E. Shikhlinskaia [1973] 3 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. 3: Fiz-Astron. (Moscow), v. 12, no. 5, 1972 p 626-628
Avail: NTIS HC $3.00; National Translations Center, John Crerar Library, Chicago, Illinois 60616

The expression for the dependence of the noise power spectral density on the radiation frequency is found by using similarity and dimensional analysis. The expression is then used to find the high frequency part of the turbulent jet noise spectrum where viscosity is essential. F.O.S.

N73-24777*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
THE USE OF HYDROGEN FOR AIRCRAFT PROPULSION IN VIEW OF THE FUEL CRISIS
Solomon Weiss 1973 38 p refs Presented at NASA Res. and Technol. Advisory Comm. on Aeronaut. Operating Systems, Moffett Field, Calif., 7-8 Mar. 1973
(NASA-TM-X-68242; E-7490) Avail: NTIS HC $4.00 CSCL 21D

Some factors influencing the technical feasiblity of operating a liquid hydrogen-fueled airplane are discussed in light of the projected decrease of fossil fuels. Other sources of energy, such as wind, tidal, solar, and geothermal, are briefly mentioned. In view of projected decreases in available petroleum fuels, interest has been generated in exploiting the potential of liquid hydrogen (LH2) as an aircraft fuel. Cost studies of LH2 production show it to be more expensive than presently used fuels. Regardless of cost considerations, LH2 is viewed as an attractive aircraft fuel because of the potential performance benefits it offers. Accompanying these benefits, however, are many new problems associated with aircraft design and operations; for example, problems related to fuel system design and the handling of LH2 during ground servicing. Some of the factors influencing LH2 fuel tank design, pumping, heat exchange, and flow regulation are discussed. Author

N73-24779# Southwest Research Inst., San Antonio, Tex. Army Fuels and Lubricants Research Lab.
ANOMALOUS RHEOLOGICAL CHARACTERISTICS OF A

HIGH INTERNAL PHASE RATIO EMULSION Final Report, Jan. 1969 - Mar. 1973
Richard J. Mannheimer Mar. 1973 23 p refs
(Contract DAAD05-67-C-0354)
(AD-758908; AFLRL-18) Avail: NTIS CSCL 21/4

High-internal-phase-ratio emulsions containing 97 to 98 percent liquid fuel as the dispersed phase, are shown to exhibit complex rheological behavior including reversible work hardening and apparent slip-flow anomalies. However, when proper precautions are taken to prevent contamination by demulsified fuel, steady flow in glass and steel tubes is characterized by the Bingham model up to a critical wall shear stress. At higher stresses a discontinuity in the flow curve is observed. Experiments in different diameter tubes are used to establish that the critical stress is associated with the rupture of emulsion droplets and the formation of a thin film of fuel at the wall of the tube. The apparent absence of a yield value and critical stress with PTFE (Polytetrafluoroethylene) tubes indicates that the film of fuel forms when the emulsion contacts a hydrophobic surface.
Author (GRA)

N73-24788# Advisory Group for Aerospace Research and Development, Paris (France).
RELATIVE AIR POLLUTION EMISSION FROM AN AIRPORT IN THE UK AND NEIGHBOURING URBAN AREAS
A. W. C. Keddie (Dept. of Trade and Ind., Stevenage, Engl.), G. H. Roberts (Dept. of Trade and Ind., Stevenage, Engl.), and J. Parker (Dept. of Trade and Ind., Stevenage, Engl.) [1971] 10 p refs Repr. from the publ. "Conference Pre-print No. 125 on Atmospheric Pullution by Aircraft Engines" Paris, AGARD, 10 p Avail: NTIS HC $3.00

Air pollution levels at Stansted Airport, England, in relation to emissions from four nearby towns are discussed. Calculations have been made of pollution emissions from these four sources and also from the airport, and the expected contributions from these sources at three local sites have been examined. These values are compared with actual measurements at the three sites.
Author

N73-24789# Northern Research and Engineering Corp., Cambridge, Mass.
THE CONTROL OF OXIDES OF NITROGEN EMISSIONS FROM AIRCRAFT GAS TURBINE ENGINES. VOLUME 1: PROGRAM DESCRIPTION AND RESULTS
R. S. Fletcher, R. D. Siegel, and E. K. Bastress Dec. 1971 109 p refs
(Contract DOT-FA70WA-2428)
(Rept-1162-1-Vol-1) Avail: NTIS HC $7.50

An analysis of the aircraft engine exhaust products which contribute to the air pollution problem was conducted. Nitrogen oxides are the only pollutant class for which control criteria do not exist. Mathematical models were developed to establish criteria for application to a range of aircraft engines. It was determined that aircraft contributions to regional loads in all categories are generally less than one percent. In the vicinity of major air terminals, densities and concentrations of aircraft emissions are comparable to densities and concentrations in adjacent communities of the same pollutants from other sources. Design criteria for combustors to reduce the amount of oxide emissions are described.
Author

N73-24790# Northern Research and Engineering Corp., Cambridge, Mass.
THE CONTROL OF OXIDES OF NITROGEN EMISSIONS FROM AIRCRAFT GAS TURBINE ENGINES. VOLUME 2: THE NITRIC OXIDE FORMATION PROCESS
R. S. Fletcher and R. D. Siegel Dec. 1971 143 p refs
(Contract DOT-FA70WA-2428)
(Rept-1162-2-Vol-2) Avail: NTIS HC $9.25

The chemical reactions which produce nitrogen oxides during aircraft engine operation are described. A mathematical analysis of the formation process is developed, the resulting computer program is described, and a user's manual for the program is included. The capabilities and limitations of the computer program are explained.
Author

N73-24791# Northern Research and Engineering Corp., Cambridge, Mass.
THE CONTROL OF OXIDES OF NITROGEN EMISSIONS FROM AIRCRAFT GAS TURBINE ENGINES. VOLUME 3: THE FLOW MODEL
R. S. Fletcher and R. D. Siegel Dec. 1971 173 p refs
(Contract DOT-FA70WA-2428)
(Rept-1162-3-Vol-3) Avail: NTIS HC $10.75

The development of a computer program to describe the flow conditions in a gas turbine combustor is discussed. Thermodynamic data computed in the computer program for nitrogen oxide formation are used as input data to the turbine combustor program. The theory behind the flow model and details of the computer program developed for its application are presented.
Author

N73-24805# Chandler Evans, Inc., West Hartford, Conn. Control Systems Div.
ADVANCED ENGINE CONTROL PROGRAM Final Report
A. H. White and D. F. Wills Nov. 1972 304 p refs
(Contract DAAJ02-70-C-0002; DA Proj. 1G1-62203-D-144)
(AD-758173; R-492-31; USAAMRDL-TR-72-59) Avail: NTIS CSCL 21/5

The report summarizes the results of a 30-month program of design, fabrication, and test of an advanced electronic engine control system for small turboshaft engines. The objective of the program was to develop engine control system technology which could be implemented in future systems to alleviate many of the problems experienced with past and present control systems. The system is comprised of three modules: a fuel-cooled hybrid electronic computer, a fluid controller with integral 37,500-rpm pump, and a remote electrohydromechanical engine geometry actuator. Closed-loop tests were made to demonstrate the control system performance on both a 2- and a 5-lb/sec analog computer engine simulator. Environmental temperature endurance testing and fuel contamination testing were completed. (Author Modified Abstract)
GRA

N73-24809# Pratt and Whitney Aircraft, East Hartford, Conn.
SUPERSONIC TORSIONAL FLUTTER IN CASCADES Final Technical Report, 16 Feb. 1972 - 16 Feb. 1973
Lynn E. Snyder 2 Apr. 1973 59 p refs
(Contract N00019-72-C-0187)
(AD-758721; PWA-4701) Avail: NTIS CSCL 21/5

A combined analytical and experimental study was made to determine the mechanism of supersonic unstalled torsional flutter in cascades of compressor blades. An unsteady supersonic cascade analysis was used to predict the onset conditions for supersonic torsional flutter. Two sets of blades, characteristic of those used in high-speed fan rotors, were tested to determine the position of the flutter boundary, and the characteristics of the aeroelastic instability. (Author Modified Abstract)
GRA

N73-24892*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
FLIGHT INVESTIGATION OF XB-70 STRUCTURAL RESPONSE TO OSCILLATORY AERODYNAMIC SHAKER EXCITATION AND CORRELATION WITH ANALYTICAL RESULTS
James M. McKay, Eldow E. Kordes, and John H. Wykes (N. Am. Rockwell Corp., Los Angeles) Washington Apr. 1973 124 p refs
(NASA-TN-D-7227; H-713) Avail: NTIS HC $3.00 CSCL 01C

The low frequency symmetric structural response and damping characteristics of the XB-70 airplane were measured at four flight conditions: heavyweight at a Mach number of 0.87 at an altitude of 7620 meters (25,000 feet); lightweight at a Mach number of 0.86 at an altitude of 7620 meters (25,000 feet); a Mach number of 1.59 at an altitude of 11,918 meters (39, 100 feet); and a Mach number of 2.38 and an altitude of 18,898 meters (62,000 feet). The flight data are compared with the response calculated by using early XB-70 design data and with the response calculated with mass, structural, and aerodyna-

mic data updated to reflect as closely as possible the airplane characteristics at three of the flight conditions actually flown.
Author

N73-24897*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NONLINEAR EQUATIONS FOR BENDING OF ROTATING BEAMS WITH APPLICATION TO LINEAR FLAP-LAG STABILITY OF HINGELESS ROTORS
Dewey H. Hodges and Robert A. Ormiston Washington May 1973 36 p refs Prepared in cooperation with Army Air Mobility R and D Lab., Moffett Field, Calif.
(NASA-TM-X-2770; A-4629) Avail: NTIS HC $3.00 CSCL 20K

The nonlinear partial differential equations for the flapping and lead-lag degrees of freedom of a torisonally rigid, rotating cantilevered beam are derived. These equations are linearized about an equilibrium condition to study the flap-lag stability characteristics of hingeless helicopter rotor blades with zero twist and uniform mass and stiffness in the hovering flight condition. The results indicate that these configurations are stable because the effect of elastic coupling more than compensates for the destabilizing flap-lag Coriolis and aerodynamic coupling. The effect of higher bending modes on the lead-lag damping was found to be small and the common, centrally hinged, spring restrained, rigid blade approximation for elastic rotor blades was shown to be reasonably satisfactory for determining flap-lag stability. The effect of pre-cone was generally stabilizing and the effects of rotary inertia were negligible. Author

N73-24933*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF FUEL VAPOR CONCENTRATIONS ON COMBUSTOR EMISSIONS AND PERFORMANCE
Carl T. Norgren and Robert D. Ingebo Washington Jun. 1973 35 p refs
(NASA-TM-X-2800; E-7336) Avail: NTIS HC $3.00 CSCL 20M

Effects of fuel vaporization on the exhaust emission levels of oxides of nitrogen, carbon monoxide, total hydrocarbons, and smoke number were obtained in an experimental turbojet combustor segment. Two different fuel injectors were used in which liquid ASTM A-1 jet fuel and vapor propane fuel were independently controlled to simulate varying degrees of vaporization. Tests were conducted over a range of inlet-air temperatures from 478 to 700 K, pressures from 4 to 20 atm, and combustor reference velocities from 15.3 to 27.4 m/sec. Converting from liquid to complete vapor fuel resulted in oxides of nitrogen reductions of as much as 22 percent and smoke number reductions up to 51 percent. Supplement data are also presented on flame emissivity, flame temperature, and primary-zone liner wall temperatures. Author

N73-24940# IIT Research Inst., Chicago, Ill. Engineering Mechanics Div.
LAUNCHER IMPROVEMENT FOR ILLUMINATION SYSTEM FLARE, SURFACE: PARACHUTE XM 183 Final Report, 28 Apr. 1971 - 28 Jan. 1972
Daniel J. Herkes Dec. 1972 25 p
(Contract DAAD05-71-C-0315)
(AD-757731; LWL-CR-09F70) Avail: NTIS CSCL 19/6

The objective of this nine-month program was to improve the present feasibility model launcher for mass production. In addition, design features such as flare package retention and positive locking were to be investigated. To assure system reliability, a method of verifying these objectives was required. During the course of this program, a development approach and test plan was generated and approved for engineering activities. A verification test fixture was designed and constructed to simulate impact type loading on a launcher. Experimental and production type launcher systems can be subjected to peak recoil conditions of 1600 lb for 5 msec through three firing elevations. (Author Modified Abstract) GRA

N73-24971 Elliott-Automation Space and Advanced Military Systems, Ltd., Camberley (England).
PROJECT MANAGEMENT COMPARISON
L. A. Mitchell *In* ESRO Proj. Management and Proj. Control Jan. 1973 p 89-100

A brief description of EASAMS Ltd. and of the type of project undertaken there is followed by an analysis of the principle on which the management of the company and the project management are based: delegation of appropriate authority; careful pre-planning; control of commitment; and identification of cost centers. A comparison of the various management factors in two different types of project - a military development project and civil engineering projects - is then developed with particular reference to selection of objectives, organization for management, choice of the management staff, and effectiveness of the different procedures. Finally, a summary of the planning processes is given with examples of problems and solutions, bringing out the similarity of management problems in widely differing projects.
Author (ESRO)

N73-24993# ARO, Inc., Arnold Air Force Station, Tenn.
AERODYNAMIC FORCES AND TRAJECTORIES OF SEPARATED STORES DISTURBED FLOW FIELDS Final Report, 16 Aug. 1971 - 30 Jun. 1972
W. N. MacDermott and P. W. Johnson AEDC Mar. 1973 102 p refs
(ARO Proj. PW5280)
(AD-757932; ARO-PWT-TR-72-148; AEDC-TR-72-162) Avail: NTIS CSCL 19/2

A vortex-lattice potential flow computer program capable of accepting nonuniform flow boundary conditions but previously restricted to incompressible flows with symmetry was modified to eliminate these restrictions. The program was structured in such a way that, after preliminary calculations of a purely geometric nature were performed one time for a given body, potential flow solutions for any set of boundary conditions on that body could be obtained in computer times measured in seconds rather than minutes. The aerodynamic characteristics of an M-117 bomb, represented by a network of 312 vortices, were calculated for uniform flow at a Mach number of 0.5 and were found to agree with wind tunnel measurements to within 10 percent, except for drag. (Author Modified Abstract) GRA

N73-24996 Princeton Univ., N.J.
WIND TUNNEL INTERFERENCE FACTORS FOR HIGH-LIFT WINGS IN CLOSED WIND TUNNELS Ph.D. Thesis
Robert Glenn Joppa 1972 144 p
Avail: Univ. Microfilms Order No. 72-29794

A problem associated with the wind tunnel testing of very slow flying aircraft is the correction of observed pitching moments to free air conditions. The most significant effects of such corrections are to be found at moderate downwash angles typical of the landing approach. The wind tunnel walls induce interference velocities at the tail different from those induced at the wing, and these induced velocities also alter the trajectory of the trailing vortex system. Results are presented comparing the tail interference angles, with and without the effect of vortex wake relocation, which show the importance of the wake shift. In some cases the tail angle corrections are reduced to zero and may even change sign. It is concluded that to correctly calculate the interference velocities affecting pitching moments, the effects of vortex wake relocation must be included.
Dissert. Abstr.

N73-24997 Cincinnati Univ., Ohio.
KELVIN IMPULSE THEORY APPLIED TO LIFT ON AIRFOILS Ph.D. Thesis
James Anthony Delaney 1972 131 p
Avail: Univ. Microfilms Order No. 72-31627

The application of the Kelvin impulse theory to computing lift on airfoils is discussed. The analysis is based on the circulation around the airfoil required to produce lift. A series of five theorems is presented for lift calculation based on variations in the basic parameters in airfoil circulation. Mathematical models are provided to clarify the theoretical concepts. Dissert. Abstr.

N73-24999# Aeronautical Research Council, London (England).
[AERODYNAMIC RESEARCH, INCLUDING HEATING, AIRFOILS, AND BOUNDARY LAYER STUDIES, VOLUME 1] Technical Report, 1959
HMSO 1971 662 p refs
Avail: NTIS HC $35.25; HMSO £15.50; PHI $58.14

Research projects in theoretical and practical aerodynamics are presented. The subjects discussed are: (1) leading edge buckling due to aerodynamic heating, (2) effect of a central jet on the base pressure of a cylindrical body in supersonic stream, (3) numerical methods for calculating the zero-lift wave drag and the lift-dependent wave drag of slender wings, (4) wind tunnel tests to determine longitudinal and lateral stability of canard aircraft model, (5) an axially symmetric analog for general three-dimensional boundary layers, and (6) effects of shock-induced boundary layer separation in transonic flight.

N73-25000 Ministry of Supply, London (England).
LEADING EDGE BUCKING DUE TO AERODYNAMIC HEATING
E. H. Mansfield *In* ARC Aerodyn. Res., including Heating, Airfoils, and Boundary Layer Studies, Vol. 1 1971 p 1-20 refs
(ARC-R/M-3197; RAE-R-Struct-250)

A formula is derived for determining the onset of leading edge buckling due to aerodynamic heating of wings which are either solid or thin walled with a shear resistant filler. The stresses induced in the wing structure are analyzed. It is shown that buckling begins when the spanwise stress at the leading edge reaches a value which depends on the shear modulus of the material and the geometry of the leading edge. Author

N73-25002 National Physical Lab., Teddington (England). Aerodynamics Div.
OBSERVATIONS OF THE FLOW OVER A TWO DIMENSIONAL 4 PERCENT THICK AEROFOIL ATTRANSONIC SPEEDS
B. D. Henshall and R. F. Cash *In* ARC Aerodyn. Res., including Heating, Airfoils, and Boundary Layer Studies, Vol. 1 1971 p 63-81 refs
(ARC-R/M-3180)

Wind tunnel tests were conducted to determine the pressure distributions for a 4 percent thick, circular arc, biconvex airfoil at transonic speeds. The boundary layers on the airfoil were turbulent and were not subjected to artificial transition methods. The pressure distributions for angles of attack of 1, 2, and 5 degrees and various free stream Mach numbers are presented. It was determined that the transonic flow past the airfoil was similar to that for round-nose airfoils. Author

N73-25003 Ministry of Aviation, London (England).
AN EXPERIMENTAL INVESTIGATION AT SUPERSONIC SPEEDS OF THE CHARACTERISTICS OF TWO GOTHIC WINGS, ONE PLANE AND ONE CAMBERED
L. C. Squire *In* ARC Aerodyn. Res., including Heating, Airfoils, and Boundary Layer Studies, Vol. 1 1971 p 83-114 refs
Previously issued as RAE-TN-Aero-2620; ARC-21390

(ARC-R/M-3211; RAE-TN-Aero-2620; ARC-21390)

Tests have been made at supersonic speeds up to M = 2.0 on a thick cambered gothic wing of aspect ratio 0.75, together with tests on the uncambered wing of the same plan-form and thickness. The camber was designed to give attached flow all along the leading edge, and over the whole wing, at one lift coefficient, together with low drag at this lift. The thickness distribution was chosen to have low zero-lift drag and also to eliminate the adverse pressure gradients due to incidence and camber at the design lift. The results show that the drag of the cambered wing is close to the theoretically estimated value at the design lift coefficient: the drag of the plane wing, however, is also of the same magnitude and the reasons for this are discussed. Other properties of the wings are not in agreement with the slender thin wing theory. At the design condition on the cambered wing the flow is attached over the whole wing. Off-the-design condition the leading edge separations on the cambered wing are much weaker than on the plane wing. Author

N73-25004 Ministry of Aviation, London (England).
FORMULAE FOR CALCULATING THE CAMBER SURFACES OF THIN SWEPTBACK WINGS OF ARBITRARY PLANFORM WITH SUBSONIC LEADING EDGES, AND SPECIFIED LOAD DISTRIBUTION
G. M. Roper *In* ARC Aerodyn. Res., including Heating, Airfoils, and Boundary Layer Studies, Vol. 1 1971 p 115-141 refs
Previously issued as RAE-Aero-2623; ARC-21430

(ARC-R/M-3217; RAE-Aero-2623; ARC-21430)

Formulas for calculating the gradients and ordinates of the camber surfaces of sweptback wings of arbitrary planform with subsonic leading edges, and specified load distribution, are given, including those which have been programmed and used for DEUCE calculations for some swept-back and M-wings with curved leading edges. Some methods for the numerical calculation of singular integrals are given. For polygonal wings with simple load distributions, the equation of the camber surface is given in closed form. This is useful for obtaining approximate results for more general planforms. Author

N73-25005 Ministry of Aviation, London (England).
THE INTERFERENCE ON A THREE DIMENSIONAL JET FLAP WING IN A CLOSED WIND TUNNEL
E. C. Maskell *In* ARC Aerodyn. Res., including Heating, Airfoils, and Boundary Layer Studies, Vol. 1 1971 p 143-154 refs
Previously issued as RAE-TN-Aero-2650; ARC-21598

(ARC-R/M-3219; RAE-TN-Aero-2650; ARC-21598)

The theory of wind-tunnel interference is extended to cover interference on the effectiveness of a full-span jet flap issuing from the trailing edge of a high aspect ratio unswept wing. It is shown that, for small constraint, corrections delta c sub j and delta alpha must be added to the observed jet momentum coefficient and wing incidence, respectively. These corrections are derived, together with the corresponding corrections to the observed lift and thrust coefficients. Corrections to the observed downwash field over a limited interval downstream of the trailing edge of the wing are also derived. These lead to a corrected jet path and a downward displacement of the downwash pattern, in addition to the direct increment to the observed downwash. Corresponding corrections to tail height and setting are also given. Author

N73-25006 Ministry of Aviation, London (England).
NUMERICAL METHODS FOR CALCULATING THE ZERO-LIFT WAVE DRAG AND THE LIFT-DEPENDENT WAVE DRAG OF SLENDER WINGS
J. Weber *In* ARC Aerodyn. Res., including Heating, Airfoils, and Boundary Layer Studies, Vol. 1 1971 p 155-173 refs
Previously issued as RAE-Aero-2629; ARC-21890

(ARC-R/M-3221; RAE-Aero-2629; ARC-21890)

The evaluation of a double integral equation for calculating wave drag due to volume as well as lift is discussed. In many practical cases the function is not given in analytical form and the integration cannot be performed explicitly. The application of several numerical methods to the three different cases which represent the wave drag parameters is described. Mathematical models are developed to clarify the theoretical considerations. Author

N73-25007 Ministry of Aviation, London (England).
SOME NOTES ON THE ZERO-LIFT WAVE DRAG OF SLENDER WINGS WITH UNSWEPT TRAILING EDGE
J. Weber *In* ARC Aerodyn. Res., including Heating, Airfoils, and Boundary Layer Studies, Vol. 1 1971 p 175-208 refs
Previously issued as RAE-Aero-2630; ARC-21909

(ARC-R/M-3222; RAE-Aero-2630; ARC-21909)

Minimum values of the zero-lift wave drag of slender wings with certain fixed properties have been calculated by slender-body theory. The cross-sectional area distributions of the wings are taken to be polynominals and the fixed properties of the wings correspond to fixed first and second derivatives of the area distributions at the apex and rear end. The drag for delta wings of rhombic cross sections has also been calculated by thin-wing theory without the slenderness assumption. Comparisons between the drag coefficients calculated by both theories have been made for a series of wings to investigate the applicability of slender theory. The calculations by both theories suggest that it should be possible to design thickness distributions which have drags as low as that of the so-called Lord V area distribution is unsuitable. Further, this can be achieved when the thickness near the apex and the slope at the trailing edge are restricted. Author

N73-25008 Ministry of Supply, London (England).
DESIGN OF WARPED SLENDER WINGS WITH THE ATTACHMENT LINE ALONG THE LEADING EDGE
J. Weber *In* ARC Aerodyn. Res., including Heating, Airfoils, and Boundary Layer Studies, Vol. 1 1971 p 209-246 refs Supersedes RAE-TN-Aero-2530; ARC-20051

(ARC-R/M-3406; RAE-TN-Aero-2530; ARC-20051)

The design of slender warped wings with unswept trailing edge but otherwise arbitrary planform which have, at the design lift coefficient, zero load along the leading edge and a near planar vortex sheet from the trailing edge is discussed. The wing can have an arbitrary chordwise curvature on which a spanwise curvature is superposed so that in any spanwise section the wing is straight over the inner part of the wing and curved over the portion near to the leading edges; the position of this change can vary arbitrarily in the chordwise direction. Formulas and working charts are given for determining the local load coefficient (and with it the streamwise velocity component), the spanwise velocity component, the total lift coefficient and the total drag. Numerical examples, for the gothic planform, are given to illustrate some of the effects of the various parameters on the load distribution, the section shapes and the drag. Slender-wing theory has been applied except for determining the wave drag. Author

N73-25009 National Physical Lab., Teddington (England).
MEASUREMENTS OF THE DIRECT PITCHING MOMENT DERIVATIVES FOR THREE WING PLANFORMS AT HIGH SUBSONIC SPEEDS
J. B. Bratt, W. G. Raymer, and J. E. G. Townsend *In* ARC Aerodyn. Res., including Heating, Airfoils, and Boundary Layer Studies, Vol. 1 1971 p 247-282 refs Supersedes ARC-16267

(ARC-R/M-3419; ARC-16267)

Wind tunnel measurements of the direct pitching damping and stiffness derivatives for a delta wing and two swept wing planforms are discussed. Results for the delta wing are compared with theoretical data. Experiments to investigate the cause of loss of damping at low frequencies are also investigated. The effect on derivative measurements of random oscillatory flow disturbances is examined. Author

N73-25010 Ministry of Aviation, London (England).
THE CALCULATION OF THE SPANWISE LOADING OF SWEPTBACK WINGS WITH FLAPS OR ALL-MOVING TIPS AT SUBSONIC SPEEDS
G. G. Brebner and D. A. Lemaire *In* ARC Aerodyn. Res., including Heating, Airfoils, and Boundary Layer Studies, Vol. 1 1971 p 283-323 refs Supersedes RAE-Aero-2553; ARC-18273

(ARC-R/M-3487; RAE-Aero-2553; ARC-18273)

Electric tank tests on wings of 45 deg sweepback with trailing edge flaps have been analyzed to provide the basis for a method of calculating the spanwise loading. The analysis yielded information about the effect of sweep on the equivalent incidence of a section with flap, on the downwash factor and on the spanwise loading distribution with an incidence discontinuity. Interpolation formulas are developed to extend the results to wings of any sweep and flap span, and thus a complete calculation method is presented for the spanwise loading with this type of control. The calculation method is tentatively extended to a wing with all-moving tip control. Author

N73-25011 Ministry of Aviation, London (England).
A WIND TUNNEL INVESTIGATION OF THE LONGITUDINAL AND LATERAL AERODYNAMIC CHARACTERISTICS OF A CANARD AIRCRAFT MODEL. PART 1: TESTS AT M EQUALS 1.04 AND M EQUALS 2.02. PART 2: TESTS AT M EQUALS 2.47
P. E. Watts, L. J. Beecham, and D. A. Treadgold *In* ARC Aerodyn. Res., including Heating, Airfoils, and Boundary Layer Studies, Vol. 1 1971 p 325-407 refs Previously issued as RAE-Aero-2575; RAE-Aero-2603; ARC-19218; ARC-20888

(ARC-R/M-3226; RAE-Aero-2575; RAE-Aero-2603; ARC-19218; ARC-20888)

Tests were made in a supersonic wind tunnel to measure the overall normal and side forces, rolling, pitching and yawing moments on a typical canard aircraft layout at M = 1.40 and M = 2.02. The complete configuration and configuration less fin, with foreplane angles, 0 deg and 10 deg were tested for combinations of incidence and sideslip up to 10 deg. Additional breakdown tests were made at M = 1.40, and supplemented by oil flow and vapour screen tests. The tests have shown that the foreplane has a reduced lifting, but an increased moment, effectiveness due to the download induced on the mainplane. The longitudinal stability increases with incidence and Mach number; neither normal force nor pitching moment is affected significantly by sideslip. The lateral and directional characteristics are less satisfactory. When sideslip is present the foreplane-wing interaction produces a large negative rolling moment which increases in magnitude with incidence and control setting. The tests indicate that further investigation is required into the effect of a free vortex on the load distribution over a lifting surface if satisfactory estimates are to be made of control-wing and control-fin interference. Author

N73-25012 Ministry of Aviation, London (England).
A WIND TUNNEL INVESTIGATION OF THE DIRECTIONAL AND LONGITUDINAL STABILITY OF THE JAVELIN AIRCRAFT AT TRANSONIC SPEEDS, INCLUDING COMPARISON WITH FLIGHT TEST RESULTS
E. P. Sutton and A. Stanbrook *In* ARC Aerodyn. Res., including Heating, Airfoils, and Boundary Layer Studies, Vol. 1 1971 p 409-462 refs Previously issued as RAE-TN-Aero-2563; RAE-Aero-2632; ARC-20582; ARC-22083

(ARC-R/M-3403; RAE-TN-Aero-2563; RAE-Aero-2632; ARC-20582; ARC-22083)

Directional and longitudinal stability measurements have been made on a 1/72 scale model of the Javelin aircraft at Mach numbers up to 1.12 in a 3 ft wind tunnel. Observations were made of the flow over the fin and the wing by the oil-flow technique. The results show directional instability near sonic speed, as observed in flight, due to shock-induced separation on the fin; this appears to have been caused by the wing trailing-edge shock wave, strengthened by the flow fields of the fin and rear fuselage. A small change in the shape of the rear fuselage delayed the separation to a higher wing incidence and eliminated the instability. For the model with the tail-on, the curves of pitching moment against normal force had stable slopes except near zero lift at isolated Mach numbers. The stability decreases at high incidence at M = 0.7 and at moderate incidences around M = 0.93. Flight and tunnel test results were in good qualitative agreement. The significant effect of a small distortion of the fuselage shape at the tail (such as might be made to accommodate a supporting sting) on directional stability is of general importance from the point of view of wind-tunnel testing. Author

N73-25018 Aeronautical Research Council, London (England).
AN APPROXIMATE INTEGRAL METHOD FOR CALCULATING THE INCOMPRESSIBLE LAMINAR BOUNDARY LAYER ON AN INFINITE SWEPT WING ON WHICH VELOCITY AND SUCTION DISTRIBUTION ARE ARBITRARY
H. G. Pinsent and P. A. Pinsent *In its* Aerodyn. Res., including Heating, Airfoils, and Boundary Layer Studies, Vol. 1 1971 p 557-594 refs Previously issued as ARC-22154; RR-54

(ARC-R/M-3241; ARC-22154; RR-54)

An approximate solution for the cross-flow velocity in an incompressible laminar boundary layer on an infinite swept wing is described. The cross flow is defined as that velocity in the boundary layer in a direction normal to the outer flow streamline. The two-dimensional flow in the chordwise direction is assumed known. The boundary-layer equations are expressed in a non-dimensional form. Head's method, which is based on the momentum and energy equations and is used to solve the two-dimensional flow, is briefly described. From the non-dimensional boundary-layer equations, an equation involving the cross-flow profile directly is obtained. This equation is then integrated throughout the boundary layer giving two integral equations. Typical cross-flow shapes have been used to calculate functions which when used in conjunction with the two integral equations and the boundary condition at the wall enable the cross flow to be determined for arbitrary velocity and suction distributions. The stability criterion for three-dimensional flow is expressed in the notation of this method and is a simple condition on the cross flow. The method is then applied to the upper and lower surfaces of a wing, suction distributions being calculated to maintain stability at each point of the wing. For the lower surface comparison is made with an independent method in the adverse pressure-gradient region. Author

N73-25019 Aeronautical Research Council, London (England).
EXAMPLES OF THE EFFECTS OF SHOCK INDUCED BOUNDARY LAYER SEPARATION IN TRANSONIC FLIGHT
H. H. Pearcey and D. W. Holder *In its* Aerodyn. Res., including Heating, Airfoils, and Boundary Layer Studies, Vol. 1 1971 p 595-652 refs Supersedes ARC-16446

(ARC-R/M-3510; ARC-16446)

The effects of shock induced boundary layer separation in transonic flight are described. The variation of the pressure coefficient at the trailing edge of the wing has been used to deduce the onset of separation. The characteristics of boundary layer separation for swept and unswept wings are analyzed. Methods for eliminating or reducing the effects of boundary layer separation are proposed. The design of wing planforms to reduce shock induced separation at low angles of incidence is proposed. Author

N73-25020# Aeronautical Research Council, London (England).
[AERODYNAMIC RESEARCH PROGRESS, INCLUDING TURBINE, NOZZLE, FLUTTER, AND INSTRUMENTATION STUDIES, VOLUME 2] Technical Report, 1959
HMSO 1971 785 p refs
Avail: NTIS HC $41.25; HMSO £ 18; PHI $69.77

Research projects in theoretical and practical aerodynamics are presented. The subjects discussed are: (1) performance of highly loaded turbine stages, (2) subsonic derivatives for an oscillating wing, (3) pitching moment derivatives for two-dimensional flow at subsonic and supersonic speeds, (4) effects of transonic speed on wing-aileron flutter, (5) effects of wing stiffness and inertia changes on modes and frequencies of model delta wing aircraft, (6) loading of helicopter blades in forward flight, (7) performance of supersonic turbine nozzles, and (8) design of wing-body combinations of low zero-lift drag rise at transonic speeds.

N73-25022 National Physical Lab., Teddington (England). Aerodynamics Div.
THEORETICAL SUBSONIC DERIVATIVES FOR AN OSCILLATING M-WING
H. C. Garner and W. E. A. Acum *In* ARC Aerodyn. Res. Progr., including Turbine, Nozzle, Flutter, and Instrumentation Studies, Vol. 2 1971 p 683-709 refs Previously issued as ARC-20649

(ARC-R/M-3214; ARC-20649)

The aerodynamic characteristics of an oscillating half-wing model of an M-wing are discussed. As compared with conventional delta or arrowhead planforms, the M-wing has a high minimum pitching damping at low speeds, which occurs for a pitching axis close to the aerodynamic center. The comparison between calculated and measured values of the pitching derivatives is good for the in-phase lift and moment and somewhat less satisfactory for the damping derivatives. The symmetrical rigid bending mode is highly damped for the range of frequency parameter. Some calculations with an antisymmetrical rolling mode were made to estimate the corrections required. Author

N73-25023 Ministry of Supply, London (England).
THE VELOCITY POTENTIAL ON TRIANGULAR AND RELATED WINGS WITH SUBSONIC LEADING EDGES OSCILLATING HARMONICALLY IN SUPERSONIC FLOW
D. E. Davies *In* ARC Aerodyn. Res. Progr., including Turbine, Nozzle, Flutter, and Instrumentation Studies, Vol. 2 1971 p 711-782 refs Previously issued as RAE-R-STRUCT-244; ARC-21185

(ARC-R/M-3229; RAE-R-STRUCT-244; ARC-21185)

A method for obtaining the velocity potential on a triangular wing with subsonic leading edges oscillating in a supersonic flow is presented. A symmetric mode of oscillation is considered which is represented by a polynomial expression in coordinates of the points of the wing. Mathematical models are included to support the theoretical concepts. Author

N73-25024 Ministry of Aviation, London (England).
A RECORD OF INFORMATION ON OSCILLATORY AERODYNAMIC DERIVATIVE MEASUREMENTS
H. Hall *In* ARC Aerodyn. Res. Progr., including Turbine, Nozzle, Flutter, and Instrumentation Studies, Vol. 2 1971 p 783-861 refs Previously issued as RAE-TN-STRUCT-268; ARC-21595

(ARC-R/M-3232; RAE-TN-STRUCT-268; ARC-21595)

A survey of aerodynamic derivative measurements since 1940 is presented. The survey shows that measuring the main surface pitching moment derivatives has received the most attention. The parameter variations include details of Mach number, frequency parameter, Reynolds number, mean incidence, amplitudes of oscillation, and axis of oscillation. The axis of oscillation is defined as a distance aft of the leading edge for an unswept rectangular wing and a distance aft of the apex for a swept or delta wing. Author

N73-25025 National Physical Lab., Teddington (England).
MEASUREMENT OF PITCHING-MOMENT DERIVATIVES FOR AEROFOILS OSCILLATING IN TWO-DIMENSIONAL SUPERSONIC FLOW
C. Scruton, L. Woodgate, K. C. Lapworth, and J. Maybrey *In* ARC Aerodyn. Res. Progr., including Turbine, Nozzle, Flutter, and Instrumentation Studies, Vol. 2 1971 p 863-897 refs Previously issued as ARC-20650

(ARC-R/M-3234; ARC-20650)

Pitching-moment derivatives have been measured by a free oscillation technique on two-dimensional airfoils of double wedge section with thickness/chord ratios of 0.08, 0.12 and 0.16; and on an airfoil of single wedge section of thickness/chord ratio 0.16. The Mach number ranged between 1.37 and 2.43 and the axis position was varied over a wide range. The Reynolds numbers and the frequency parameters of the tests were less than one million and 0.03 respectively. A few tests were made at incidence. For some axis positions and low values of Mach number, negative values of the aerodynamic damping were found

considerably in excess of those predicted by theory. Theories which take into account thickness effects correctly predicted the trends of the derivatives with changes in axis position and in Mach number, and also the axis position at which the damping changes from positive to negative. However, substantial differences in the numerical values were often found, particularly at low Mach numbers and these are attributed in part to the detached bow-wave on the thicker wings at low Mach numbers and in part to the effects of the boundary layer and of flow separations. Author

N73-25026 Ministry of Aviation, London (England).
PART 1: A DESCRIPTION OF THE EXCITATION AND RECORDING EQUIPMENT USED FOR FLIGHT FLUTTER TESTS ON A METEOR 8. PART 2: COMPARATIVE FLIGHT FLUTTER TESTS USING THE DECAYING OSCILLATION AND AMPLITUDE RESPONSE TECHNIQUES
P. D. R. Luscombe and W. T. Kirkby *In* ARC Aerodyn. Res. Progr., including Turbine, Nozzle, Flutter, and Instrumentation Studies, Vol. 2 1971 p 899-930 refs Previously issued as RAE-TN-STRUCT-252; ARC-21056; RAE-STRUCT-248; ARC-21158
(ARC-R/M-3247; RAE-TN-STRUCT-252; ARC-21056; RAE-R-STRUCT-248; ARC-21158)

A description is given of the installation of a single linear inertia exciter and multichannel recording equipment which was fitted to a Meteor aircraft for use in the development of flight flutter test techniques. The installation was designed so that either amplitude response or damping measurements could be made. Typical records and results are illustrated and the accuracy and capabilities of the equipment are assessed. Author

N73-25027 National Physical Lab., Teddington (England). Aerodynamics Div.
MEASUREMENTS OF THE DIRECT PITCHING-MOMENT DERIVATIVES FOR TWO-DIMENSIONAL FLOW AT SUBSONIC AND SUPERSONIC SPEEDS AND FOR A WING OF ASPECT RATIO 4 AT SUBSONIC SPEEDS
J. B. Bratt, W. G. Raymer, and J. E. G. Townsend *In* ARC Aerodyn. Res. Progr., including Turbine, Nozzle, Flutter, and Instrumentation Studies, Vol. 2 1971 p 931-986 refs Previously issued as ARC-20714

(ARC-R/M-3257; ARC-20714)

Apparatus based on a self-excitation technique has been developed for the measurement of direct pitching-moment derivatives at high speeds, and has proved to function satisfactorily. Measurements have been made at subsonic speeds on a two-dimensional RAE 104 airfoil, both with and without spoilers, and on a rectangular wing of aspect ratio 4 with the same section; and at supersonic speeds (M = 1.42 and 1.61) on two-dimensional biconvex airfoils of 7.5 percent and 5 percent thickness. Comparisons with theory are made and discussed. Author

N73-25028 Ministry of Aviation, London (England).
SOME POSSIBLE EFFECTS OF TRANSONIC SPEEDS ON WING-AILERON FLUTTER
E. G. Broadbent and E. Violet Hartley *In* ARC Aerodyn. Res. Progr., including Turbine, Nozzle, Flutter, and Instrumentation Studies, Vol. 2 1971 p 987-1000 refs Previously issued as RAE-TN-STRUCT-258; ARC-21055

(ARC-R/M-3258; RAE-TN-STRUCT-258; ARC-21055)

Ternary calculations between wing bending, wing torsion, and aileron rotation for a typical wing-aileron configuration were made. The results are plotted as graphs of flutter speed against aileron frequency and the effects of changes in aerodynamic derivatives such as might occur at transonic speeds. It was found that the derivative changes are first in direct aerodynamic damping on the aileron and then all stability derivatives and second an aft shift of wing aerodynamic center and aileron aerodynamic center, separately and together. Author

N73-25029 Ministry of Aviation, London (England).
A PROPOSED APPARATUS FOR MEASURING OSCILLATORY AERODYNAMIC DERIVATIVES c14
L. H. G. Sterne *In* ARC Aerodyn. Res. Progr., including Turbine, Nozzle, Flutter, and Instrumentation Studies, Vol. 2 1971 p 1001-1006 Previously issued as RAE-TN-Aero-2656; ARC-14227
(ARC-R/M-3260; RAE-TN-Aero-2656; ARC-14227)

The principles involved in designing an apparatus, including a half-model of an aircraft, for measuring longitudinal oscillatory aerodynamic derivatives in a high speed wind tunnel. The model is to be oscillated in pitch about two axes, one near the leading edge and one near the trailing edge. The use of a floating raft for measuring the alternating aerodynamic force on the model is discussed. Author

N73-25030 Aeronautical Research Council, London (England).
WIND TUNNEL TESTS AND THEORETICAL INVESTIGATIONS ON THE EFFECT OF A LOCALIZED MASS ON THE FLUTTER OF A DELTA WING WITH FIXED ROOT
G. F. Donno *In its* Aerodyn. Res. Progr., including Turbine, Nozzle, Flutter, and Instrumentation Studies, Vol. 2 1971 p 1007-1076 refs Previously issued as ARC-21234

(ARC-R/M-3264; ARC-21234)

Wind tunnel tests and theoretical investigations have been carried out to study the effect of a localized mass on the flutter characteristics of a delta wing. The experimental work covered a wide range of spanwise and chordwise positions of the mass c.g., variation of the magnitude and radius of gyration of the mass itself, and the effect of the stiffness distribution of the wing. The theoretical work was more limited in its scope and was primarily intended to investigate the reliability of the theoretical approach to this kind of problem. These investigations have shown that the flutter characteristics of a delta wing carrying a localized mass are primarily dependent on the location of the mass, its magnitude and the stiffness distribution of the wing itself. The flutter speed with a localized mass judiciously placed may be from three to four times that obtained with the same mass in a bad position. A localized mass in the region around the structural axis generally has an adverse effect on the flutter characteristics, while locations well aft, towards the trailing edge, are usually favourable. Particularly high flutter speeds are often associated with a localized mass close to the leading edge, but some caution is necessary, especially around the mid-span position, as the flutter characteristics in this region are very sensitive to variations in actual mass. Author

N73-25031 Ministry of Supply, London (England).
EFFECTS OF WING STIFFNESS AND INERTIA CHANGES ON THE MODES AND FREQUENCIES OF MODEL DELTA AIRCRAFT
D. R. B. Webb *In* ARC Aerodyn. Res. Progr., including Turbine, Nozzle, Flutter, and Instrumentation Studies, Vol. 2 1971 p 1077-1092 refs Previously issued as RAE-STRUCT-245; ARC-21290
(ARC-R/M-3268; RAE-R-STRUCT-245; ARC-21290)

Resonance tests were made on a model delta aircraft to investigate the effect of stiffness changes of the leading- and trailing-edge spars on the frequencies and modes of vibration of the model. The results showed that, although considerable frequency changes were apparent, the general shape of the modes of vibration did not change significantly. A criterion of modal orthogonality proved to be very useful in checking the purity of the modes. Author

N73-25032 Ministry of Aviation, London (England).
THE LOADING OF HELICOPTER ROTOR BLADES IN FORWARD FLIGHT
M. A. P. Willmer *In* ARC Aerodyn. Res. Progr., including Turbine, Nozzle, Flutter, and Instrumentation Studies, Vol. 2 1971 p 1093-1136 refs Supersedes RAE-NAVAL-2; ARC-21233

(ARC-R/M-3318; RAE-R-NAVAL-2; ARC-21233)

A method is described for calculating the spanwise loading

of helicopter rotor blades in forward flight at various azimuth angles. The method is an extension of Glauert's lifting-line theory. The problem is reduced to solving a series of simultaneous linear equations and the computations were performed by an electronic digital computer. Theoretical results obtained by this method for tip speed ratios of 0.08, 0.15 and 0.29 show considerably better agreement with experimental results than that obtained by previous methods. The report also shows how the theory may be used to calculate the vertical forces transmitted by the blades to the rotor hub. Author

N73-25043 Ministry of Aviation, London (England).
ON THE DESIGN OF WING-BODY COMBINATIONS OF LOW ZERO-LIFT DRAG RISE AT TRANSONIC SPEEDS
W. T. Lord *In* ARC Aerodyn. Res. Progr., including Turbine, Nozzle, Flutter, and Instrumentation Studies, Vol. 2 1971 p 1381-1426 refs Previously issued as ARC-22503

(ARC-R/M-3279; ARC-22503)

The design of wing-body combinations of low zero-lift drag rise at transonic speeds is discussed. The use of the sonic area rule to obtain the desired design parameters is analyzed. Results for several optimum area distributions for minimum drag jump are given, specific examples of the optimum wing-body design are included. Author

N73-25045*# Aerophysics Research Corp., Bellevue, Wash.
AN IMPROVED METHOD FOR THE AERODYNAMIC ANALYSIS OF WING-BODY-TAIL CONFIGURATIONS IN SUBSONIC AND SUPERSONIC FLOW. PART 1: THEORY AND APPLICATION
F. A. Woodward Washington NASA May 1973 129 p refs 2 Vol.
(Contract NAS1-10408)
(NASA-CR-2228-Pt-1) Avail: NTIS HC $3.00 CSCL 01C

A new method has been developed for calculating the pressure distribution and aerodynamic characteristics of wing-body-tail combinations in subsonic and supersonic potential flow. A computer program has been developed to perform the numerical calculations. The configuration surface is subdivided into a large number of panels, each of which contains an aerodynamic singularity distribution. A constant source distribution is used on the body panels, and a vortex distribution having a linear variation in the streamwise direction is used on the wing and tail panels. The normal components of velocity induced at specified control points by each singularity distribution are calculated and make up the coefficients of a system of linear equations relating the strengths of the singularities to the magnitude of the normal velocities. The singularity strengths which satisfy the boundary condition of tangential flow at the control points for a given Mach number and angle of attack are determined by solving this system of equations using an interactive procedure. Once the singularity strengths are known, the pressure coefficients are calculated, and the forces and moments acting on the configuration determined by numerical integration. Author

N73-25046*# Aerophysics Research Corp., Bellevue, Wash.
AN IMPROVED METHOD FOR THE AERODYNAMIC ANALYSIS OF WING-BODY-TAIL CONFIGURATIONS IN SUBSONIC AND SUPERSONIC FLOW. PART 2: COMPUTER PROGRAM DESCRIPTION
F. A. Woodward Washington NASA May 1973 316 p ref 2 Vol.
(Contract NAS1-10408)
(NASA-CR-2228-Pt-2) Avail: NTIS HC $6.00 CSCL 01C

A new method has been developed for calculating the pressure distribution and aerodynamic characteristics of wing-body-tail combinations in subsonic and supersonic potential flow. A computer program has been developed to perform the numerical calculations. The configuration surface is subdivided into a large number of panels, each of which contains an aerodynamic singularity distribution. A constant source distribution is used on the body panels, and a vortex distribution having a linear variation in the streamwise direction is used on the wing and tail panels. The normal components of velocity induced at specified control points by each singularity distribution are calculated and make up the coefficients of a system of linear equations relating the strengths of the singularities to the magnitude of the normal velocities. The singularity strengths which satisfy the boundary condition of tangential flow at the control points for a given Mach number and angle of attack are determined by solving this system of equations using an interactive procedure. Once the singularity strengths are known, the pressure coefficients are calculated, and the forces and moments acting on the configuration determined by numerical integration. Author

N73-25047*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AERODYNAMIC CHARACTERISTICS OF A VECTORED-THRUST V/STOL FIGHTER IN THE TRANSITION SPEED RANGE
Raymond E. Mineck (Army Air Mobility R and D Lab., Hampton, Va.) and Myles F. Schwendemann (Northrop Corp., Hawthorne, Calif.) Washington May 1973 181 p refs
(NASA-TN-D-7191; L-8457) Avail: NTIS HC $3.00 CSCL 01C

A wind-tunnel investigation was conducted with a vectored-thrust V/STOL fighter configuration. The model was equipped with two nacelle-mounted vectored-thrust jet simulators and one lift-jet simulator. The vectored-thrust jet could be tested at two alternate longitudinal positions and three nozzle deflection angles. The vectored-thrust configuration with the rear nozzles showed an increase in lift and a decrease in pitching moment when compared with the forward nozzles. The rear nozzles also improve stall characteristics. Author

N73-25048*# Nielsen Engineering and Research, Inc., Mountain View, Calif.
DEVELOPMENT OF A NONLINEAR UNSTEADY TRANSONIC FLOW THEORY
Stephen S. Stahara and John R. Spreiter (Stanford Univ., Calif.) Washington NASA Jun. 1973 47 p refs
(Contract NAS1-11567)
(NASA-CR-2258; NEAR-TR-46) Avail: NTIS HC $3.00 CSCL 20D

A nonlinear, unsteady, small-disturbance theory capable of predicting inviscid transonic flows about aerodynamic configurations undergoing both rigid body and elastic oscillations was developed. The theory is based on the concept of dividing the flow into steady and unsteady components and then solving, by method of local linearization, the coupled differential equation for unsteady surface pressure distribution. The equations, valid at all frequencies, were derived for two-dimensional flows, numerical results, were obtained for two classses of airfoils and two types of oscillatory motions. Author

N73-25049*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
FLIGHT-MEASURED X-24A LIFTING BODY CONTROL SURFACE HINGE MOMENTS AND CORRELATION WITH WIND TUNNEL PREDICTIONS
Ming H. Tang and George P. E. Pearson Washington Jun. 1973 38 p refs
(NASA-TM-X-2816; H-748) Avail: NTIS HC $3.00 CSCL 01B

Control-surface hinge-moment measurements obtained in the X-24A lifting body flight-test program are compared with results from wind-tunnel tests. The effects of variations in angle of attack, angle of sideslip, rudder bias, rudder deflection, upper-flap deflection, lower-flap deflection, Mach number, and rocket-engine operation on the control-surface hinge moments are presented. In-flight motion pictures of tufts attached to the inboard side of the right fin and the rudder and upper-flap surfaces are discussed. Author

N73-25051# Aeronautical Research Inst. of Sweden, Stockholm.
DISK APPROXIMATION FOR A HELICOPTER ROTOR IN FORWARD FLIGHT
Bo C. A. Johansson Jul. 1972 66 p refs Sponsored in part by Swed. Board for Tech. Develop.
(FFA-123) Avail: NTIS HC $5.50; Almqvist and Wiksell, Stockholm Sw.Kr. 35

A theory for calculating the induced velocity distribution of a helicopter rotor in forward flight was developed. The rotor is approximated by an actuator disk of continuous thrust and in-plane force distributions, which are assumed to be known. Its wake is represented by a semi-infinite cylinder of distributed vorticity. Also suggested is a method of using this theory to solve the full rotor problem, when the inflow data are given but the force distribution is unknown. A numerical example applied to a rotor with blades without torsion and with constant chord is calculated. ESRO

N73-25053# ARO, Inc., Arnold Air Force Station, Tenn.
WIND TUNNEL INVESTIGATION OF THE PRESSURE DISTRIBUTION ON A TWO DIMENSIONAL AIRFOIL WITH PYLON MOUNTED STORES AT MACH NUMBERS FROM 0.7 TO 0.95 Final Report
D. K. Smith AEDC Apr. 1973 145 p
(AD-759582; ARO-PWT-TR-73-27; AEDC-TR-73-71; AFATL-TR-73-75) Avail: NTIS CSCL 20/4

A wind tunnel test was conducted to determine pressure distributions on a two-dimensional airfoil with pylon-mounted stores at Mach numbers from 0.70 to 0.95 and angles of attack from 0 to 14 deg. Four geometrically similar pylon-mounted stores differing in diameter by a factor of about four and four pylons differing in height were tested. Pressure distributions on the airfoil were obtained for the clean airfoil configuration and 12 pylon/store combinations. The pressure distributions were integrated and the lift, drag, and pitching-moment coefficients for the airfoil are presented. Total pressure wake surveys and oil flow photographs were also obtained for the test, and typical data are presented. Author (GRA)

N73-25054# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
WEIGHT OPTIMIZATION OF SOLID BEAMS WITH DYNAMIC CONSTRAINTS M.S. Thesis
Floyd W. Isley Mar. 1973 74 p refs
(AD-759169; GAW/MC/73-9) Avail: NTIS CSCL 01/3

The mass distribution of solid beams and panels is optimized to produce a weight savings while maintaining a dynamic constraint. The basic procedure used in solving the problems is the transition matrix method, a numerical technique of optimization adapted from optimal control theory. The weight of a solid beam of rectangular cross section is shown to be reduced from that of a beam of uniform thickness by ten percent. The weight savings was accomplished by varying the thickness while insuring that the beam with the optimal thickness had the same fundamental frequency as the beam of uniform thickness. (Author Modified Abstract) GRA

N73-25055 Purdue Univ., Lafayette, Ind.
A SIMULATION OF A LINEAR OPTIMAL DIGITAL AUTOPILOT CONTROLLING A STOL AIRCRAFT Ph.D. Thesis
Franklin DeLoe Farrington 1972 188 p
Avail: Univ. Microfilms Order No. 72-30891

An air traffic control scheme is developed which allows airport landing patterns along curved approach trajectories. The particular problems attacked are the required data to be transmitted from ground control to the aircraft, the type of curved trajectory feasible, and the on-board control system requirements for accurate maintenance of prescribed trajectories during adverse weather conditions. The data requirements are developed, the curved approach proposed is a sequence of straight lines and circular arcs with the three spatial dimensions and time specified at each point of tangency, and the control system is a digital realization of a linear optimal estimator and controller. Dissert. Abstr.

N73-25057*# Kanner (Leo) Associates, Redwood City, Calif.
COMFORTABLE TRAVEL ON 11 'COUNTRY ROUTES'
K. H. Eyermann Washington NASA Jun. 1973 17 p Transl. into ENGLISH from Tech.-Okonomische Inform. Zivilen Luftfahrt (West Germany), v. 8, no. 8, 1972 p 356-363 Sponsored by NASA
(NASA-TT-F-14943) Avail: NTIS HC $3.00 CSCL 01C

The Yak-40 - a short-haul (865-1600 km), twin-jet aircraft designed particularly for service in isolated areas of the U.S.S.R. and capable of landing on small airfields without concrete runways, is discussed. The Yak-40 features bypass jet turbines, rear-mounted engines, and a T tail section coupled with the conventional large-aspect-ratio delta wing, all-surface landing gear, and ease of maintenance of the Li-2 and Il-14 propeller aircraft which it replaces. The Yak-40 can take off from airstrips only 340-360 meters long, has takeoff and landing speeds of 160 and 150 km/hr, respectively, and has fast climbing ability. The Yak-40 is equipped with all the instrumentation required for allweather flight, including an onboard computer and radar with a range of up to 350 km. Author

N73-25058# Royal Netherlands Aircraft Factories Fokker, Amsterdam.
RATIONAL CALCULATION OF DESIGN GUST LOADS IN RELATION TO PRESENT AND PROPOSED AIRWORTHINESS REQUIREMENTS
J. Yff [1972] 13 p refs Presented at AGARD Symp. Flight in Turbulence, Bedfordshire, Engl.
(Fok-K66) Avail: NTIS HC $3.00

Accurate gust load calcuations for three short haul aircraft were used to compare: (1) PSD are discrete gust methods, (2) PSD mission analysis and design envelope results, and (3) PSD results for vertical and lateral gusts. These data are also used to study in detail problems of T-tails. Author

N73-25059# Cranfield Inst. of Technology (England).
A PERFORMANCE TEST SURVEY OF THE AERODYNAMIC DEVELOPMENT OF THE SLINGSBY T51 DART SAILPLANE
H. A. Torode Feb. 1973 21 p refs
(Cranfield-Aero-16) Avail: NTIS HC $3.25

Comparison is drawn between performance test data gathered from several variants of the Slingsby T51 Dart sailplane as tested during 1964/5 and also from other contemporary sources. In each case an identical statistical approach has been used in the data analysis. The data shows excellent correllation both between the aerodynamic variants tested and also between the Cranfield tests and those from elsewhere, and has enabled useful conclusions on the aerodynamic development of the Dart to be drawn. Performance testing is considered to be economic means whereby a manufacturer may monitor the development of his product. Author

N73-25060# Cranfield Inst. of Technology (England). Structural and Aerospace Dynamics Group.
ANALYSIS OF TAXIING INDUCED VIBRATIONS IN AIRCRAFT BY THE POWER SPECTRAL DENSITY METHOD.
C. L. Kirk Feb. 1973 38 p refs
(Contract F44620-71-C-0084)
(Cranfield-Aero-15) Avail: NTIS HC $4.00

The root mean square (r.m.s.) center of gravity accelerations and undercarriage forces are determined for a KC-135 tanker aircraft taxiing on a randomly rough runway surface at various speeds up to 260 ft/sec. The maximum r.m.s. acceleration was found to be 0.32g at a taxiing speed of 210 ft/sec. Tire deformations were found to be of the order of 0.6 in r.m.s., and strut displacements were about 0.34 in r.m.s. The maximum forces in the tires and struts were found to be almost identical and equal to about 10% of the static load on the main undercarriage. Author

N73-25061# Royal Netherlands Aircraft Factories Fokker, Schiphol-Oost. Manufacturing Research and Product Development Dept.

ADHESIVE BONDING IN THE FOKKER-VFW F-28 FELLOWSHIP
Rob J. Schliekelmann Feb. 1973 15 p
Avail: NTIS HC $3.00

The various design aspects of the adhesive bonding components, as well as the adhesive bonding processes and quality control methods used in constructing the Fokker F-28 Fellowship aircraft are given. The F-28 is designed for economical short haul operations and must have the following structural characteristics: (1) long crack free life, (2) fail safe design, (3) high durability under severe operational conditions, and (4) ample accessability for inspection of the structure and its installations. E.H.W.

N73-25062*# Battelle Columbus Labs., Ohio.
EFFECTIVENESS EVALUATION OF STOL TRANSPORT OPERATIONS Final Report
Ellis F. Hitt, Juergen M. H. Bruckner, Vincent J. Drago, Ronald A. Brown, Fred G. Rea, and Richard F. Porter 20 Feb. 1973 296 p refs
(Contract NAS2-6889)
(NASA-CR-114631) Avail: NTIS HC $17.00 CSCL 01C

A short-takeoff and landing (STOL) systems simulation model has been developed and implemented in a computer code (known as STOL OPS) which permits evaluation of the operation of a STOL aircraft and its avionics in a commercial airline operating environment. STOL OPS concentrated on the avionics functions of navigation, guidance, control, communication, hazard avoidance, and systems management. External world factors influencing the operation of the STOL aircraft include each airport and its geometry, air traffic at each airport, air traffic control equipment and procedures, weather (including winds and visibility), and the flight path between each airport served by the route. The development of the STOL OPS program provides NASA a set of computer programs which can be used for detailed analysis of a STOL aircraft and its avionics and permit establishment of system requirements as a function of airline mission performance goals. Author

N73-25063*# Case Western Reserve Univ., Cleveland, Ohio. School of Engineering.
AUTOMATED DESIGN OPTIMIZATION OF SUPERSONIC AIRPLANE WING STRUCTURES UNDER DYNAMIC CONSTRAINTS
Richard L. Fox, Hirokazu Miura (Tech. Univ. of Norway), and Singiresu S. Rao (Indian Inst. of Tech.) Oct. 1972 20 p refs Backup document for AIAA Synoptic scheduled for publication in Journal of Aircraft in June 1973
(Grant NGR-36-003-002)
(NASA-CR-112319) Avail: NTIS HC $3.00 CSCL 01C

The problems of the preliminary and first level detail design of supersonic aircraft wings are stated as mathematical programs and solved using automated optimum design techniques. The problem is approached in two phases: the first is a simplified equivalent plate model in which the envelope, planform and structural parameters are varied to produce a design, the second is a finite element model with fixed configuration in which the material distribution is varied. Constraints include flutter, aeroelastically computed stresses and deflections, natural frequency and a variety of geometric limitations. Author

N73-25064# National Transportation Safety Board, Washington, D.C.
AIRCRAFT ACCIDENT REPORTS: BRIEF FORMAT US CIVIL AVIATION, ISSUE NO. 2 OF 1972 ACCIDENTS
3 Apr. 1973 518 p
(NTSB-BA-73-3) Avail: NTIS HC $28.00

Selected aircraft accident reports, in brief format, occurring in U.S. Civil Aviation operations during calendar year 1972 are presented. The 899 General Aviation accidents contained in this publication represent a random selection. This publication is issued irregularly, normally six times each year. The brief format presents the facts, conditions, circumstances, and probable causes for each accident. Additional statistical information is tabulated by type of accident, phase of operation, kind of flying, injury index, aircraft damage, conditions of light, pilot certificate, injuries, and causal factors. Author

N73-25065*# Lockheed-California Co., Burbank.
QUIET TURBOFAN STOL AIRCRAFT FOR SHORT HAUL TRANSPORTATION, VOLUME 1 Final Report
J. H. Renshaw 14 Jun. 1973 690 p refs 2 Vol.
(Contract NAS2-6995)
(NASA-CR-114612) Avail: NTIS HC $36.25 CSCL 01C

The characteristics for a quiet turbofan short takeoff aircraft for short haul transportation applications are discussed. The following subjects are examined: (1) representative aircraft configurations, characteristics, and costs associated with the short haul aircraft development and operation, (2) critical technology and technology related problems to be resolved in successful introduction of representative short haul aircraft, (3) relationships between quiet short takeoff aircraft and the economic and social viability of short haul, and (4) identification of high payoff technology areas. In order to properly evaluate the candidate aircraft designs and to determine their economic viability and community acceptance, a real world scenario was developed and projected to 1990. Author

N73-25066*# Lockheed-California Co., Burbank.
QUIET TURBOFAN STOL AIRCRAFT FOR SHORT HAUL TRANSPORTATION, VOLUME 2 Final Report
J. H. Renshaw 14 Jun. 1973 655 p refs 2 Vol.
(Contract NAS2-6995)
(NASA-CR-114613) Avail: NTIS HC $34.75 CSCL 01C

The characteristics for a quiet turbofan short takeoff aircraft for short haul transportation applications are discussed. The following subjects are examined: (1) representative aircraft configurations, characteristics, and costs associated with the short haul aircraft development and operation, (2) critical technology and technology related problems to be resolved in successful introduction of representative short haul aircraft, (3) relationships between quiet short takeoff aircraft and the economic and social viability of short haul, and (4) identification of high payoff technology areas. In order to properly evaluate the candidate aircraft designs and to determine their economic viability and community acceptance, a real world scenario was developed and projected to 1990. Author

N73-25067*# Scripta Technica, Inc., Washington, D.C.
GRID PLANNING AND MANAGEMENT IN AIR TRANSPORT
A. V. Miroshnikov, A. S. Kravets, and A. N. Zhizhnyak NASA May 1973 119 p refs Transl. into ENGLISH of the book "Setevoye Planirovaniye i Upravleniye na Vozdushnom Transporte" Moscow, Transport Press, 1971 112 p
(Contract NASw-2036)
(NASA-TT-F-742) Avail: NTIS HC $3.00 CSCL 05C

The essentials, importance, range of application, and advantages of grid planning and management (U.S. usage: PERT (Program Evaluation and Review Technique)) systems as applied to air transport are presented. The basic concepts of the grid planning and management system are set forth and the rules for construction of various types of grid diagrams (U.S. usage: critical diagrams or PERT charts) and the procedure for calculation of their parameters are described. Methods of optimizing grid models and operations-management methods in work from grid diagrams in civil aviation are reported. Author

N73-25068*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
WIND TUNNEL INVESTIGATION OF STATIC LONGITUDINAL AND LATERAL CHARACTERISTICS OF A FULL SCALE MOCKUP OF A LIGHT SINGLE ENGINE HIGH WING AIRPLANE
H. Douglas Greer, James P. Shivers, Marvin P. Fink, and C. Robert Carter (Army Air Mobility Res. and Develop. Lab.) Washington May 1973 158 p refs

(NASA-TN-D-7149; L-8682) Avail: NTIS HC $3.00 CSCL 01C

The model was a full-scale mockup of a light single-engine high-wing monoplane. Tests were made over an angle-of-attack range of -4 deg to 24 deg and over a sideslip range of plus or minus 8 deg at thrust coefficients of 0, 0.14, and 0.30. Control effectiveness and hinge moments were taken on the aileron, elevator, and rudder for a full range of deflections. Downwash measurements at the tail were obtained for the range of thrust coefficient and flap deflection. Author

N73-25069*# Scripta Technica, Inc., Washington, D.C.
THE ECONOMICS OF AIR TRANSPORT
N. N. Gromov, Ye. V. Mukhordykh, Ye. A. Ovrutskiy, G. A. Parsegov, B. M. Parakhonskiy, Ya. I. Prutkin, and L. A. Tsekhanovich NASA May 1973 265 p refs Transl. into ENGLISH of the book "Ekonomika Vozdushnogo Transporta" Moscow, Transport Press, 1971 p 1-245
(Contract NASw-2036)
(NASA-TT-F-741) Avail: NTIS HC $3.00 CSCL 05C

A brief exposition of the basic problems of air-transport economics is presented. On the basis of analysis of a large amount of factual material and generalization of scientific data, the authors cast light on the basic economic patterns in the development of air transport. Problems of increasing the efficiency of air-transport utilization and improving management and planning occupy a central position in the book in accord with the resolutions of the September (1965) Plenary Session of the Central Committee of the Communist Party of the Soviet Union (CC CPSU), the Twenty-Third Party Congress, and the December (1969) Plenary Session of the CC CPSU. Areas requiring improvement are brought out in analyses of specific problems, and prospects for the development of air transport are set forth. Author

N73-25070*# Bell Helicopter Co., Fort Worth, Tex.
FULL SCALE HOVER TEST OF A 25 FOOT TILT ROTOR
S. Helf, E. Broman, S. Gatchel, and B. Charles 16 May 1973 135 p refs
(Contract NAS2-7308)
(NASA-CR-114626; Rept-300-099-010) Avail: NTIS HC $8.75 CSCL 01A

The tilt rotor underwent a hover performance test on the Aero Propulsion Laboratory whirl stand at Wright-Patterson Air Force Base. The maximum thrust over density ratio measured at the design tip speed of 740 feet per second was 10,016 pounds. This occurred when the power over density ratio was 1721 horsepower. At the hover overspeed rpm, the thrust and power, over density ratio, were 11,008 pounds and 1866 horsepower. During the test, the maximum measured thrust coefficient was 0.177, and the rotor figure of merit exceeded 0.81. Measured lifting efficiency was 8.35 pounds per horsepower at the thrust a 13,000-pound aircraft would require for hover at sea level on a standard day. No effect of compressibility on performance is discernible in the test results (the range of tip Mach numbers tested was 0.55 to 0.71). Author

N73-25071# Defence and Civil Inst. of Environmental Medicine, Downsview (Ontario). Behavioural Sciences Div.
REAR COCKPIT RECONFIGURATION OF THE CF100 EW AIRCRAFT
Leslie G. Innes Dec. 1972 12 p
(DCIEM-904) Avail: NTIS HC $3.00

The CF100 aircraft is to be re-equipped with new avionics in the rear (navigators) cockpit for upgrading its electronics warfare training capability. Human engineering assistance was provided during the cockpit reconfiguration stage, and a full-scale mock-up, prepared to test the feasibility of specific equipment layouts, demonstrated the recommended configuration. Author

N73-25074# Royal Aircraft Establishment, Farnborough (England).
A COMPUTER PROGRAM FOR CALCULATING FLIGHT PROFILES OF CONCORDE
V. Hilary Mitchell Oct. 1972 36 p refs
(RAE-TR-72102; BR-32220) Avail: NTIS HC $4.00

A computer program which can calculate flight profiles of a Concorde for a variety of flight procedures and atmospheric conditions was written. The layout and capabilities of the program are described and detailed instructions for the preparation of its data, which consists of a series of descriptive phrases, are given. Author (ESRO)

N73-25075# Aeronautical Systems Div., Wright-Patterson AFB, Ohio.
COMPUTER PROGRAMS FOR COMPUTATIONAL ASSISTANCE IN THE DESIGN OF AIRCRAFT CONTROL SYSTEMS Technical Report, Jun. - Sep. 1971
Henry J. McGlynn Dec. 1972 191 p refs
(AD-758781; ASD-TR-72-112) Avail: NTIS CSCL 01/3

A package of FORTRAN subroutines capable of generating aircraft transfer functions in six degrees of freedom is presented. Considerable flexibility is afforded in the specification of the reference condition and the vehicle aerodynamic, inertial, and geometric properties. The package is designed to be used with a main program defining the particular system configuration under study. The package has been prepared for use on the CDC 6600, the IBM 7090/7094, and the IBM 360 computers. The report includes program listings. GRA

N73-25076# Technology, Inc., Dayton, Ohio.
T-38 STRUCTURAL FLIGHT LOADS DATA FOR JUNE 1970 - DECEMBER 1971 Final Report, 1 Jun. 1970 - 31 Mar. 1972
Larry E. Clay and Ronald I. Rockafellow Wright-Patterson AFB, Ohio ASD Apr. 1973 148 p refs
(Contracts F33657-70-D-1161; F33657-71-D-0662)
(AD-758891; ASD-TR-72-54) Avail: NTIS CSCL 01/3

In a fifth part of a continuing T-38 Service Loads Recording Program (SLRP) to cover the period from 1 June 1970 through 31 December 1971, 4265 hours of VGH data were recorded by A/A24U-10 magnetic tape recording systems installed in twenty-eight T-38 aircraft: 22 fleet and 6 lead-the-force T-38's operating from Williams, Reese, and Moody Air Force Bases. As in previous reports, the data presentation includes curves showing normal load factor (nz) exceedances above each nz level per thousand flight hours. Only one nz exceeded 7.8 (design limit is 7.33), and the comparison of the exceedance curves for the current and previous programs substantiated that the T-38 nz spectrum had remained unchanged during the T-38 SLRP. (Author Modified Abstract) GRA

N73-25077# Army Foreign Science and Technology Center, Charlottesville, Va.
TAXIING ABILITY OF AN AIRCRAFT ON EARTH
A. A. Degtyarev 11 Aug. 1972 12 p Transl. into ENGLISH from Vestn. Protivovozovshanoi Oporony (Moscow), no. 8, 1965 p 61-66
(AD-756588; FSTC-HT-23-335-72) Avail: NTIS CSCL 01/5

The useability of an aircraft for flights from dirt strips is characterized primarily by its taxiing ability, i.e. its ability to start up from a stop using its engine, accelerate and separate from the ground within the limits of the runway. The track which the aircraft leaves must not be deeper than a certain permissible limit. Calculations of taxiing ability are required for selection and maintenance of dirt air strips and determination of the possibility of performing flights from the strips. The article studies the influence of the characteristics of the aircraft and soil on taxiing ability and the method of calculating taxiing ability. Author (GRA)

N73-25078# National Transportation Safety Board, Washington, D.C.
AIRCRAFT ACCIDENTS REPORTS: BRIEF FORMAT. US

CIVIL AVIATION, ISSUE NO. 4 OF 1971 ACCIDENTS
29 Sep. 1972 513 p
(PB-214412/9; NISB-BA-72-7) Avail: NTIS HC $6.00 CSCL 01B

The publication contains selected aircraft accident reports, in brief format, occurring in U.S. Civil Aviation operations during calendar year 1971. The 899 General Aviation accidents represent a random selection. The publication is issued irregularly, normally six times each year. The brief format presents the facts, conditions, circumstances, and probable cause(s) for each accident. Additional statistical information is tabulated by type of accident, phase of operation, kind of flying, injury index, aircraft damage, conditions of light, pilot certificate, injuries, and causal factors.
Author (GRA)

N73-25079# National Academy of Sciences - National Research Council, Washington, D.C. Environmental Studies Board.
BIOLOGICAL IMPACT OF INCREASED INTENSITIES OF SOLAR ULTRAVIOLET RADIATION Final Report
Kendric C. Smith Feb. 1973 54 p refs
(Contract DOT-OS-00035)
(PB-215524/0; LC-72-13835) Avail: NTIS HC $4.50 CSCL 01C

The possible environmental impacts of a future fleet of supersonic transport (SST) aircraft has become a topic of intense national interest. One of the possibilities discussed was that emissions from SST aircraft might reduce the amount of ozone in the upper atmosphere and thereby lead to an increase in solar ultraviolet (UV) radiation reaching the surface of the earth. The goals of this report are to review some of the known effects of ultraviolet radiation on man and other living organisms; assess, the consequences to man and other living organisms; identify those areas where knowledge is inadequate and where further research is urgently needed. Author (GRA)

N73-25080# Bolt, Beranek, and Newman, Inc., Canoga Park, Calif.
AIRCRAFT NOISE ANALYSES FOR THE EXISTING AIR CARRIER SYSTEM
1 Sep. 1972 296 p refs
(Contract CON-AAC-72-12)
(PB-215811/5; BBN-2218) Avail: NTIS HC $3.00 CSCL 01C

The objectives of this study were to develop a rational evaluation of the courses of action and costs to alleviate noise exposure in the vicinity of airports, taking into consideration reduction of aircraft noise at the source, the use of various aircraft operational procedures and various means for achieving noise compatible land use. This project utilizes a subset of 12 of these airports as a base to assess the effects of noise control of existing aircraft, new technology aircraft, flight operational variations, and land use conversion on the capital, social, and political costs for achieving a sensible balance between an acceptable noise environment and an expanded air transportation system. Author (GRA)

N73-25081# Booz-Allen Applied Research, Inc., Bethesda, Md.
SYSTEM SELECTION STUDY SYSTEMS EVALUATION TASK (TASK 360)
John Wing and Robert Weirich 9 Jun. 1972 145 p
(PB-215533/1) Avail: NTIS HC $5.45 CSCL 01B

The report describes three basic alternative national aviation systems and evaluation factors for each. As in all complex analyses, the approach taken to defining and evaluating these systems evolved as problems were identified and solved. This report reflects a finer-grained evaluation than originally contemplated. Systems were defined at a demand-center level, rather than solely at a national level. Author (GRA)

N73-25082# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECTS OF STRUCTURAL ELASTICITY ON THE ACCUMULATION OF FATIGUE DAMAGE
T. V. Pavelko 12 Apr. 1973 8 p refs Transl. into ENGLISH from Vopr. Elektromodelirovaniya Aviakonstruckt. (USSR), v. 196, no. 1, 1971 p 24-26
(AD-759634; FTD-HT-23-262-73) Avail: NTIS CSCL 01/3

The article examines the effect of wing elasticity on the repetition of stresses in the sections during flight in turbulence. The investigation was conducted on an electrical model of a heavy transport with straight wings. Author (GRA)

N73-25083# Aerospace Systems, Inc., Burlington, Mass.
A STUDY OF TECHNIQUES FOR REAL-TIME, ON-LINE OPTIMUM FLIGHT PATH CONTROL: MINIMUM-TIME MANEUVERS TO SPECIFIED TERMINAL CONDITIONS Final Technical Report, Aug. 1971 - Nov. 1972
William C. Hoffman and Arthur E. Bryson, Jr. Jan. 1973 48 p refs
(Contracts F44620-72-C-0001; N00014-67-A-0112-0063; AF Proj. 9769)
(AD-758799; ASI-TR-73-12; AFOSR-73-0553TR) Avail: NTIS CSCL 01/3

Some three-dimensional, minimum-time paths to a specified terminal line (or point), heading and energy are presented for an example supersonic aircraft. These paths were calculated using numerical solution techniques implemented in a digital computer program for the CDC-6600 computer. The optimum maneuvers have been determined using the calculus of variations and the energy-state approximation. These are compared with suboptimal solutions obtained using only three discrete values of bank angle. Constraints on thrust, Mach number, angle-of-attack, dynamic pressure and load factor are included. (Author Modified Abstract) GRA

N73-25084# Naval Air Development Center, Warminster, Pa. Air Vehicle Technology Dept.
STRUCTURAL INTEGRITY INVESTIGATION OF DELAMINATED F-4 CANOPIES IN SUPPORT OF THE ANALYTICAL REWORK PROGRAM Final Report
R. P. Swartz 29 Sep. 1972 54 p
(AD-759349; NADC-72179-VT) Avail: NTIS CSCL 01/3

Cyclic pressure tests, under various environmental conditions, were run on the F-4 forward and aft canopies to determine the safe life that could be expected after these canopies had suffered delamination damage of the acrylic sheet. Canopies having edge delaminations were initially tested for 17757 pressure cycles, the equivalent of 7102 hours of flight. Additional damage was then introduced by cutting 1/16 inch deep grooves into the canopy's surfaces. Results are discussed. (Author Modified Abstract) GRA

N73-25085# Loening (Grover), Key Biscayne, Fla.
[TECHNOLOGICAL POSSIBILITIES IN INERTIAL NAVIGATION, V/STOL, AND STOL AIRCRAFT, AND AIR TRAFFIC CONTROL FOR THE YEARS 1975 - 2000] Report to Chairman, Aviation Advisory Commission
Grover Loening 19 Apr. 1972 8 p
(PB-217102) Avail: NTIS CSCL 01B

An analysis of short takeoff aircraft design and development is presented. The subjects considered are: (1) aircraft performance requirements, (2) aircraft equipment for navigation, (3) airframe materials and construction, and (4) reduction of aircraft noise for greater acceptability. The air traffic control aspects of STOL and V/STOL aircraft operation during the period 1975 to 2000 are analyzed. P.N.F.

N73-25086# Bell Helicopter Co., Fort Worth, Tex.
SUMMARY OF DESIGN STUDIES AND RESULTS OF MODEL TESTS OF THE FOLDING-PROPROTOR AIRCRAFT CONCEPT Final Report
J. A. DeTore and E. L. Brown Wright-Patterson AFB, Ohio AFAL Jul. 1972 131 p refs
(Contract F33615-69-C-1578; AF Proj. 643A)

(AD-759534; AFFDL-TR-72-81) Avail: NTIS CSCL 01/3

Design studies and wind-tunnel test investigations were conducted to define preliminary designs of folding-proprotor VTOL aircraft for USAF rescue and transport missions and to identify and investigate technical risk areas. The aircraft had gross weights of 66,000 pounds and extended hover capability to 7,000 feet. Convertible fan-jet engines provided forward flight speeds to 452 knots with blades folded. Technical risk areas associated with the aircraft designs were found to be in areas of mechanisms, aerodynamics, stability and control, and dynamics. A dynamic wind-tunnel investigation, conducted with a semispan aeroelastic model, demonstrated successful continuous stop/fold/unfold/start sequences, and freedom from proprotor/pylon stability and blade flutter. (Author Modified Abstract) GRA

N73-25087# Minnesota Univ., Minneapolis. Dept. of Aerospace Engineering and Mechanics.

WIND TUNNEL FEASIBILITY STUDY OF AERODYNAMIC REEFING OF SUBSONIC PARACHUTES Final Report, Feb. 1970 - Aug. 1972

Helmut G. Heinrich and Robert A. Noreen May 1973 27 p refs

(Contract F33615-68-C-1227)

(AD-759209; AFFDL-TR-72-126) Avail: NTIS CSCL 01/3

The inflation characteristics of solid flat circular model parachutes with stiffness indices in the order of 1.17 and various annular slots were studied in a wind tunnel at velocities up to 265 fps. The amount of the geometric porosity was varied as well as the location of the annular slots. It was found that at a speed of 250 fps models with geometric porosities up to 18% inflated immediately, with porosities between 18% and 28% the models showed random inflation and collapsing, and at porosities of 28% and higher squidding or aerodynamic reefing was observed. The location of the slots did not influence the inflation characteristics significantly. The critical speed was established for a number of models; however, the conclusion was reached that more efforts have to be made in order to understand the mechanics of squidding to be able to take advantage of the principle of aerodynamic reefing for full scale design. Author (GRA)

N73-25088# Pennsylvania State Univ., University Park. Ordnance Research Lab.

THE INFLUENCE OF LEADING EDGE SERRATIONS ON THE NOISE RADIATION FROM A STATICALLY THRUSTING ROTOR M.S. Thesis

Robert T. Nagel 9 Aug. 1972 144 p refs

(Contract N00017-70-C-1407)

(AD-759028; TM-72-188) Avail: NTIS CSCL 01/3

The noise attenuation effects of leading edge serrations on rotors is studied in detail. Total radiated power, far-field SPL, directivity patterns, near-field sound characteristics, rotor slip stream and wake characteristics, and flow patterns have been compared with rotors with and without leading-edge devices. Near-field data were collected in a manner indicative of rotational noise components. A considerable noise reduction in the higher harmonics of rotational noise was detected. Thrust and torque data indicate that the addition of leading edge serrations results in a decrease in L/D. Hot wire data are analyzed. (Author Modified Abstract) GRA

N73-25089# Technion - Israel Inst. of Tech., Haifa. Dept. of Aeronautical Engineering.

THE CALCULATION OF THE LIFT DISTRIBUTION AND THE NEAR VORTEX WAKE BEHIND HIGH AND LOW ASPECT RATIO WINGS IN SUBSONIC FLOW

Josef Rom and Carlos Zorea Jan. 1973 109 p refs

(Grant AF-AFOSR-2145-71; AF Proj. 9781)

(AD-759262; TAE-168; AFOSR-73-0652TR; SR-2) Avail: NTIS CSCL 01/3

A method is presented for the combined calculation of the lift and lift distribution on a wing and also of the trailing vortex flow behind the wing. It is assumed that the lift of a wing is generated by a system of vortices distributed over the complete wing planform and shed away from each elemental area on the planform. Using the concepts of the vortex lattice method, it is assumed in the linear lift variation case, that the vortices are aligned on the wing planform and are shed away from the trailing edges. Vortex line interaction calculations for the trajectories of the vortex lines are programmed. As a result, the leading edge lift vortices which are obtained on slender wings can now be handled. This report contains a description of the numerical method. (Author Modified Abstract) GRA

N73-25090# Hough Lab., Springfield, Ohio.

UNIQUE FIBROUS FLAME ARRESTOR MATERIALS FOR EXPLOSION PROTECTION Final Technical Report, 20 Jun. - 20 Dec. 1972

Ralph L. Hough, Maro Lavy, and W. Marold Wright-Patterson AFB, Ohio AFAPL Dec. 1972 34 p refs

(Contract F33615-72-C-2153; AF Proj. 3048)

(AD-759193; AFAPL-TR-73-108) Avail: NTIS CSCL 01/3

A flame arrestor serves to prevent the propagation of a flame throughout a flammable media while allowing free passage of the media. Organic foams now being utilized in aircraft fuel cells as arrestors exhibit two serious limitations. These limitations are hydrolytic and thermal instability while in the fuel tank environment. A need exists for new arrestor materials which are more compatible with the currently operational fuel tank environment. In addition, it is desirable that such materials provide potential compatability with more severe environments which might exist in advanced flight vehicle fuel tanks. During the feasibility study, eighteen different combinations of materials and geometries were fabricated and examined for such properties as air flow and density, and compared to baseline polyurethane foam. Promising arrestors were identified by screening in the Hough Laboratory flame tube facility. Some of these arrestors show considerable promise with respect to low density, low cost, extreme resistance to degradation, and effectiveness as a flame arrestor. Author (GRA)

N73-25091# Calspan Corp., Buffalo, N.Y.

DIRECT SIDE FORCE CONTROL (DSFC) FOR STOL CROSSWIND LANDINGS Final Report, 1 May - 31 Dec. 1972

Edward M. Boothe and Howard J. Ledder Wright-Patterson AFB, Ohio AFFDL Feb. 1973 262 p refs

(Contract F33615-72-C-1712; AF Proj. 643A)

(AD-759555; AK-5148-F-1; AFFDL-TR-73-2) Avail: NTIS CSCL 01/2

The application of Direct Side Force Control (DSFC) during crosswind landings of an airplane having the characteristics of a Class II STOL was investigated in the USAF Total In-Flight Simulator (TIFS) airplane. The primary purpose was to evaluate the usefulness of DSFC during the crosswind landing. Other objectives were to investigate the type of cockpit controller or mechanization scheme for use with DSFC, and to define parameters which affect pilot workload during crosswind landings with DSFC. Landing approaches to simulated touchdown were flown both without and with the aid of DSFC. The approach speed was 130 knots. Two modes of DSFC control were investigated, an independent manual control of DSFC through a cockpit mounted thumbwheel proportional controller, and an automatic scheme which tracked the ILS localizer signal. (Author Modified Abstract) GRA

N73-25092# Air Force Weapons Lab., Kirtland AFB, N.Mex.

GULLS AND USAF AIRCRAFT HAZARDS Technical Report, 1 Sep. 1971 - 18 Jan. 1972

Rutherford C. Wooten, Jr., George E. Meyer, and Ronald J. Sobieralski Apr. 1973 43 p refs

(AD-759824; AFWL-TR-73-32) Avail: NTIS CSCL 01/2

Gulls are often identified in bird-aircraft collisions in the United States Air Force. A study was performed to determine the impact of gulls on the air mission and to determine the effective means available to reduce the number of strikes. Review

of the literature indicates that gull populations are increasing around the country. Unless positive steps are taken around the airport environment, the strike problem will increase. Control measures include habitat modifications, dispersal techniques, population control, and forecasting and avoidance.
Author (GRA)

N73-25093# Boeing Commercial Airplane Co., Seattle, Wash.
AIRCRAFT HYDRAULIC SYSTEM DYNAMICS Final Report, Jun. - Dec. 1972
Alvin W. Waterman, Arun K. Trikha, and Kenneth D. Groom Wright-Patterson AFB, Ohio Feb. 1973 58 p refs
(Contract F33615-72-C-1699; AF Proj. 3145)
(AD-757537; D6-41108; AFAPL-TR-73-2) Avail: NTIS CSCL 01/3

It is desirable to use computerized analysis techniques in place of costly ground testing and outmoded hand calculations as methods of analyzing aircraft hydraulic system dynamic performance. The current potential for accomplishing this objective was assessed to establish recommendations for future development. Criteria established as desirable features were the use of digital programming and building-block concepts in each of three technical areas (Transient Response, Frequency Response, and Thermal Analysis) needed to describe a composite of system performance. Basic development work was determined to be accomplished in all three technical areas, but in no area did these efforts meet the USAF objectives. Transient Response capability needs improvement to simulate frequency-dependent friction and cavitation characteristics. Frequency Response programming requires much improvement in the technique for analyzing pump/system interactions. Thermal Analysis steady-state analysis programming needs to be expanded to provide transient capability. These efforts are recommended to be accomplished in a coordinated 5-year program with continuous parallel effort being conducted in each of the three technical areas. These efforts involve evaluation of performance characteristics, development of programming subroutines, validation testing against typical aircraft system operational performance, and documentation of programming for general industry use.
Author (GRA)

N73-25094# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
AERODYNAMIC INTERFERENCE BETWEEN AN AIRCRAFT AND WING STORE M.S. Thesis
Larry N. Looney Mar. 1973 111 p refs
(AD-759170; GAW/MC/73-10) Avail: NTIS CSCL 01/3

Aerodynamic interference between an aircraft and wing store is studied by the use of analytical wing, fuselage, and store models. Inviscid flow is assumed and the Gothert transformation is used to correct for compressibility. An elliptic wing is represented by a bound vortex followed by a trailing vortex sheet. The fuselage and store are assumed to be slender bodies and modeled by a series of sources and doublets along their axis of revolution. Aerodynamic interference of the aircraft model is studied by observing the store in captive and free flight modes in the vicinity of the wing and fuselage models. The aerodynamic forces and moments experienced by the store as well as store trajectories are computed. Comparisons are made of store reactions (motion and trajectory) to only the wing model and to the wing and fuselage models combined. Author (GRA)

N73-25097*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
IMPROVED DESIGN OF A HIGH RESPONSE SLOTTED PLATE OVERBOARD BYPASS VALVE FOR SUPERSONIC INLETS
John A. Webb, Jr., Oral Mehmed, and Kirby W. Hiller Washington Jun. 1973 23 p refs
(NASA-TM-X-2812; E-7399) Avail: NTIS HC $3.00 CSCL 20D

The electrohydraulically actuated slotted-plate bypass valve used to control the position of the normal shock during wind-tunnel investigations of supersonic inlets also has proven to be a valuable device for determining inlet dynamics and creating airflow disturbances. Operation of previous valves at high frequencies (to 100 Hz) for extended testing has resulted in numerous failures. An improved bypass-valve design is presented which increases the cyclic tolerance of the device considerably over past designs. The use of dynamic limit criteria to obtain an optimum actuator-piston size results in a frequency response which is flat within + or - 3 decibels to 120 Hz for a peak-to-peak variation of 20 percent of full area. Author

N73-25162 Maryland Univ., College Park.
RESOLUTION IN FREQUENCY-MODULATED RADARS Ph.D. Thesis
Louis Mario Tozzi 1972 183 p
Avail: Univ. Microfilms Order No. 72-28878

The fundamental principles of frequency-modulated radar systems are developed in terms of a generic system. Several practical embodiments of radars and altimeters are reviewed which illustrate practical ways of extracting range and velocity information. The post-mixing spectrum resulting from the use of sine-wave, triangular, and sawtooth frequency modulation is derived in detail, and the spectra produced by both single and double-point targets are shown. Based on this analysis, triangular and sawtooth modulated systems are described which extract range and velocity information by observing individual post-mixing spectral lines, and a method is presented for determining the direction of motion of targets by observing the post-mixing signals produced by sawtooth modulation. This analysis is then extended to describe a technique for the suppression of range side lobes by using multiple modulation functions. Dissert. Abstr.

N73-25178# Lincoln Lab., Mass. Inst. of Tech., Lexington.
ATC SURVEILLANCE/COMMUNICATION ANALYSIS AND PLANNING Quarterly Technical Summary, 1 Dec. 1972 - 28 Feb. 1973
1 Mar. 1973 30 p refs
(Contracts DOT-FA72WAI-242; F19628-70-C-0230; FAA Proj. 022-243-012; FAA Proj. 033-241-062)
(FAA-RD-73-35) Avail: NTIS HC $3.50

FAA funded air traffic control Surveillance/Communication Analysis and Planning activities during the period 1 December 1972 to 28 February 1973 are reported. Status information is provided on the modification and preliminary testing of a demonstration ASR radar and its associated signal and display processing equipment. New approaches to rain clutter rejection and near-optimum receiver design are discussed. Author

N73-25194# RHG Electronics Lab., Inc., Farmingdale, N.Y.
C BAND RECON DATA TRANSMISSION SYSTEM Final Technical Report, 30 Jul. 1971 - 30 Jun. 1972
Theodore W. Stone Wright-Patterson AFB, Ohio AFAL Nov. 1972 41 p
(Contract F33615-72-C-1003)
(AD-759184; FP-5-721; AFAL-TR-72-358) Avail: NTIS CSCL 17/2

The design and evaluation of a C band airborne recon data transmission system consisting of an airborne 20 Watt FM transmitter and a ground receiver is presented. The equipment transmits video signals with a baseband of 3.5 MHz from an aircraft to a ground station. The transmitter operates at one of three selectable channels in the 4.4 to 4.8 GHz band, and the receiver is continuously tuneable over this range. The system signal to noise performance is presented, and several of the problems encountered in this design are discussed.
Author (GRA)

N73-25200# Naval Electronics Lab. Center, San Diego, Calif.
HF COMMUNICATIONS IMPROVEMENT FOR NAVAL AIRCRAFT Research and Development Report, Jul. 1971 - Sep. 1972
J. M. Horn 2 Jan. 1973 24 p refs

(NAVAIR Proj. W-3243; NELC Proj. B705)
(AD-759709; NELC-TR-1857) Avail: NTIS CSCL 09/5

Research pinpoints techniques that promise improvement in aircraft hf communication system design. Approaches discussed in the report include: adaptive hf antenna array inducing antijam, miniature passive and active antenna elements, adaptive phase equalization/predetection combining, polarization diversity, mode averaging diversity combiner, and antenna mathematical modeling techniques. Two techniques show promise for diversity reception -Villard mode averaging and predetection/phase equalization combining. Improved aircraft antenna systems are the key to improved aircraft communications. Mathematical modeling shows promise for designing aircraft antennas. Hf adaptive antennas may be feasible for both beam and null steering. Author (GRA)

N73-25231# Texas Instruments, Inc., Dallas. Equipment Group.
PARALLEL CHANNEL FORWARD LOOKING INFRARED DISPLAY Final Technical Report, Jun. 1971 - Jul. 1972
Harry L. Higginbotham and Gary L. Johnson Griffiss AFB, N. Y. RADC Feb. 1973 48 p
(Contract F30602-71-C-0329)
(AD-759224; TI-U1-990-110-F; RADC-TR-73-46) Avail: NTIS CSCL 09/5

The report describes a program that demonstrates the feasibility of a high-resolution, pulsewidth-modulated, small-volume paralled-channel display technique suitable for remote use with high-resolution forward-looking infrared (FLIR) systems. The report includes a description of the development and evaluation of an engineering model display, and describes an electronic simulator used in evaluating the display. Results of the evaluation demonstrated that this advanced display technique provides improved resolution, modulation transfer capability, and opportunity for growth over current FLIR display techniques. Supporting design studies outlined approaches to applying this technique to existing FLIR systems. Author (GRA)

N73-25238# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
AN AVIONICS DIGITAL FREQUENCY SYNTHESIZER
Harlan H. Knapp Nov. 1972 56 p refs
(Contract N00017-72-C-4401)
(AD-759699; APL-TG-1203) Avail: NTIS CSCL 09/5

The avionics frequency synthesizer generates frequencies in four bands for use with aircraft communications and navigational equipment. Four phase-locked loops having a common reference oscillator and using digital techniques have been used to give a reliable, accurate, and low-cost design. Author (GRA)

N73-25251# Lincoln Lab., Mass. Inst. of Tech., Lexington.
ADVANCED ELECTRONIC TECHNOLOGY Quarterly Technical Summary Report, 1 Nov. 1972 - 31 Jan. 1973
Melvin A. Herlin, Herbert G. Weiss, and Alan L. McWhorter 15 Feb. 1973 23 p refs
(Contract F19628-73-C-0002; AF Proj. 649L)
(AD-759180; ESD-TR-73-60) Avail: NTIS CSCL 20/12

The Quarterly Technical Summary covers the period 1 November 1972 through 31 January 1973. It consolidates the reports of Division 2 (Data Systems), Division 4 (Air Traffic Control), and Division 8 (Solid State) on the Advanced Electronic Technology Program. Author (GRA)

N73-25253# Polytechnic of Central London (England). Transport Studies Group.
THE ECONOMICS OF BRITISH AIRPORTS
R. S. Doganis and G. F. Thompson May 1973 242 p refs Sponsored by Social Sci. Res. Council
(Rept-73-01210) Avail: NTIS HC $14.25

An analysis is presented on the economics and finances of airports, as industrial units, to develop a theory of airport economics, with special reference to airport pricing. Recommendations were made on the following major issues: (1) the financial structure of airports, (2) measures of airport profitability and efficiency, (3) the scope and effect of management decisions on airport finances, and (4) possible improvements in current pricing and charging policies. Data are presented in the form of tables and graphs to show airport practices and operations from a financial standpoint. Author

N73-25254# Lincoln Lab., Mass. Inst. of Tech., Lexington.
DUAL LANE RUNWAY STUDY Final Report, 15 Oct. 1971 - 15 Dec. 1972
V. S. Dolat and J. C. Koegler 22 May 1973 244 p refs
(Contracts F19628-73-C-0002; DOT-FA72WAI-248; FAA Proj. 082-421-214)
(ATC-17; FAA-RD-73-60) Avail: NTIS HC $14.25

A series of dual lane runway computer simulation experiments were performed to investigate the pertinent dual lane issues: (1) centerline spacing, (2) arrival/departure preference, (3) parallel taxiway, (4) threshold stagger, and (5) high speed exits. In addition, time was spent analyzing operational high density airport terminal facilities. Airport administrative and operations personnel were interviewed to obtain their views on high density operations and the dual lane concept. Peak rush hour periods were sought out to determine control strategies employed in directing peak period traffic. Air crews utilizing these high density airport terminals were interviewed in the course of their operations into and out of these major hub airports. Author

N73-25257# Construction Engineering Research Lab., Champaign, Ill.
DEVELOPMENT OF A STANDARD DATA BASE AND COMPUTER SIMULATION MODEL FOR AN AIR CARGO TERMINAL
Lawrence P. McNamee and Chao Lee Jan. 1973 51 p refs
(AD-753925; TR-A-8; Rept-73-01198) Avail: NTIS HC $4.75 CSCL 01E

A GERTS 3Q simulation model for a Dortech air cargo facility is described and a recommendation for the development of a compatible Army-Air Force air cargo data ba ɔ system is given. Author

N73-25259*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DESCRIPTION AND PERFORMANCE OF THE LANGLEY DIFFERENTIAL MANEUVERING SIMULATOR
B. R. Ashworth and William M. Kahlbaum, Jr. Washington Jun. 1973 96 p refs
(NASA-TN-D-7304; L-8827) Avail: NTIS HC $3.00 CSCL 14B

The differential maneuvering simulator for simulating two aircraft or spacecraft operating in a differential mode is described. Tests made to verify that the system could provide the required simulated aircraft motions are given. The mathematical model which converts computed aircraft motions into the required motions of the various projector gimbals is described. Author

N73-25276*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
LOCAL SKIN FRICTION COEFFICIENTS AND BOUNDARY LAYER PROFILES OBTAINED IN FLIGHT FROM THE XB-70-1 AIRPLANE AT MACH NUMBERS UP TO 2.5
David F. Fisher and Edwin J. Saltzman Washington Jun. 1973 70 p refs
(NASA-TN-D-7220; H-710) Avail: NTIS HC $3.00 CSCL 20D

Boundary-layer and local friction data for Mach numbers up to 2.5 and Reynolds numbers up to 3.6 x 10 to the 8th power were obtained in flight at three locations on the XB-70-1 airplane: the lower forward fuselage centerline (nose), the upper rear fuselage centerline, and the upper surface of the right wing. Local skin friction coefficients were derived at each location by

using (1) a skin friction force balance, (2) a Preston probe, and (3) an adaptation of Clauser's method which derives skin friction from the rake velocity profile. These three techniques provided consistent results that agreed well with the von Karman-Schoenherr relationship for flow conditions that are quasi-two-dimensional. At the lower angles of attack, the nose-boom and flow-direction vanes are believed to have caused the momentum thickness at the nose to be larger than at the higher angles of attack. The boundary-layer data and local skin friction coefficients are tabulated. The wind-tunnel-model surface-pressure distribution ahead of the three locations and the flight surface-pressure distribution ahead of the wing location are included. Author

N73-25291# Hydronautics, Inc., Laurel, Md.
THE USE OF SHIP MODEL BASINS FOR THE STUDY OF VORTEX WAKE PHENOMENA
Clinton E. Brown Mar. 1973 33 p refs
(Contract F44620-71-C-0080; AF Proj. 9781)
(AD-758893; TR-7115-2; AFOSR-73-0567TR) Avail: NTIS CSCL 14/2

The basic differences between tests in air and in water are discussed relative to the study of aircraft vortex wake phenomena. It is shown that use of large ship model basins is valid for simulation up to critical Mach numbers of flight. Free surface interference is shown to be negligible for tests made at sufficient towing depths and is avoided at typical towing speeds. Effects of Reynolds number mismatch on the test results is analyzed and it is concluded that wing profile drag coefficients should be matched between full and model scale. Consideration is given to the problem of stopping and starting disturbances in towed-model testing. (Author Modified Abstract) GRA

N73-25305# Illinois Inst. of Tech., Chicago. Dept. of Mechanics, Mechanical and Aerospace Engineering.
CONFINED MIXING OF MULTIPLE JETS
G. Fabris and Andrew A. Fejer Nov. 1972 27 p refs
(Contract F44620-69-C-0022; AF Proj. 7921)
(AD-758838; THEMIS-ITT-R72-10-Nov-72; AFOSR-73-0591TR) Avail: NTIS CSCL 20/4

The study deals with the transfer of kinetic energy from an array of primary jets to a surrounding secondary stream. It explores the basic features of such flows and examines to what extent the results of single jet research may be applied to multiple jet configurations. It presents an analytical technique for estimating the performance of multiple jets and examines in a special multiple - jet test facility the validity of the assumptions used in the analysis. (Author Modified Abstract) GRA

N73-25441# Office of the Secretary of Transportation, Washington, D.C.
JOINT ATMOSPHERIC MODELING AND CHEMICAL DYNAMICS WORKSHOP
Reynold Greenstone, ed. and Robert L. Underwood, ed. Nov. 1972 57 p refs Conf. held at Gaithersburg, Md., 12-13 Sep. 1972
(PB-214100/0; DOT-TST-90-2) Avail: NTIS HC $3.00 CSCL 04A

On 12-13 September 1972, the Department of Transportation sponsored a joint atmospheric modeling and chemical dynamics workshop. Concerns of the workshop were to establish a chemical kinetics and atmospheric dynamics data base for use in computational models that would be used to assess possible climatic effect due to a projected fleet of high-altitude aircraft. New reaction rate data were reported; models were described; and some predictions of climatic effects were made. Areas needing further work were defined. The report summarizes these findings. Author (GRA)

N73-25489# Boeing Aerospace Co., Seattle, Wash. Research and Engineering Div.
COCKPIT AND CONTROL: DISPLAY DESIGN CRITERIA FOR TACTICAL STOL AND V/STOL AIRCRAFT Technical Report, 1 Jul. 1971 - 1 Mar. 1972
Joseph S. Musgrave Nov. 1972 155 p refs
(Contract F33615-71-C-1832; AF Proj. ADP-643A)
(AD-758787; D180-14635-1; AFFDL-TR-72-72) Avail: NTIS CSCL 01/4

The unique performance characteristics of the advanced STOL and V/STOL aircraft require a review and analysis of the cockpit, display, and control design requirements. The report presents an analysis resulting in requirements based upon detailed descriptions of a new STOL and V/STOL tactical transport operating in a severe tactical environment. Each item established as a cockpit requirement is the result of a traceable line of development that starts with the new airplane operating requirements and proceeds in directions determined by the capabilities of both hardware and humans. The end product of this analysis is a definition of cockpit display and control requirements based on the new operational needs rather than following the general tendency to use conventional cockpit displays and controls in new aircraft. (Author Modified Abstract) GRA

N73-25532# Battelle Columbus Labs., Ohio.
APPLICATION OF HOT-ISOSTATIC PRESSING, HYDROSTATIC EXTRUSION, AND DEFORMABLE-DIE TUBE TAPERING PROCESSES TO PRODUCTION OF TITANIUM-6AI-4V TAPERED TUBES
George E. Meyer, George H. Harth, Jerry A. Houck, and Tom G. Byrer Feb. 1973 87 p refs
(Contract DAAJ02-71-C-0038; DA Proj. 1F1-62208-A-170)
(AD-759504; USAAMRDL-TR-72-71) Avail: NTIS CSCL 13/8

The report presents the results of an investigation to determine the potential of hot-isostatic pressing, hydrostatic extrusion, and deformable-die processes for the production of low-cost Ti-6AI-4V titanium helicopter rotor blade spars. GRA

N73-25653*# Massachusetts Inst. of Tech., Cambridge. Decision and Control Sciences Group.
CONTROL OPTIMIZATION, STABILIZATION AND COMPUTER ALGORITHMS FOR AIRCRAFT APPLICATIONS Status Report, 1 Jan. - 1 May 1973
S. K. Mitter Mar. 1973 36 p refs
(Grant NGL-22-009-124; MIT Proj. DSR 76265)
(NASA-CR-133002; SR-14; ESL-SR-494) Avail: NTIS HC $4.00 CSCL 12A

Computationally useful algorithms are considered that can aid the control engineer in designing systems control in linear time invariant dynamics for aircraft applications. Structural aspects of system identification, matrix parameterization, and the effect of feedback on identifiability of systems. Adaptive and stochastic control model constructions are projected, and a method for approximate identification of aircraft characteristics and subsequent generation of control signals is outlined. G.G.

N73-25677# National Weather Service, Silver Spring, Md. Techniques Development Lab.
AUTOMATED PROBABILITY FORECASTS OF CEILING AND VISIBILITY BASED ON SINGLE STATION DATA Final Report
Richard L. Crisci and Frank Lewis Feb. 1973 68 p refs
(Contract DOT-FA67WAI-131)
(FAA-RD-73-13) Avail: NTIS HC $5.50

A set of computer programs was developed to produce multiple linear regression equations for predicting the probability of specified ceiling and visibility categories at air terminals. The equations were based upon weather observations made solely at the terminal and were derived with the REEP screening technique from 329 possible predictors. The programs accepted raw data in a standard format, and a complete set of prediction equations for five time projections was produced for each of 50 stations in a single computer run. The accuracy of forecasts generated by the equations was evaluated for 20 terminals. Three measures of accuracy were used to compare the objective forecasts to persistence and climatology. The equations were

superior for the P-score and the Allen utility score, but for percent corrrect, persistence was better than the equations for the 4-hour forecast and climatology was about as good as the equations at 10 and 16 hours. Author

N73-25682# Stanford Research Inst., Menlo Park, Calif.
LIDAR EVALUATION OF FOG DISSIPATION TECHNIQUES Final Report, 10 Nov. 1971 - 30 Nov. 1972
William Viezee, John Oblanas, and Ronald T. H. Collis Feb. 1973 123 p refs
(Contract F19628-72-C-0018; ILIR Proj. 9-71; SRI Proj. 1597)
(AD-758767; AFCRL-TR-73-0052) Avail: NTIS CSCL 04/2

During July 1972, laser radar (lidar) observations were made by Stanford Research Institute in support of a thermal fog dissipation program conducted by the Air Force at Vandenberg AFB. The program was designed to test the merging heat plume concept as a practical and efficient method of warm-fog dispersal. The ground-based heating system consisted of 213 liquid propane burners arranged in four lines perpendicular to the prevailing wind direction. The heat tests (conducted whenever fog reduced the horizontal visibility to less than 1/2 mile (800 m)) consisted to lighting various rows of burners at various burner intensities and spacings under various meteorological conditions (primarily wind speed variations). Profiles of atmospheric backscatter vs. range were observed with a ruby lidar at a point downwind from the ground-based heating system by firing every three seconds while scanning in a vertical plane normal to the wind. The observations are described and discussed in terms of their significance to demonstrating the operational feasibility of using lidar to document fog modification. (Author Modified Abstract) GRA

N73-25699 Stanford Univ., Calif.
IMPROVED NAVIGATION BY COMBINING VOR/DME INFORMATION WITH AIR OR INERTIAL DATA Ph.D. Thesis
John Charles Bobick 1972 154 p
Avail: Univ. Microfilms Order No. 72-30594

The primary navigation aid for civil aircraft is the VOR/DME system. Using VOR and DME measurements, bearing and range relative to a fixed ground station can be determined onboard the aircraft. Reductions in air traffic congestion and air controller workloads can be realized by combining VOR/DME information (from one or two stations) with data from an inertial navigation system by means of a maximum likelihood filter. It was found that the addition of air data to the information from two VOR/DME stations yields large factors of improvement in RMS position accuracy over the use of a single VOR/DME station, roughly 15 to 20 for the air data case and 25 to 35 for the inertial data case. Dissert. Abstr.

N73-25700# National Aviation Facilities Experimental Center, Atlantic City, N.J.
AUTOMATED SELECTION OF VOR, ILS, AND TACAN/DME FREQUENCIES Final Report, Jan. 1965 - Feb. 1972
T. Steger and R. Johnson May 1973 75 p
(FAA-NA-73-4; FAA-RD-73-53) Avail: NTIS HC $5.75

A computer program developed to automate the selection of VOR, ILS, and Tacan/DME frequencies is presented. It includes a thumbnail sketch of the need for such a capability and describes: the program logic involved for this problem; the advantages of automatic frequencies selection in general; and some possible future applications. The results of an operational evaluation are highlighted and among other conclusions it was concluded the complete program offers a savings in time with no sacrifice in accuracy. Author

N73-25701# Lincoln Lab., Mass. Inst. of Tech., Lexington.
DEVELOPMENT OF A DISCRETE ADDRESS BEACON SYSTEM Quarterly Technical Summary, 1 Jan. - 31 Mar. 1973
1 Apr. 1973 115 p refs
(Contracts DOT-FA72WAI-261; F19628-73-C-0002)
(FAA-RD-73-48) Avail: NTIS HC $7.75

Development of a Discrete Address Beacon System (DABS) is reported. Included in the report are brief reviews of: DABS link design modulation and interference studies; transponder design-cost studies; ATCRBS transponder tests; transponder antenna/airframe pattern measurements; and sensor monopulse antenna-processor studies. Also included are the results of studies pertaining to: interrogation scheduling the rotating antenna equipped sensor; aircraft tracking/correlation at the sensor and at the SCP; protocol for extended length messages; use of DABS sensors in various system configurations; Synchro-DABS scheduling constraints; and sensor netting and siting. A status report on the implementation of the Lincoln Laboratory DABS Experimental Facility and a review of planned direction finding experiments is included. Author

N73-25702# National Aviation Facilities Experimental Center, Atlantic City, N.J.
THE 1972 SEMINAR ON OPERATIONAL PROBLEMS OF THE AIR TRAFFIC CONTROL RADAR BEACON SYSTEM
Apr. 1973 257 p Seminar held at Atlantic City, 8-11 Feb. 1972
(FAA-NA-72-80) Avail: NTIS HC $15.00

The proceedings of a conference on the operational problems of the air traffic control beacon system are reported. The subjects discussed are: (1) problems of broken targets in display devices, (2) emergency false alarm difficulties, (3) electromagnetic interference, (4) false targets, and (5) missing and fading targets. Recommendations to control or eliminate the air traffic control problems are included. Author

N73-25703# Federal Aviation Administration, Washington, D.C. Office of Systems Research and Development Service.
ENGINEERING AND DEVELOPMENT PLAN: PERFORMANCE ASSURANCE
May 1973 32 p
(FAA-ED-21-2) Avail: NTIS HC $3.75

The development activities that are being pursued to enhance overall performance assurance of all air traffic control and navigation facilities within the National Airspace System (NAS) are described. The plan provides detailed information on the objectives, goals, program structure, technical approach, resources, and possible implementation, as well as, general discussions which emphasize the rationale and philosophy which dictates the course of action. This plan is indicated on the basic assumption that improvements and efficiencies in the current methods and concept of facility performance assurance are imperative in the face of continuing facility expansion, maintenance workforce freezes and economy drives. Author

N73-25705# Champlain Technology, Inc., West Palm Beach, Fla.
VERTICAL AREA NAVIGATION SYSTEM ANALYSIS Final Report
E. H. Bolz and E. D. McConkey Sep. 1972 180 p refs
(Contract DOT-FA72WA-2831)
(FAA-RD-72-125) Avail: NTIS HC $11.00

An analysis and digital computer simulation of the operational and performance aspects of vertical area navigation (VNAV) systems is presented. A sensitivity analysis was performed relating each of the various error elements of various levels of VNAV system complexity and cost to the overall system use accuracy. A parallel investigation was made of the procedural and operational impacts of several categories of user aircraft operating under a variety of external environmental conditions. Author

N73-25710*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PILOT'S MANUAL FOR AUTOMATED 4D GUIDANCE

SYSTEM
Heinz Erzberger and Thomas Pecsvaradi Apr. 1973 43 p refs
(NASA-TM-X-62233) Avail: NTIS HC $4.25 CSCL 17G

Operational procedures and modes of an experimental 4D guidance system are described from the pilot's point of view. The system consists of the experimental avionics equipment referred to as STOLAND and a specially developed software package for the STOLAND digital computer. A capture mode of the system provides arrival time control and automatic tracking of the 4D flight path from any feasible initial aircraft state to any waypoint. Precise arrival time at a waypoint is achieved by means of speed control or, if large delays are required, by path stretching. Continuous recomputation and display of the capture flight path prior to engaging the system permits the pilot to determine the exact moment for terminating a holding or path stretching maneuver in order to achieve a specified arrival time. Author

N73-25711# Royal Aircraft Establishment, Farnborough (England).
A COMPREHENSIVE AIRPORT COMMUNICATION SYSTEM (CACS): FEASIBILITY STUDY
M. E. Smith Nov. 1972 93 p
(RAE-TR-72133; BR-32587) Avail: NTIS HC $6.75

A survey was conducted of the need for computer-based data communications and/or processing facilities at a major civil airport. This survey revealed an imbalance in the current development of such facilities within civil aviation which is to the detriment of the airport and which, if not redressed, will limit the advantage to be derived from those facilities already in operation or under development. A proposal is made for a system comprising data communication and processing facilities that is intended to enable the airport to participate fully in future developments of civil aviation automation. The proposal is made in varying depth for the various aspects of the overall system: great consideration was given to the requirements of the airport ATC where the need for improved communications is thought to be the most pressing. Author (ESRO)

N73-25713# Boeing Commercial Airplane Co., Seattle, Wash.
CONTROL-DISPLAY TESTING REQUIREMENTS STUDY, VOLUME 1 Final Report, 24 Jan. - 24 Aug. 1972
D. L. Parks, D. M. Fadden, and J. R. Fries Wright-Patterson AFB, Ohio AFFDL Jan. 1973 184 p refs
(Contract F33615-72-C-1663; AF Proj. 404L)
(AD-758791; D6-60162-Vol-1; AFFDL-TR-121-Vol-1) Avail: NTIS CSCL 17/7

Control-display test development requirements are defined for the microwave landing system portion of the Air Force Advanced Landing System Program. Included are individual test plans, a test integration plan, and program schedules. The approach to deriving test requirements is outlined, including results of surveys and analyses covering the microwave landing system, Air Force users, and landing display systems, and the system analyses to define basic data requirements and to collate system user data based on functional flows and action-information requirements. Details of plan development and supporting data are presented as reference material for use in subsequent test design and test program conduct and for trade data to support on-line decisions. Author (GRA)

N73-25714# Boeing Commercial Airplane Co., Seattle, Wash.
CONTROL-DISPLAY TESTING REQUIREMENTS STUDY, VOLUME 2 Final Report, 24 Jan. - 24 Aug. 1972
D. L. Parks, D. M. Fadden, and J. R. Fries Wright-Patterson AFB, Ohio AFFDL Jan. 1973 131 p refs
(Contract F33615-72-C-1663; AF Proj. 404L)
(AD-758792; D6-60162-1-Vol-2; AFFDL-TR-121-Vol-2) Avail: NTIS CSCL 17/7

As an appendix to volume 1 of the Control-Display Testing Requirements Study, the report contains two appendixes relevant to control-display-pilot factor testing for the Air Force in the Microwave Landing System (MLS) Program: Appendix I--Facilities: Facility resource summaries covering resources available or negotiable for Air Force use in the MLS test program, and Appendix 2--Derivation of Action-Information Requirements: These requirements are based on a systems analysis covering approach functions, required actions, and resulting information requirements. Author (GRA)

N73-25715# Lincoln Lab., Mass. Inst. of Tech., Lexington.
THE ROLE OF AN AIRBORNE TRAFFIC AND SITUATION DISPLAY IN THE EVOLVING ATC ENVIRONMENT
Richard W. Bush and Herbert G. Weiss 1 May 1973 363 p refs
(Contract CON-AAC-71-02)
(PB-215714/7) Avail: NTIS HC $9.00 CSCL 17G

The report summarizes the results of a study to investigate the role of an Airborne Traffic and Situation Display (ATSD) in the evolving air traffic control environment. While the concept of displaying traffic information in the cockpit has been under discussion for more than two decades, only in recent years has it been possible to provide an aircraft-centered display of pertinent information with acceptable quality and cost. The Aviation Advisory Commission initiated this study to determine if the performance of the overall ATC system would be enhanced by permitting a pilot with an ATSD to participate more effectively in the ATC function. Author (GRA)

N73-25718# Naval Research Lab., Washington, D.C. Electromagnetic Propagation Branch.
OMEGA IN THE ARCTIC Interim Report
John W. Brogden Apr. 1973 18 p refs
(AD-759009; NRL-MR-2575) Avail: NTIS CSCL 17/7

The Federal Aviation Administration (FAA) is sponsoring a program at the Naval Research Laboratory to investigate the effects of polar cap absorption events (PCA), and other propagation anomalies, on the Omega Navigation System when used in the high latitude regions. There is interest by FAA in this area because of the so-called polar routes of the commercial air lines. Preliminary results presented show the effects of two PCA events. One of these produced a phase advance of 50 CELS for the 10.2 kHz Norway-Hawaii transmissions as received in Washington, D.C. (Author Modified Abstract) GRA

N73-25719# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
ANALYSIS OF DATA RATE REQUIREMENTS FOR LOW VISIBILITY APPROACH WITH A SCANNING BEAM LANDING GUIDANCE SYSTEM Technical Report, Aug. 1969 - 1 Jul. 1972
James D. Dillow, Paul R. Stolz, and Meyer D. Zuckerman Feb. 1973 173 p refs
(AF Proj. 8219)
(AD-758786; AFFDL-TR-71-177) Avail: NTIS CSCL 17/7

Data rate requirements for low visibility approach with a sample data measurement of glideslope deviation are investigated analytically. A window is defined by specifying certain allowable deviations in the aircraft motion variables which are acceptable for continuation of the landing at a 100-ft-decision altitude. The approach performance is defined as the probability of missing the window, which corresponds to the probability of a missed approach. The landing approach process is modeled by a system of stochastic differential equations, which account for the aircraft dynamics, atmospheric disturbances, guidance errors, and data rate. The flight control system is modeled by a state estimator and a state feedback matrix which is optimized so as to minimize the probability of a missed approach subject to rms constraints on control activity. (Author Modified Abstract) GRA

N73-25734*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ANALYTICAL EVALUATION OF JET NOISE SOURCE LOCATION TECHNIQUE UTILIZING AN ACOUSTICALLY

HARD BAFFLE WITH APERTURE
Thomas D. Norum and Edward P. McDaid Washington Jun. 1972 24 p refs
(NASA-TN-D-7229; L-8739) Avail: NTIS HC $3.00 CSCL 20A

An analytical investigation was conducted on the experimental technique that uses shielding by an acoustically hard baffle to determine the location of noise sources in a jet. The jet exhausts through a circular hole in the baffle and the radiated acoustic power is considered to be generated by a distributed source along the jet axis. It is found that the effect of the baffle on the radiated power can be neglected only when the size of the source is on the order of a wavelength of the emitted sound or larger. Since noise sources in a jet are compact, the experimental technique is insufficient to identify these sources. Author

N73-25737# Transportation Systems Center, Cambridge, Mass.
AMBIENT NOISE LEVEL MEASUREMENTS IN PROPOSED FLORIDA AIRPORT AREA Final Report
Robert W. Quinn Dec. 1972 106 p
(Contract DOT-OS-307)
(PB-214459/0; DOT-TSC-OST-72-19) Avail: NTIS HC $3.00 CSCL 13B

Measurement results made at ten locations near the three remaining sites being studied for the south Florida regional airport are reported. Tabulated data display a summary of the measured noise levels at each location expressed as noise levels exceeded 1, 10, 50, 90 and 99 percent of the time in A-weighted decibels. The standard deviation, minimum and maximum A-weighted levels are also tabulated. Author (GRA)

N73-25814# Naval Research Lab., Washington, D.C.
FLAMMABILITY PROPERTIES OF HYDROCARBON FUELS. PART 4: THE SIGNIFICANCE OF FLASH POINT AS AN INDICATOR OF THE FLAMMABILITY HAZARD OF HYDROCARBON FUELS Interim Report
W. A. Affens, G. W. McLaren, and H. W. Carhart 6 Mar. 1973 14 p refs
(NRL Proj. C01-03; SR0240201)
(AD-758643; NRL-7549) Avail: NTIS CSCL 21/4

The significance of flash point as a measurement of flammability hazard of flammable liquids and multicomponent solutions and its experimental determination were evaluated. Experimentally determined flash points were found to be in good agreement with values which were calculated from theoretical principles. The results confirm that liquid hydrocarbon solutions follow the laws of Dalton, Raoult, and LeChatelier governing the vapor pressure, composition, and flammability limits above a liquid of two or more components, and also confirm the concept of flash point as that temperature at which the vapor concentration above a liquid is equal to that at its lower flammability limit. Author (GRA)

N73-25816*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CONTROLLED SEPARATION COMBUSTOR Patent Application
Albert J. Juhasz and Richard N. Niedzwiecki, inventors (to NASA) Filed 24 May 1973 22 p
(NASA-Case-LEW-11593-1; US-Patent-Appl-SN-363691) Avail: NTIS HC $3.25 CSCL 21E

A short annular combustor is described which utilizes diffuser bleed to control the airflow distribution in a gas turbine engine at various operating conditions. This technique improves the performance of a gas turbine engine at idle, takeoff, cruise, and altitude relight operating conditions by varying the combustor airflow distribution using non-mechanical means. NASA

N73-25817*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ANALYTIC AND EXPERIMENTAL PERFORMANCE OF TWO ISENTROPIC MIXED COMPRESSION AXISYMMETRIC INLETS AT MACH NUMBERS 0.8 TO 2.65
Donald B. Smeltzer and Norman E. Sorensen Washington Jun. 1973 57 p refs
(NASA-TN-D-7320; A-4675) Avail: NTIS HC $3.00 CSCL 21E

A mixed compression axisymmetric inlet model with a capture diameter of 50 cm was tested at Mach numbers ranging from 0.8 to 2.65 at 0 deg angle of attack and a constant total pressure of approximately 1 atm. Analytical methods accounting for the effects of both viscous and inviscid flows and incorporating empirical bleed discharge coefficients were used in the procedure for designing the inlet contours and the bleed system. Experimental results are compared with analytic predictions and are also compared with results from earlier tests of an inlet with the same internal contours but with a bleed system developed by cut and try methods in the wind tunnel. With the bleed configuration predicted by the design procedure, maximum total pressure recovery at the engine face at the design Mach number of 2.65 was 93 percent, with a total pressure distortion less than 10 percent. Corresponding bleed mass flow was approximately 7.5 percent, which was about 1.3 percent less than predicted. At lower supersonic Mach numbers, pressure recovery and bleed were generally lower and distortion generally higher. Author

N73-25818*# Pratt and Whitney Aircraft, West Palm Beach, Fla. Research and Development Center.
SINGLE STAGE EXPERIMENTAL EVALUATION OF TANDEM-AIRFOIL ROTOR AND STATOR BLADING FOR COMPRESSORS. PART 4: DATA AND PERFORMANCE FOR STAGE B
J. A. Brent and J. G. Cheatham 15 Jun. 1973 273 p refs (Contract NAS3-11158)
(NASA-CR-121145; FR-5083-Pt-4) Avail: NTIS HC $15.75 CSCL 21E

Stage B, composed of tandem-airfoil rotor B and stator B, was tested with uniform inlet flow and with hub radial, tip radial and 90 degree one-per-revolution circumferential distortion of the inlet flow as part of an overall program to evaluate the effectiveness of tandem airfoils for increasing the design point loading capability and stable operating range of rotor and stator blading. The results of this series of tests provide overall performance and blade element data for evaluating: (1) the potential of tandem blading for extending the loading limit and stable operating range of a stage representative of a middle stage of an advanced high pressure compressor, (2) the effect of loading split between the two airfoils in tandem on the performance of tandem blading, and (3) the effects of inlet flow distortion on the stage performance. The rotor had an inlet hub/tip ratio of 0.8 and a design tip velocity of 757 ft/sec. With uniform inlet flow, rotor B achieved a maximum adiabatic efficiency of 88.4% at design equivalent rotor speed and a pressure ratio of 1.31. The stage maximum adiabatic efficiency at design equivalent rotor speed with uniform inlet flow was 82.5% at a pressure ratio of 1.28. Tip radial and circumferential distortion of the inlet flow caused substantial reductions in surge margin. Author

N73-25819# Cranfield Inst. of Technology (England).
THE DESIGN OF A SHAFT CROSS COUPLING SYSTEM FOR THE ENGINES OF AN STOL AIRCRAFT
J. Webb Oct. 1972 15 p refs
(Cranfield-Aero-14) Avail: NTIS HC $3.00

The design of a system for mechanically cross coupling the engines of a STOL transport aircraft was studied, with emphasis on the initial design problems of selecting the operating speed and assessing the weight of the system. It was found that a minimum weight system will exist where by the speed limitations brought about by the shaft support and other bearings will determine the admissable weight of the system as a whole. Author

N73-25822*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CALCULATED PERFORMANCE MAP OF A 4 1/2-STAGE

15.0 CENTIMETER (5.9 INCH) MEAN DIAMETER TURBINE DESIGNED FOR A TURBOFAN SIMULATOR
Charles A. Wasserbauer Washington Jun. 1973 14 p ref
(NASA-TM-X-2822; E-7403) Avail: NTIS HC $3.00 CSCL 21E

The overall performance of an existing high-ratio turbine is calculated analytically over a range of speed and pressure ratio in order to determine its capability for other applications. The analytical performance covers a speed range from 50 to 120 percent of design and a pressure-ratio range from 5.0 to 35.0. The turbine was designed for a 50.8 centimeter (20.0 in.) tip diameter turbofan simulator. Computed results are compared with the experimental turbine data obtained from testing three fan configurations with the turbofan simulator in air. The comparison indicates good agreement over the range of speeds and pressure ratios covered by the experimental data. Author

N73-25823*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL COLD-FLOW EVALUATION OF A RAM AIR COOLED PLUG NOZZLE CONCEPT FOR AFTERBURNING TURBOJET ENGINES
David M. Straight and Douglas E. Harrington Washington Jun. 1973 25 p refs
(NASA-TM-X-2811; E-7387) Avail: NTIS HC $3.00 CSCL 21E

A concept for plug nozzles cooled by inlet ram air is presented. Experimental data obtained with a small scale model, 21.59-cm (8.5-in.) diameter, in a static altitude facility demonstrated high thrust performance and excellent pumping characteristics. Tests were made at nozzle pressure ratios simulating supersonic cruise and takeoff conditions. Effect of plug size, outer shroud length, and varying amounts of secondary flow were investigated.
Author

N73-25824*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TERMINAL SHOCK POSITION AND RESTART CONTROL OF A MACH 2.7, TWO-DIMENSIONAL, TWIN DUCT MIXED COMPRESSION INLET
Gary L. Cole, George H. Neiner, and Robert J. Baumbick Washington Jun. 1973 44 p refs
(NASA-TM-X-2818; E-7223) Avail: NTIS HC $3.00 CSCL 21E

Experimental results of terminal shock and restart control system tests of a two-dimensional, twin-duct mixed compression inlet are presented. High-response (110-Hz bandwidth) overboard bypass doors were used, both as the variable to control shock position and as the means of disturbing the inlet airflow. An inherent instability in inlet shock position resulted in noisy feedback signals and thus restricted the terminal shock position control performance that was achieved. Proportional-plus-integral type controllers using either throat exit static pressure or shock position sensor feedback gave adequate low-frequency control. The inlet restart control system kept the terminal shock control loop closed throughout the unstart-restart transient. The capability to restart the inlet was non limited by the inlet instability. Author

N73-25829*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LOW-SPEED WIND TUNNEL INVESTIGATION OF THE AERODYNAMIC AND ACOUSTIC PERFORMANCE OF A TRANSLATING-CENTERBODY CHOKED-FLOW INLET
Brent A. Miller and John M. Abbott Washington Jun. 1973 32 p refs
(NASA-TM-X-2773; E-7372) Avail: NTIS HC $3.00 CSCL 21E

Low-speed wind-tunnel tests were conducted to determine the effects of free-stream velocity and incidence angle on the aerodynamic and acoustic performance of a translating centerbody choked-flow inlet. The inlet was sized to fit a 13.97 cm diameter fan with a design weight flow of 2.49 kg/sec. Performance was determined at free-stream velocities to 45 meters per second and incidence angles of 0 deg to 50 deg. The inlet was operated in both the choked and unchoked modes over a range of weight flows. Measurements were made of inlet total pressure recovery, flow distortion, surface static pressure distribution, and fan noise suppression. In the choked mode, increasing incidence angle tended to reduce the amount of inlet noise suppression for a given amount of inlet suction. This tendency was overcome by applying sufficient inlet suction to increase the flow Mach number. At 45 meters per second free-stream velocity, at least 22 decibels of suppression were measured at 35 deg incidence angle with a total pressure recovery of 0.985. Author

N73-25834# Ultrasystems, Inc., Irvine, Calif.
INSTABILITY AND NOISE GENERATION IN AIR BREATHING PROPULSION SYSTEMS Interim Progress Report, 1 Jun. 1971 - 31 May 1972
J. J. Tyson Jan. 1973 48 p refs
(Contract F44620-71-C-0104; AF Proj. 9711)
(AD-758890; AFOSR-73-0565TR) Avail: NTIS CSCL 21/5

The report presents the progress of research accomplished on instability and noise generation in airbreathing propulsion systems during the period 1 Jun 1971 to 31 May 1972. During this period the focus has been on the theoretical delineation of various possible afterburner instability mechanisms. A literature review was made of other investigations of mechanisms whereby energy is pumped from the combustion process into a standing or traveling wave system within the combustor cavity. A theoretical analysis was initiated based on a periodic vortex shedding model. It is hypothesized in this model that vorticity is shed in an oscillatory manner from the flame holder at a frequency consistent with the cavity resonance. (Author Modified Abstract) GRA

N73-25835# Advanced Technology Labs., Inc., Jericho, N.Y.
TIME-DEPENDENT SUBSONIC DIFFUSER ANALYSIS Technical Report, 1 Oct. 1971 - 31 Jul. 1972
John Erdos and John Ranlet Dec. 1972 75 p refs
(Contract F33615-72-C-1089; AF Proj. 1476)
(AD-758803; AFFDL-TR-72-148) Avail: NTIS CSCL 21/5

A mathematical model of the time-dependent flow in the subsonic diffuser section of an external compression, supersonic inlet is described. The flow is divided, in standard fashion, into inviscid and boundary layer components. The inviscid flow is assumed to be two dimensional (i.e., axisymmetric) as well as time-dependent, and the region considered extends from the inlet terminal shock to the engine face. A finite-difference technique for solution of the inviscid flow is developed utilizing a moving, polar coordinate system attached to the shock for the exterior flow field and a fixed, rectilinear system for the interior flow field. The boundary conditions consist of the inlet flow conditions upstream of the terminal shock and the pressure distribution at the engine face; either a steady, transient or periodic solution can be sought depending on the imposed boundary conditions. Both laminar and turbulent boundary layers have been considered. (Author Modified Abstract) GRA

N73-25837# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE MANUFACTURE OF THE BASIC PARTS OF AIRCRAFT ENGINES
M. I. Evstigneev and I. A. Morozov 31 Jan. 1973 663 p refs Transl. into ENGLISH of the mono. "Izogotovlenie Osnovnykh Detalei Aviatvigatelei" Moscow, Izd-vo Mashinostroyeniya, 1972 p 1-478
(FTD Proj. 60108; FTD Proj. T72-01-40)
(AD-759577; FTD-MT-24-1460-72) Avail: NTIS CSCL 21/5

In the book, which is an educational aid for students of aviation higher educational institutes and schools, are discussed the technological processes of manufacture of the critical parts of engines of flight vehicles. Their structural features, technical specifications for manufacture and materials, the structure of

technological processes, the methods of carrying out basic operations, methods and means of control are examined. Information is given on the technology of manufacture of parts from plastics and refractory materials. Author (GRA)

N73-25926# Army Engineer Waterways Experiment Station, Vicksburg, Miss. Soils and Pavements Lab.
STRENGTHENING OF KEYED LONGITUDINAL CONSTRUCTION JOINTS IN RIGID PAVEMENTS Final Report, Apr. 1971 - May 1972
R. W. Grau Aug. 1972 126 p
(Contracts DOT-FA71WAI-218; F29601-71-X-0007)
(FAA-RD-72-106) Avail: NTIS HC $8.50

The performance of keyed and doweled longitudinal construction joints in rigid airfield pavement under mutiple wheel heavy gear loadings (MWHGL) was investigated along with the feasibility of strengthening existing keyed longitudinal joints. Results from the study show that: (1) performance of keyed joints on medium-strength foundations is marginal; (2) it is feasible to strengthen the keyed joints in existing rigid pavements that are founded on low- to medium-strength materials and are in good condition if the airfield is scheduled for MWHGL aircraft traffic; (3) keyed longitudinal construction joints in existing rigid pavements constructed on high-strength or stabilized soil foundations will probably perform satisfactorily under MWHGL aircraft traffic; (4) a sand-filter course beneath a pavement structure will be effective in minimizing subgrade pumping; (5) a 6-in.-thick stabilized base course placed over a low-strength subgrade is very effective in increasing the load-carrying capacity of a 10-in.-thick nonreinforced PCC pavement; and (6) doweled longitudinal construction joints in rigid pavements constructed on low-, medium-, and high-strength subgrades performed satisfactorily under MWHGL traffic. Author

N73-25966*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FLOW THROUGH A WIRE-FORM TRANSPIRATION-COOLED VANE
Albert Kaufman Washington Jun. 1973 26 p refs
(NASA-TN-D-7341; E-7385) Avail: NTIS HC $3.00 CSCL 20M

Results of recent research to develop techniques for analyzing coolant flow in transpiration-cooled vanes are summarized. Flow characteristics of the wire-form porous material are correlated; the effects on the flow characteristics of oxidation, coolant temperature, gas crossflow, and airfoil curvature are evaluated. An analytical method is presented for predicting coolant flows and pressures in a strut-supported vane. Author

N73-25972# Naval Ordnance Lab., White Oak, Md.
INTERNAL BLAST DAMAGE MECHANISMS COMPUTER PROGRAM Final Report, Jun. 1971 - Feb. 1972
James F. Proctor 31 Aug. 1972 118 p refs
(AD-759002; NOLTR-72-231) Avail: NTIS CSCL 19/4

A computer program has been developed at NOL that describes the shock and blast loading characteristics of the detonation of a high explosive projectile internal to an aircraft structure; both shock wave and confined-explosion gas pressure loads are considered. With certain modifications, the program can be made applicable to any internal explosion irrespective of the type of confining configuration, e.g., a naval ship compartment, land vehicle, or building structure. Discussions are given on the general use and content of the program, the input options available in the code, and the technical aspects of the calculational methods used to determine shock loading functions, confined-explosion gas pressure, venting of the confined gases, and damage propagation to other areas of the aircraft. (Author Modified Abstract) GRA

SUBJECT INDEX

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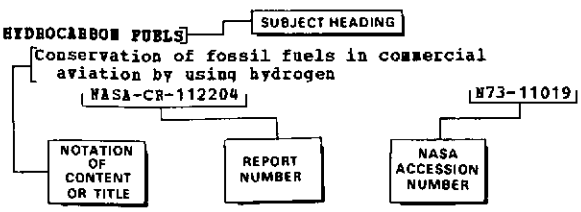

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Acoustic measurements for large model engine-over-wing configurations with conventional and powered lift, various flap settings, and comparison with engine-under-wing aircraft
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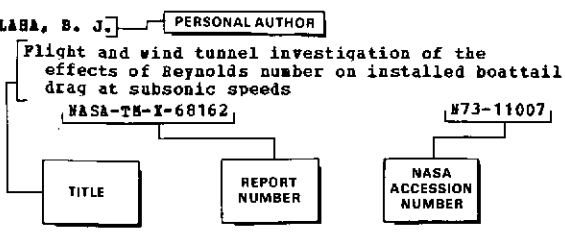

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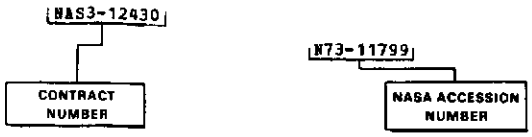

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