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AERONAUTICAL ENGINEERING

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Supplement 39

JANUARY 1974

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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NASA SP-7037 (39)

AERONAUTICAL ENGINEERING

A Special Bibliography

Supplement 39

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 December 1973 in

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

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INTRODUCTION

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

This supplement to *Aeronautical Engineering—A Special Bibliography* (NASA SP-7037) lists 417 reports, journal articles, and other documents originally announced in December 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.

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

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

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All publications abstracted in this Section are available from the Technical Information Service, American Institute of Aeronautics and Astronautics, Inc., (AIAA), as follows: Paper copies are available at $5.00 per document up to a maximum of 20 pages. The charge for each additional page is 25 cents. Microfiche [1] are available at the rate of $1.00 per microfiche for documents identified by the # symbol following the accession number. A number of publications, because of their special characteristics, are available only for reference in the AIAA Technical Information Service Library. Minimum airmail postage to foreign countries is $1.00. Please refer to the accession number, e.g., **A73-10468**, when requesting publications.

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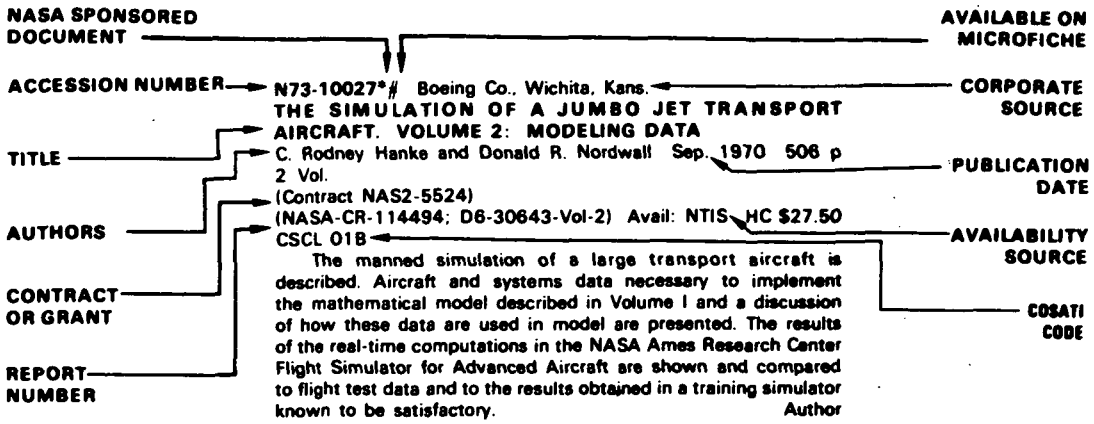

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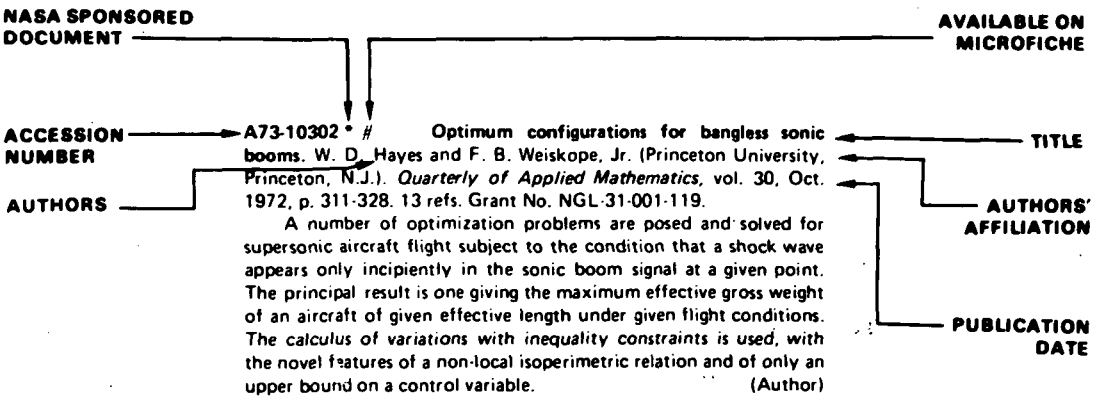

AERONAUTICAL ENGINEERING

A Special Bibliography (Suppl. 39) JANUARY 1974

IAA ENTRIES

A73-43205 # **A note on the flow in a trailing vortex.** K. K. Tam. *Journal of Engineering Mathematics,* vol. 7, Jan. 1973, p. 1-6. 7 refs. National Research Council of Canada Grant No. A-5228.

It is shown that if the equations governing the fluid motion in a trailing vortex are linearized, as was done by Batchelor, more than one solution can be constructed. Within the framework of the linear theory, there is no criterion to determine which solution is to be used. To clarify the situation, the Navier-Stokes equations are formulated in parabolic coordinates, and asymptotic solutions are sought which are valid far downstream. By insisting that the interaction of the swirl with the uniform stream be a first-order effect, the first two terms in the asymptotic expansions for the Stokes stream function and the angular momentun are obtained. The result thus obtained differs from that given by Batchelor in that the axial velocity defect decays algebraically. (Author)

A73-43210 # **On the application of a new version of lifting surface theory to nonslender and kinked wings.** T. E. Labrujere (Nationaal Luchtvaartlaboratorium, Amsterdam, Netherlands) and P. J. Zandbergen (Technische Hogeschool Twente, Enschede, Netherlands). *Journal of Engineering Mathematics,* vol. 7, Jan. 1973, p. 85-96.

Results of a determination of the characteristics of thin wings in subsonic flow by a new elaborate method. Attention is paid to the rate of convergence of the numerical solutions, especially with respect to the number of collocation points. Two rectangular wings have been treated in order to examine the influence of the aspect ratio. The influence of the rounding of a kink is demonstrated by means of a series of constant-chord wings with hyperbolic edges. (Author)

A73-43263 # **Glide modes in problems with a conflict situation (Skol'ziashchie rezhimy v zadachakh s konfliktnoi situatsiei).** E. V. Kuzin. *In: Studies of spacecraft flight dynamics.* Moscow, Izdatel'stvo Nauka, 1973, p. 33-43. 5 refs. In Russian.

The necessary conditions for the existence of an optimal control on a set of glide modes are formulated. The optimality conditions obtained are extended to cover problems with a conflict situation. V.P.

A73-43277 **Sensitivity, adaptivity and optimality; Proceedings of the Third Symposium, Ischia, Italy, June 18-23, 1973.** Sponsored by the International Federation of Automatic Control, Consiglio Nazionale delle Ricerche, and Associazione Nazionale Italiana per l'Automazione. Edited by G. Guardabassi, A. Locatelli, and S. Rinaldi (Milano, Politecnico, Milan, Italy). Düsseldorf, International Federation of Automatic Control; Pittsburgh, Instrument Society of America, 1973. 462 p. $25.

Topics discussed include model reference adaptive techniques, sensitivity and covariance matrices for performance estimation, the effect of feedback control on trajectory sensitivity, the use of the state-space and transfer-function concepts in the design of linear multivariable systems, the synthesis of feedback systems which minimize the effect of sensor white noise at the plant input, the synthesis of parameter- and state-insensitive feedback systems, automatic aircraft landing control, the sensitivity of optimal control systems, the design of adaptive models for real-time identification, the design of discrete model reference adaptive systems, the design of multivariable adaptive models, the synthesis of a two-level controller for linear plants, and the effect of structural perturbations on large-scale dynamic systems. A.B.K.

A73-43284 **Optimal landing flare control of aircrafts with sensitivity consideration.** H. Ohta and I. Sugiura (Nagoya University, Nagoya, Japan). *In: Sensitivity, adaptivity and optimality; Proceedings of the Third Symposium, Ischia, Italy, June 18-23, 1973.* Düsseldorf, International Federation of Automatic Control; Pittsburgh, Instrument Society of America, 1973, p. 251-259. 8 refs.

Theoretical synthesis of an automatic closed-loop optimal landing flare control system characterized by reduced sensitivity. The reduced sensitivity system shows excellent responsiveness to flight velocity and mass parameter variations. Further theoretical and experimental studies are necessary for putting the obtained results into practice. M.V.E.

A73-43288 **Design of multivariable adaptive model following control systems.** I. D. Landau and B. Courtiol (Société Générale de Constructions Electriques et Mécaniques Alsthom, Grenoble, France). *In: Sensitivity, adaptivity and optimality; Proceedings of the Third Symposium, Ischia, Italy, June 18-23, 1973.* Düsseldorf, International Federation of Automatic Control; Pittsburgh, Instrument Society of America, 1973, p. 315-322. 5 refs. Research supported by the Délégation Générale à la Recherche Scientifique et Technique.

The results for the problems of perfect model following and hyperstability of model reference adaptive systems are integrated in order to develop a general design method for multivariable adaptive model following control systems. Two types of adaptation are involved: adaptation of the parameters of the control loop and signal synthesis adaptation for model following control systems with a fixed structure. The design and the implementation of the adaptation mechanism based on the use of a hyperstable adaptation algorithm are discussed. The feasibility and the advantages of the procedure are illustrated by applying it to a nontrivial aircraft control problem. (Author)

A73-43296 **The effect of variable environment temperature on heat transfer in extended surfaces.** D. Pnueli (Technion - Israel Institute of Technology, Haifa, Israel). *Israel Conference on*

Mechanical Engineering, 7th, Haifa, Israel, June 27, 28, 1973.) Israel Journal of Technology, vol. 11, no. 4, 1973, p. 233-235.

Extended surfaces appear as structural members in aircraft. These fin-like parts are subjected to temperatures which can be well above those considered safe. Heat transfer analysis must yield the temperatures which are actually reached by these members. Because modern aircraft design cannot allow for large safety factors, the thermal analysis must be rather accurate. Therefore, a general solution for heat transfer in fins with variable environment temperatures is presented. It is generalized to include variable convection coefficients. Two examples are also presented. (Author)

A73-43327 Emissions from and within an Allison J-33 combustor. II - The effect of inlet air temperature. J. H. Tuttle, R. A. Altenkirch, and A. M. Mellor (Purdue University, West Lafayette, Ind.). *Combustion Science and Technology*, vol. 7, no. 3, 1973, p. 125-134. 10 refs. Environmental Protection Agency Grant No. R-801284.

A model of the flow pattern within an Allison J-33 combustor using unheated inlet air was previously postulated (Mellor et al., 1972), based on internal measurements. Additional data consistent with the postulated flow model were obtained from the same combustor using heated inlet air at near design conditions. Profiles of gas temperature, carbon monoxide, unburned hydrocarbons, and nitric oxide concentrations are reported as a function of axial and radial position inside the combustor. Combustor exit-plane pollutant concentrations are also reported; specifically, the effects of combustor pressure, overall equivalence ratio, air flow rate, and inlet air temperature were investigated. (Author)

A73-43385 Response of glass-fiber-reinforced epoxy specimens to high rates of tensile loading. A. E. Armenakas (Brooklyn, Polytechnic Institute, Brooklyn, N.Y.) and C. A. Sciammarella (Illinois Institute of Technology, Chicago, Ill.). *Experimental Mechanics*, vol. 13, Oct. 1973, p. 433-440. 11 refs. Contract No. F33615-71-C-1533.

A73-43396 A study of a fluidic open loop damping flight stability augmentation system. F. Holoubek (Royal Aircraft Establishment, Farnborough, Hants., England). In: Cranfield Fluidics Conference, 5th, Uppsala, Sweden, June 13-16, 1972, Proceedings. Volume 1. Cranfield, Beds., England, British Hydromechanics Research Association, 1973, p. C3-49 to C3-68. 7 refs.

The ideas underlying the open loop damping method of stability augmentation for flight attitude control systems, its parametric design, and laboratory performance testing are described. The use of conventional response rate feedback, requiring some form of a rate gyroscope, is obviated, in a feed-forward manner, by operating on the demand signal by means of shaping network in such a way as to achieve a system response identical or similar to that realised by the application of rate feedback. The obvious advantage of such an arrangement is the absence of the need of any differentiation, which is here replaced by relatively easier time integration (lead-lag RC networks). The paper outlines the derivation of a suitable shaping function and the calculation of the necessary gains and time constants. (Author)

A73-43466 # Improvement of the corrosion-fatigue strength of aluminum alloys by exposure of the medium to a magnetic field (Povyshenie korrozionno-ustalostnoi prochnosti aliuminievogo splava pri obrabotke sredy magnitnym polem). A. V. Karlashov and I. I. Priakhin (Kievskii Institut Inzhenerov Grazhdanskoi Aviatsii, Kiev, Ukrainian SSR). *Fiziko-Khimicheskaia Mekhanika Materialov*, vol. 9, no. 4, 1973, p. 23-26. 7 refs. In Russian.

A 7000-Oe unipolar constant magnetic field was applied to corrosive media (3% aqueous solution of NaCl, fresh water, and a petroleum fuel) flowing at 0.5 m/sec. The test temperature was 20 C and the usable length 100 mm. It is shown that the fatigue strength in pure bending of aircraft aluminum 2-mm sheet samples exposed to the magnetized medium was greater than in the absence of a magnetic field. V.P.

A73-43493 # Closing the air transport gap on intermodal containers. J. L. Weingarten (USAF, Aeronautical Systems Div., Wright-Patterson AFB, Ohio). *Intersociety Conference on Transportation, 2nd, Denver, Colo., Sept. 23-27, 1973, ASME Paper 73-ICT-30.* 8 p. 7 refs. Members, $1.00; nonmembers, $3.00.

The intermodal container today is still limited to movement by land and sea. The United States Air Force is currently working to close this gap and provide true intermodality. A three-prong approach is underway to determine capabilities and limitations of air movement of containers. This includes a major revision of air transportability concepts, testing of current land-sea containers to determine air movement procedures, and design and development of tri-mode containers. Much of the results of these efforts will help mold air cargo movement of the future. (Author)

A73-43494 # Economics of airport system planning. J. A. Neiss (Aerospace Corp., Los Angeles, Calif.). *Intersociety Conference on Transportation, 2nd, Denver, Colo., Sept. 23-27, 1973, ASME Paper 73-ICT-33.* 8 p. Members, $1.00; nonmembers, $3.00.

An airport system plan generally defines the developmental needs and requirements that are necessary to meet five-, ten-, and twenty-year aeronautical activity forecasts. Unfortunately, these system plans do not adequately address or meet the current economic needs of many of the nation's airports with respect to economics of operation, ownership, and finance. An analysis is made of the economics of airport operation, ownership, and finance, and the economic criteria that should be integrated into airport system planning to produce a viable plan are indicated. (Author)

A73-43495 # Reducing the threat of mid-air collisions. T. M. Johnston (FAA, Technical Programs Div., Washington, D.C.). *Intersociety Conference on Transportation, 2nd, Denver, Colo., Sept. 23-27, 1973, ASME Paper 73-ICT-49.* 7 p. Members, $1.00; nonmembers, $3.00.

A much discussed but poorly understood problem, associated with air travel, is the threat of midair collision by the ever-increasing number of planes utilizing the air space over the United States. This problem is put in the proper perspective, and current efforts by Government and industry to advance the state-of-the-art in collision avoidance systems and to develop a timely solution to the midair collision problem are discussed. (Author)

A73-43496 # Dual lane runway issues. J. C. Koegler (MIT, Lexington, Mass.). *Intersociety Conference on Transportation, 2nd, Denver, Colo., Sept. 23-27, 1973, ASME Paper 73-ICT-61.* 13 p. 5 refs. Members, $1.00; nonmembers, $3.00.

The issues involved in the design and operation of dual-lane runways are discussed. Dual-lane runway questions were investigated via fast-time and real-time simulations at Lincoln Laboratory over the period from October 1971 to December 1972. Included is an overview of the critical issues and findings identified with dual-lane runway configuration and operation. (Author)

A73-43497 # The role ground transportation can play in the airport site selection process. N. F. McGinnis (TRW, Inc., Washington, D.C.). *Intersociety Conference on Transportation, 2nd, Denver, Colo., Sept. 23-27, 1973, ASME Paper 73-ICT-70.* 17 p. Members, $1.00; nonmembers, $3.00.

Significant aspects of the mass transit system analysis activity associated with the recent South Florida Airport Site Selection

Program are discussed. The configuration, performance, cost, and service characteristics of the quasi-conceptual ground access transportation systems continually represented one of the main decision factors as the review authorities deliberated on each candidate airport site. Discussion of the transportation system impact on these deliberations is essentially the prime objective of this presentation. (Author)

A73-43498 * # Some considerations for air transportation analysis to non-urban areas. S. D. Norman (NASA, Ames Research Center, Systems Studies Div., Moffett Field, Calif.). *Intersociety Conference on Transportation, 2nd, Denver, Colo., Sept. 23-27, 1973, ASME Paper 73-ICT-72.* 6 p. 6 refs. Members, $1.00; nonmembers, $3.00.

Review of some of the problems associated with air transportation to and from nonurban areas. While a significant proportion of public transportation needs of nonurban areas are met by aircraft, there are indications that improvement in air transportation service are called for and would be rewarded by increased patronage. However, subsidized local service carriers are attracted by large aircraft operation, and there is a tendency to discontinue service to low density areas. Prospects and potential means for reversing this trend are discussed. M.V.E.

A73-43499 * # Potential of hydrogen fuel for future air transportation systems. W. J. Small, D. E. Fetterman, and T. F. Bonner, Jr. (NASA, Langley Research Center, Hampton, Va.). *Intersociety Conference on Transportation, 2nd, Denver, Colo., Sept. 23-27, 1973, ASME Paper 73-ICT-104.* 11 p. 26 refs. Members, $1.00; nonmembers, $3.00.

Recent studies have shown that hydrogen fuel can yield spectacular improvements in aircraft performance in addition to its more widely discussed environmental advantages. The characteristics of subsonic, supersonic, and hypersonic transport aircraft using hydrogen fuel are discussed, and their performance and environmental impact are compared to that of similar aircraft using conventional fuel. The possibilities of developing hydrogen-fueled supersonic and hypersonic vehicles with sonic boom levels acceptable for overland flight are also explored. (Author)

A73-43520 # The future for STOL. R. E. Hage and M. D. Marks (Douglas Aircraft Co., Long Beach, Calif.). *RAeS, AIAA, and CASI, Anglo-American Aeronautical Conference, 13th, London, England, June 4-8, 1973, Paper.* 6 p.

Technology developments which are important for the future of short takeoff and landing aircraft in the high-density air transport system are examined. The developments relate to the relief of major airport congestion and community acceptance of satellite short-haul airports. A system evaluation is discussed together with the technology base. Attention is given to the high lift system, handling qualities, the functions of the stability augmentation system, aspects of airfoil design, problems of acoustics, and questions of operating economics. G.R.

A73-43720 # A generalization of thin foil theory (Ob odnom obobshchenii teorii tonkogo profilia). I. L. Goloborod'ko and I. V. Ostoslavskii. *Aviatsionnaia Tekhnika,* vol. 16, no. 2, 1973, p. 19-23. In Russian.

Description of a method of determining the aerodynamic characteristics of a slightly bent thin foil in the case of an arbitrarily located flow separation point. The problem is solved on the basis of thin foil theory. Analytical expressions are obtained for determining the lift coefficient and the longitudinal moment of the foil, and a study is made of the effect of the location of the flow separation point on the values of these two parameters. A.B.K.

A73-43722 # The effect of walls on the lifting force of a solid-foil wing (Vliianie stenok na pod'emnuiu silu kryla telesnogo profilia). V. N. Kravets. *Aviatsionnaia Tekhnika,* vol. 16, no. 2, 1973, p. 29-33. 7 refs. In Russian.

Consideration of the motion of a wing in a bounded ideal incompressible two-dimensional fluid flow. It is shown that if the perturbations introduced into the flow by the wing are small, a fairly general theory concerning this motion can be developed with the aid of the acceleration potential method. The solution of the singular integral equations to which this method leads can be simplified by using the asymptotic method of functional parameters. Curves showing the variation of the influence function for specific foil configurations are presented. A.B.K.

A73-43723 # Determination of the deflections and stresses in a small-aspect-ratio wing by the displacement method (K opredeleniiu progibov i napriazhenii v kryle malogo udlineniia metodom peremeshchenii). P. D. Levashov. *Aviatsionnaia Tekhnika,* vol. 16, no. 2, 1973, p. 34-39. In Russian.

Description of a method of obtaining a system of resolvent equations for determining the deflections of the middle plane of a thin-walled small-aspect-ratio wing. The proposed method is similar in form to the Ritz method but differs from it in that the values of the node deflections are taken directly as the unknowns. The boundary kinematic conditions in the root cross section are satisfied by solving a conditional-extremum energy-minimization problem. The system of resolvent equations for the deflections is simple to derive, and the calculation of the coefficients of the unknowns can be easily programmed. A.B.K.

A73-43724 # Calculation of the deformations of a propeller blade in flight (Raschet deformatsii lopasti vozdushnogo vinta v polete). A. Iu. Liss. *Aviatsionnaia Tekhnika,* vol. 16, no. 2, 1973, p. 40-45. 9 refs. In Russian.

Development of a method of calculating the in-flight deformations of a propeller blade with allowance for bending in two planes and torsion. The proposed method is based on an expansion of the deformations in powers of the blade eigenmodes, followed by a determination of the deformation coefficients with the aid of the Galerkin method. In addition, a method of allowing for a nonlinear damper mounted on a vertical hinge is also proposed, as well as a method of allowing for the variability of the blade setting angle with respect to azimuth. A.B.K.

A73-43725 # Study and calculation of the vibrations of a rotating rotor with allowance for clearances in the bearings (Issledovanie i raschet kolebanii vrashchaiushchegosia rotora s uchetom zazorov v oporakh). Iu. M. Klimov. *Aviatsionnaia Tekhnika,* vol. 16, no. 2, 1973, p. 46-52. 6 refs. In Russian.

Consideration of the problem of calculating the nonlinear vibrations of elastically deformable rotors of gas turbine engine compressors and turbopump units with allowance for radial clearances in the bearings. The equations describing the forced vibrations of such a rotor are derived, and an approximate analytical method of solving them is proposed. The results of theoretical and experimental studies of the effect of clearances and rotor imbalance on the excitation of parametric vibrations are presented. Recommendations are made regarding the elimination of dangerous resonances so as to improve the reliability of the machines. A.B.K.

A73-43728 # Designing a slender-wing-type cantilever plate under conditions of unsteady creep (Raschet konsol'noi plastiny tipa tonkogo kryla v usloviiakh neustanovivsheisia polzuchesti). V. G. Shataev. *Aviatsionnaia Tekhnika,* vol. 16, no. 2, 1973, p. 66-71. 7 refs. In Russian.

A73-43733 # Thermodynamics of an air-cooled gas-turbine stage (K termodinamike stupeni gazovoi turbiny s vozdushnym okhlazhdeniem). E. N. Bogomolov. *Aviatsionnaia Tekhnika,* vol. 16, no. 2, 1973, p. 97-106. In Russian.

Formulas are derived for calculating the efficiency and other principal parameters of a gas-turbine stage with air-cooled nozzle ring and rotor. The formulas are valid in the case where the cooling air is fed into the air-gas flow area. Quantitative estimates of the enthalpy drop in the rotor and other thermodynamic effects are obtained from example computations. V.P.

A73-43735 # Vibrations of turbojet-engine components containing structural dampers of the type of sandwich rods (K zadache o kolebaniiakh detalei TRD, soderzhashchikh konstruktsionnye dempfery tipa sloenykh sterzhnei). A. A. Samarin. *Aviatsionnaia Tekhnika,* vol. 16, no. 2, 1973, p. 111-115. In Russian.

The problem of determining the dissipation of the vibrational energy in a two-layer rod of arbitrarily varying cross section is examined. The layers are pressed together by a force that varies along the rod's length. The interface is governed by Coulomb's dry friction law. Inertia forces are taken into account. An expression for calculating the mutual slipping of the layers is derived for the case of phased vibrations of the layers. V.P.

A73-43736 # Classification of methods for solving the direct problem of axisymmetric flow calculation in turboengines (O klassifikatsii metodov resheniia priamoi zadachi rascheta osesimmetrichnogo potoka v turbomashinakh). A. M. Topunov and R. D. Iosifov. *Aviatsionnaia Tekhnika,* vol. 16, no. 2, 1973, p. 116-121. 33 refs. In Russian.

A73-43740 # Effect of the circumferential nonuniformity of a temperature field in front of a turbine on the vibrational stresses in the turbine blades (O vliianii okruzhnoi neravnomernosti temperaturnogo polia pered turbinoi na vibronapriazhennost' rabochikh lopatok). N. A. Gachegov and V. D. Ronzin. *Aviatsionnaia Tekhnika,* vol. 16, no. 2, 1973, p. 131-135. In Russian.

A73-43741 # The problem of extrapolating test data on the efficiency of turbine-blade cooling to actual conditions (K voprosu perenesenila rezul'tatov opytov po effektivnosti okhlazhdenila turbinnykh lopatok na naturnye usloviia). V. I. Lokai and A. S. Limanskii. *Aviatsionnaia Tekhnika,* vol. 16, no. 2, 1973, p. 135-143. 10 refs. In Russian.

Lokai's (1970) formulas for extrapolating cooling efficiency to actual high-altitude conditions are verified experimentally, using a gasdynamic test stand and longitudinally cooled turbine blades. The need for careful study of the heat transfer in the cooling channels of rotating blades is demonstrated. V.P.

A73-43742 # Synchronized operation of a positive-displacement gear pump and a vane pump within the lubricant oil delivery system of a jet engine (O sovmestnoi rabote ob'emnogo i lopatochnogo nasosov v kachaiushchem agregate maslosistemy VRD). V. A. Rakhal'skii. *Aviatsionnaia Tekhnika,* vol. 16, no. 2, 1973, p. 144-147. In Russian.

The efficiency of two versions of a jet-engine high-speed oil delivery system is analyzed and compared. One system consists of a vaned booster pump which supplies the oil to a conventional positive-displacement gear pump, and whose rpm's may be higher than those of the gear pump. The other system uses a common shaft to drive a gear and centrifugal impellers mounted in front of the gear. It is shown that the first system is the more efficient one. It provides synchronous operation over the entire range of rpm's. Maximum-power altitude is limited only by the cavitation parameters of the vane pump. V.P.

A73-43743 # Utilization of semiartificial thermocouples in gas-turbine engine tests (K voprosu primeneniia poluiskusstvennykh termopar pri ispytaniiakh gazoturbinnykh dvigatelei). D. F. Simbirskii, L. S. Grigor'ev, A. Ia. Anikin, and L. O. Miroshnichenko. *Aviatsionnaia Tekhnika,* vol. 16, no. 2, 1973, p. 148-150. In Russian.

Thermocouples, one of whose wires was prepared from the same metal as the component studied, were used to determine the temperature fields in combustion-chamber casings, disks, and blades of gas turbine engines. It is found that the use of such 'semiartificial' thermocouples diminishes the distortion of the temperature fields. The thermoelectric properties of a number of heat-resistant alloys are studied at temperatures of up to 1200 C. V.P.

A73-43809 Fatigue crack growth retardation after single-cycle peak overload in Ti-6Al-4V titanium alloy. R. E. Jones (Dayton, University, Dayton, Ohio). *Engineering Fracture Mechanics,* vol. 5, Sept. 1973, p. 585-604. 13 refs.

A73-43811 Environmental effects on fracture resistant and biaxial fatigue design of aircraft structures. U. G. Goransson and D. D. Froerer (Boeing Co., Seattle, Wash.). *(Symposium on Fracture and Fatigue, George Washington University, Washington, D.C., May 3-5, 1972.) Engineering Fracture Mechanics,* vol. 5, Sept. 1973, p. 627-645. 10 refs.

Discussion of the two interrelated fields of crack initiation and crack propagation, presenting analytical techniques for calculating fatigue damage in biaxially stressed structures along with determinations of safe inspection intervals for contained crack growth. The equivalent stress concept is used to derive a set of uniaxial stresses that produce the same amount of fatigue damage as the biaxial stress exposure. The distortion energy concept serves as the basis for combining alternating principal stresses by translating the uniaxial SN curves for zero mean stress into a family of concentric ellipses. Empirical procedures are given for treating problems with varying principal stress directions and areas with directionally dependent fatigue performance. The Goodman diagram relates alternating stresses and mean stresses at any constant cyclic life. If two uniaxial Goodman diagrams are constructed on each reference axis, a three-dimensional body can be visualized which intercepts the zero alternating stress plane in a shape identical to that described by the applicable static load criterion. (Author)

A73-43813 * Fracture analysis of surface- and through-cracked sheets and plates. J. C. Newman, Jr. (NASA, Langley Research Center, Hampton, Va.). *(Symposium on Fracture and Fatigue, George Washington University, Washington, D.C., May 3-5, 1972.) Engineering Fracture Mechanics,* vol. 5, Sept. 1973, p. 667-689. 33 refs.

The Neuber stress-concentration relation for notches in an elastic-plastic material subjected to shear loading was generalized for a crack in a finite plate subjected to tensile loading. An equation was derived which related the linear elastic stress-intensity factor, the applied stress, and two material parameters. The equation was then used as a two-parameter fracture criterion for surface- and through-cracked specimens. Fracture data from the literature on surface- and through-cracked sheet and plate specimens of steel, titanium alloy, titanium weldment, and aluminum alloy tested at room and cryogenic temperature were analyzed according to the proposed equation. For surface cracks, wide ranges of crack-depth to crack-length ratio and crack-depth to specimen-thickness ratio were considered. For through cracks, wide ranges of crack length and specimen width were also considered. (Author)

A73-43859 Meridional distribution of tropospheric ozone from measurements aboard commercial airliners. H. K. Tiefenau, P. G. Pruchniewicz, and P. Fabian (Max-Planck-Institut für Aeronomie, Lindau über Northeim, West Germany). *(Symposium on Atmospheric Ozone, Arosa, Switzerland, Aug. 21-25, 1972.) Pure and Applied Geophysics,* vol. 106-108, no. 5-7, 1973, p. 1036-1040. Research supported by the Deutsche Forschungsgemeinschaft.

A73-43911 **Present status and development trends in the processing of titanium (Stand und Entwicklungstendenzen der Titanverarbeitung).** H. Kellerer and G. Gans (Messerschmitt-Bölkow-Blohm GmbH, Munich, West Germany). *(Universität Erlangen-Nürnberg, Hauskolloquium, 3rd, Erlangen, West Germany, Oct. 12, 1972.) Zeitschrift für Metallkunde,* vol. 64, Sept. 1973, p. 606-612. 11 refs. In German.

Metal-physical parameters strongly influence the technology of fabrication of titanium alloys: hexagonal structure, high strength at low Young's modulus, Bauschinger effect, high affinity to oxygen, stable oxides, susceptibility to hydrogen embrittlement, stress corrosion cracking by halogens, and low thermal conductivity. Techniques of fabrication are described which serve to overcome these problems in aeronautic and space applications: hot forming - e.g., by creep and relaxation deformation, shaping by chemical means and spark cutting, electron beam and diffusion welding under vacuum, stress relaxation annealing, special quenching media, and coating and hardening of surfaces. Moreover, unsolved problems - e.g., problems regarding techniques and heat treatments - are discussed. (Author)

A73-44000 **Aluminum brazed titanium honeycomb sandwich structure - A new system.** S. D. Elrod, D. T. Lovell, and R. A. Davis (Boeing Co., Seattle, Wash.). *(American Welding Society and Welding Research Council, International Brazing Conference, 4th, Chicago, Ill., Apr. 4, 5, 1973.) Welding Journal, Research Supplement,* vol. 52, Oct. 1973, p. 425-s to 432-s.

The results of a development and production scale-up program for an Al-brazed Ti honeycomb sandwich structure are summarized, covering tests results for corrosion resistance, creep, metallurgical stability, mechanical strength, and fracture toughness. Creep-rupture tests were conducted at 450, 600 and 800 F. The corrosion tests included aircraft service of about three years, laboratory salt spray tests, and electric-potential measurements. The flatwise tension creep-rupture strength was adequate for structural applications of 800 F. The corrosion resistance was essentially equivalent to that of 3033 aluminum sheet. The production process is evaluated positively for 800 F operation, wedge and acoustic panel designs, and panel configurations for 30,000 lb/in. Cost analysis shows that the structure is economically feasible for high performance vehicles. V.Z.

A73-44025 **The effect of composition changes on the fracture toughness of an Al-Zn-Mg-Cu-Mn forging alloy.** C. J. Peel and P. J. E. Forsyth (Royal Aircraft Establishment, Materials Dept., Farnborough, Hants., England). *Metal Science Journal,* vol. 7, July 1973, p. 121-127. 15 refs.

A73-44052 **Society of Flight Test Engineers, National Symposium, 3rd, Arlington, Tex., September 11-14, 1972, Proceedings.** *California, Md., Society of Flight Test Engineers,* 1973. 420 p.

Aspects of FAA certification flight testing are discussed together with details of Army flight test program management, the management of Air Force test and evaluation activities, the flight test programs of the Naval Air Systems Command, the management of commercial flight test programs, and the control of flight test programs at Bell Helicopter Company. The role of a military flight test engineer in test management and the capabilities of government test facilities are considered. G.R.

A73-44053 # **Management and control of flight test programs of the Western Region FAA.** C. E. Richards (FAA, Aircraft Engineering Div., Los Angeles, Calif.). In: Society of Flight Test Engineers, National Symposium, 3rd, Arlington, Tex., September 11-14, 1972, Proceedings. California, Md., Society of Flight Test Engineers, 1973. 30 p.

The mission performed by the Aircraft Engineering Division of the Federal Aviation Administration (FAA) is considered. As a service organization, the Aircraft Engineering Division influences the management and planning of a manufacturer's test program but does not directly manage it. Basically, the Aircraft Engineering Division certificates the aircraft which use the airports and airways. The specialties involved in certifying a modern complex aircraft are examined. The certification requires a close coordination of the Manufacturing Inspection Branch, the Airframe Branch, the Systems and Equipment Branch, the Propulsion Branch, and the Flight Test Branch. Questions regarding the general philosophy behind the certification program are discussed and sample pages from a typical flight test program are provided. G.R.

A73-44054 # **Management and control of flight test programs at U.S. Army Aviation Systems Command.** C. C. Crawford, Jr. (U.S. Army, Washington, D.C.). In: Society of Flight Test Engineers, National Symposium, 3rd, Arlington, Tex., September 11-14, 1972, Proceedings. California, Md., Society of Flight Test Engineers, 1973. 28 p.

Organizational questions are considered, giving attention to the Contractor's Development and Airworthiness Qualification Program. The tests are done entirely by industry and witnessed to varying extents by Army technical specialists. Specifications are provided to industry regarding the tests required to convince the Army that the aircraft is in fact airworthy. Tests carried out by industry are supplemented with tests conducted by the Army within the framework of an Army Preliminary Evaluation (APE). The APE's are generally short two week evaluations. A typical program would involve one APE early for performance assessment. Other investigations include a flying qualities evaluation and an evaluation of key subsystems on the aircraft. These tests are followed by endurance tests, flight characteristics tests, climatic laboratory tests, and a service test. G.R.

A73-44055 # **Management of Air Force test and evaluation activities.** J. P. Streit (USAF, Systems Command, Andrews AFB, Washington, D.C.). In: Society of Flight Test Engineers, National Symposium, 3rd, Arlington, Tex., September 11-14, 1972, Proceedings. California, Md., Society of Flight Test Engineers, 1973. 51 p.

The Air Force manages a wide variety of testing activities beginning with such tasks as the examination of the smallest pieces or components undergoing environmental or qualification testing and extending to the assessment of the relative effectiveness of different tactical applications of entire new weapon systems. In addition, there are other testing programs related to basic research and technology advancement. The current Air Force test and evaluation (T and E) management concepts are discussed, giving attention to the evolution of these concepts in the period since about 1967. The total Air Force test and evaluation work effort is now divided into three broad classes, including R and D T and E, acquisition T and E, and engineering services T and E. G.R.

A73-44056 # **Management and control of flight test programs of the Naval Air Systems Command.** F. H. Baughman (U.S. Naval Air Systems Command, Washington, D.C.). In: Society of Flight Test Engineers, National Symposium, 3rd, Arlington, Tex., September 11-14, 1972, Proceedings. California, Md., Society of Flight Test Engineers, 1973. 17 p.

The planning and setting up of a flight test program for a major Navy weapons systems development are discussed, giving attention to Navy project manager reporting relationships. The S-3A Viking contractor flight test program considered consists of three interlocking phases, including a detailed laboratory test integration and evaluation program. The second phase, the flying test bed, is an intermediate step between the laboratory and aircraft tests. The third phase is the normal aircraft flight test program itself. Questions of avionics development and testing are explored together with aspects of the S-3A initial operational test and evaluation. G.R.

A73-44057 # **Management and control of commercial flight test programs.** H. W. Zimmerman (Boeing Co., Flight Operations Dept., Seattle, Wash.). In: Society of Flight Test Engineers, National Symposium, 3rd, Arlington, Tex., September 11-14, 1972, Proceedings. California, Md., Society of Flight Test Engineers, 1973. 33 p.

The historical evolution of commercial flight test programs is discussed, giving attention to advances occurring in response to the changes which took place since 1963 in the commercial transport market. Various aspects regarding the development of the Boeing 747 are considered, taking into account special design problems and aerodynamic testing conducted with the aid of an onboard electronic calculator. Questions of specific program responsibilities are investigated. Details of aircraft control are discussed together with the responsibilities of the product division, the technology staff of the group engineering, and the flight operations department. The manufacturing preflight is considered along with the results of the Boeing 747 flight test program. G.R.

A73-44058 # **Management and control of military and commercial flight test programs at Bell Helicopter Company.** R. H. Wheelock (Bell Helicopter Co., Fort Worth, Tex.). In: Society of Flight Test Engineers, National Symposium, 3rd, Arlington, Tex., September 11-14, 1972, Proceedings. California, Md., Society of Flight Test Engineers, 1973. 13 p.

Problem areas which have to be investigated are related to torsional stability, power management, fuel control characteristics, preflight ground endurance, components fatigue life, static and dynamic stability of the machine, cooling, and throttle response. Aspects of management procedures are considered, taking into account general technical measurements, instruction influence, data management, and cost-time schedule performance. Questions of instrumentation are discussed together with approaches for the efficient evaluation of test data. The responsibilities of various experts involved in the analysis of the test are examined. Attention is given to cost-schedule performance control methods designed to avoid major cost overruns in the development of the aircraft. G.R.

A73-44059 # **Management and control of military flight test programs at McDonnell Douglas St. Louis, Missouri.** R. L. Tuttle (McDonnell Douglas Corp., St. Louis, Mo.). In: Society of Flight Test Engineers, National Symposium, 3rd, Arlington, Tex., September 11-14, 1972, Proceedings. California, Md., Society of Flight Test Engineers, 1973. 26 p.

A contractor must thoroughly understand the objective of the weapon system and must design and test it for the most probable critical service environments. Testing requires sound management techniques. Basic considerations peculiar to test program management are discussed. In the development phase, fatigue testing will investigate the life of the system. The various phases of flight testing are described. Questions of test effectiveness are examined along with test program plans and requirements of test support. G.R.

A73-44060 # **SFTE Symposium 12 October 1972.** F. G. Edwards (Grumman Aerospace Corp., Bethpage, N.Y.). In: Society of Flight Test Engineers, National Symposium, 3rd, Arlington, Tex., September 11-14, 1972, Proceedings. California, Md., Society of Flight Test Engineers, 1973. 52 p.

A number of basic questions regarding the objectives of flight tests are examined, giving attention to the responsibility to the customer, obligations to the corporation, and organizational relations. A flight test system was developed through the integration of five elements, including detailed planning, advanced test techniques, supporting facilities, integrated flight operations, and control. The heart of the flight test system is an Automated Telemetry Station (ATS). ATS test operations are discussed together with ATS real time benefits, integrated flight operations, budget considerations, and plans for improvements. G.R.

A73-44061 # **Air Force Prototype Program management.** R. E. Whelan (USAF, Prototype Program Office, Wright-Patterson AFB, Ohio). In: Society of Flight Test Engineers, National Symposium, 3rd, Arlington, Tex., September 11-14, 1972, Proceedings. California, Md., Society of Flight Test Engineers, 1973. 34 p.

The Charter of the AF Advanced Prototype Program Office basically delineates a low cost advanced development effort for the development of advanced prototype aircraft and subsystems for technical evaluation against anticipated operational needs. The factors which characterize adaptive management as applied to advanced prototype programs are discussed. The prototype program concept is considered together with questions of prototype program office organization, the responsibilities of Air Force and other government agencies, aspects of program control, engineering, procurement/financial management, and logistics. The lightweight fighter prototype project is examined as one of the major programs to result from the prototype study. G.R.

A73-44062 # **The role of a military flight test engineer in test management.** J. K. Potts (USAF, Aeronautical Systems Div., Wright-Patterson AFB, Ohio). In: Society of Flight Test Engineers, National Symposium, 3rd, Arlington, Tex., September 11-14, 1972, Proceedings. California, Md., Society of Flight Test Engineers, 1973. 16 p.

Test and evaluation is the single largest task of the Air Force Systems Command. The Air Force flight test engineer has the background to play an important role in flight test management beyond the actual testing operations. The flight test engineer at the Air Force Flight Test Center is not a specialist. He reads film, prepares test plans, develops data reduction routines, flies in the test aircraft and plots and analyzes the test data. If he demonstrates the necessary competence he will become a project engineer responsible for an entire flight test program. After one or two major projects the project engineer will become a flight test manager at the test center level. The genesis of an engineering development program is discussed, giving particular attention to the role of the flight test manager. G.R.

A73-44063 # **NAFEC test facilities.** R. M. Spangler (FAA, National Aviation Facilities Experimental Center, Atlantic City, N.J.). In: Society of Flight Test Engineers, National Symposium, 3rd, Arlington, Tex., September 11-14, 1972, Proceedings. California, Md., Society of Flight Test Engineers, 1973. 27 p.

Technical data are presented regarding the functions and capabilities of the test-bed, service, and commissioned facilities at the National Aviation Facilities Experimental Center (NAFEC), Atlantic City, New Jersey. The background of NAFEC is discussed together with the range instrumentation environment, the navigational aids environment, the communications environment, the ATC systems laboratory environment, the service facilities environment, the aircraft safety environment, the aircraft environment, the airport environment, and the computation environment. Other subjects considered include the magnetic tape data acquisition systems, the flight simulation facility, and the vortex measurement facility. G.R.

A73-44064 # **The capabilities of army test facilities.** S. G. Cockerham (U.S. Army, Washington, D.C.). In: Society of Flight Test Engineers, National Symposium, 3rd, Arlington, Tex., September 11-14, 1972, Proceedings. California, Md., Society of Flight Test Engineers, 1973. 55 p.

The Army test capabilities which are dedicated to aircraft testing are discussed, giving attention to the people, the locations, and the equipment which provide these capabilities. Questions of organizational relations are considered. The Aviation Systems Command is responsible for aircraft procurement, engineering, engineering flight tests, and logistics support. The Test and Evaluation Command tests and evaluates all Army Materiel Command material

with the exception of aircraft. Important installations include the Electronic Proving Ground, the Yuma Proving Ground, the Tropic Test Center, and the Central Ground Station. G.R.

A73-44066 # **Remarks before the Third National Symposium Society of Flight Test Engineers 13 September 1972.** R. M. Isaman (U.S. Naval Air Test Center, Patuxent River, Md.). In: Society of Flight Test Engineers, National Symposium, 3rd, Arlington, Tex., September 11-14, 1972, Proceedings. California, Md., Society of Flight Test Engineers, 1973. 12 p.

The Navy's capabilities for the test and evaluation of aircraft are examined, giving attention to organizational relationships. The Naval Civil Engineering Laboratory, the Naval Electronics Laboratory Center, the Naval Ordnance Laboratory, and the Naval Undersea Center are oriented along technology lines. The Naval Air Development Center and the Naval Ship Research and Development Center are concerned with associated technologies such as the materials, structures, fluid dynamics, and control problems of aircraft and ships. The Naval Weapons Laboratory and the Naval Weapons Center are focused on surface warfare, air warfare, and air-launched weapons. G.R.

A73-44155 # **On the process of precipitation in Mg-Ce alloy.** G. Omori, S. Matsuo (National Research Institute for Metals, Tokyo, Japan), and H. Asada (Nihon University, Chiba, Japan). *Japan Institute of Metals, Journal,* vol. 37, July 1973, p. 677-682. 17 refs. In Japanese, with abstract in English.

The precipitation process in Mg-1.3 wt % Ce alloy was studied by means of electrical resistivity measurement and electron microscopy. On isochronal annealing of the alloy, the electrical resistivity decreased gradually up to about 200 C, followed by an abrupt decrease between 200 and 325 C. This abrupt decrease was attributed to the precipitation of an intermediate phase. On further heating, the electrical resistivity increased steadily, but the increase halted temporarily at 450 to 500 C. At this stage, the precipitation of the equilibrium phase was observed. On isothermal annealing in the temperature range from 100 to 150 C, the electrical resistivity decreased in two stages. Following Johnson-Mehl equation, the values of 2/3 and 1.0 were obtained as the time exponents, n, for the first and second stage, respectively. Using the isothermal curves of resistivity change, estimations of apparent activation energies for the above two stages were also made. (Author)

A73-44219 **Measuring technological change - Aircraft turbine engines.** A. J. Alexander and J. R. Nelson (Rand Corp., Santa Monica, Calif.). *Technological Forecasting and Social Change,* vol. 5, no. 2, 1973, p. 189-203. 5 refs.

A technique for measuring technological change is discussed, giving attention to the definition of a breakthrough and the meaning of the phrase that a device is ahead of its time. The analysis conducted is confined to the development process. It proceeds on the assumption that the device under development can be adequately characterized by a limited number of parameters. The increase in the value of the parameter set is called technological advance. Basic research and invention are excluded. American aircraft turbine engines are selected as the initial subject for testing the new technique. A statistical analysis of a data sample on turbine engines is performed. The analysis of technological change is extended to take into account additional factors. Thus, a technological production function is defined. The function relates the technology and production costs to the resources or costs of development. G.R.

A73-44223 * # **The many uses of the dirigible.** J. R. Hunt (Embry-Riddle Aeronautical University, Daytona Beach, Fla.), B. B. Levitt (Operations Research, Inc., Silver Spring, Md.), F. Morse (Boston University, Boston, Mass.), K. R. Stehling (NASA, Washington, D.C.), and J. G. Vaeth (NOAA, National Environmental Satellite Service, Washington, D.C.). *Astronautics and Aeronautics,* vol. 11, Oct. 1973, p. 58-65. 6 refs.

Prospects for a revival of large airships are based on a number of unique services which can be provided by the dirigibles. It is shown that airships are not unduly weather-sensitive. Modern technological advances will give the airship of the future operational features which will be greatly superior to those of the Zeppelins of the past. Projections set the payload of a 22-million-cu ft conventionally propelled airship of conservative design at 615,000 lb for a range of 2950 mi. The corresponding figure for the C-5A aircraft is only 265,000 lb. Dirigibles could, therefore, become merchant ships of the air, carrying low-density and large-dimension cargoes that jet freighters find economically unattractive or practically impossible to handle. The absence of landing-facility requirements would make the airship a logical candidate for introducing trade into otherwise inaccessible regions of the world. G.R.

A73-44292 # **Errors produced by the influence of unsteady heating in strain measurement by wire-type resistance strain gages (Pogreshnost' v izmerenii deformatsii provolochnymi tenzorezistorami, obuslovlennaia vliianiem nestatsionarnogo nagreva).** A. N. Ser'eznov and G. A. Tsareva. *Problemy Prochnosti,* vol. 5, Aug. 1973, p. 85-87. 7 refs. In Russian.

A73-44294 # **Determination of the temperature fields of turbine disks and blades, using irradiated diamond indicators (Opredelenie polei temperatur diskov i lopatok turbin indikatorami iz obluchennogo almaza).** E. F. Barbashin, K. S. Pul'kis, and V. A. Nikolaenko. *Problemy Prochnosti,* vol. 5, Aug. 1973, p. 117-119. In Russian.

The method proposed is based on the property of a crystalline diamond to increase the volume of the crystal lattice under bombardment by high-energy particles, and to gradually decrease the volume to the initial size under the effect of heating. The method provides an effective means of monitoring turbine temperatures in the temperature range from 130 to 1200 C. V.P.

A73-44329 **Determinate systems on modal control theory.** T. P. Grigor'eva and L. I. Kozhinskaia. *(Avtomatika i Telemekhanika,* Apr. 1973, p. 5-8.) *Automation and Remote Control,* vol. 34, no. 4, Sept. 1, 1973, pt. 1, p. 513-516. Translation.

Consideration of the problem of synthesizing a linear control system with a desired spectrum on the basis of incomplete information regarding this system. Necessary and sufficient conditions are obtained under which a closed-loop linear control system possesses a desired spectrum and the information vector of the system has a minimum dimension. A.B.K.

A73-44377 # **Dynamic buckling of an axially compressed cylindrical shell with discrete rings and stringers.** C. A. Fisher and C. W. Bert (Oklahoma, University, Norman, Okla.). *(Canadian Congress of Applied Mechanics, 4th, Montreal, Canada, May 28-June 1, 1973.) ASME, Transactions, Series E - Journal of Applied Mechanics,* vol. 40, Sept. 1973, p. 736-740. 19 refs.

As an exploratory effort toward improving the crashworthiness of light aircraft cabins, a theoretical analysis was made to predict the dynamic buckling load and buckling time of a stiffened, thin-walled circular cylindrical shell. To provide for the large stiffener spacing in light aircraft, the stiffeners were considered as discrete elements by means of a Dirac delta procedure. The nonlinear governing equations were derived using Hamilton's principle and the final equations were obtained by means of Galerkin's method. Solution was carried out by using a Gauss-Jordan technique on the algebraic equations and a Runge-Kutta technique on the nonlinear differential equations. Numerical results are presented for an idealized model of a typical light aircraft cabin. (Author)

A73-44575 **The translantic charter policy of the United States.** L. S. Keyes. *Journal of Air Law and Commerce,* vol. 39, Spring 1973, p. 215-248. 81 refs.

In 1972, the governments of both the U.S. and the UK abandoned longstanding restrictive attitudes toward the air transportation of passengers by charter carriers and by charters operated by scheduled carriers. The early policy of extreme caution on the part of the U.S. toward independent international charter air carriage is considered together with the change in policy and its impact on IATA fares. Questions of the expansion of charter traffic and the renewal of certificates are examined. Recent moves towards liberalization are discussed, giving attention to the disapproval of resolution 045, the adoption of nonaffinity charter regulations, and efforts to regularize charter landing rights. G.R.

A73-44690 **The aerodynamics of aircraft and other things /Fifteenth Lanchester Memorial Lecture/.** P. R. Owen (Imperial College of Science and Technology, London, England). *Aeronautical Journal,* vol. 77, Aug. 1973, p. 383-405. 65 refs.

A review of some basic problems of aircraft aerodynamics, including the author's contributions to the field. Among the topics covered are the slender body theory, the responses of airships and buildings to atmospheric turbulence, boundary layers vs atmospheric turbulence, wind tunnel contractions, grids and boiler tubes as turbulence agents, aircraft radiator blocks, and various types of vortex-induced oscillations. Rough surfaces and sand storms, wind tunnel simulation, laminar flows, turbulent-to-laminar flow transition in the human lung, and a hypersonic flow past a blunt body are also considered. V.Z.

A73-44692 **On problems of flight over an extended angle-of-attack range.** H. H. B. M. Thomas (Royal Aircraft Establishment, Farnborough, Hants., England). *Aeronautical Journal,* vol. 77, Aug. 1973, p. 412-423. 53 refs.

An attempt is made at providing a basis for the preparation of brief background leaflets as supplements to airworthiness requirement statements, with particular attention to adequate high lift performance and safe post-stall flight control of the aircraft. The topics include design features affecting aircraft performance under limiting angle-of-attack conditions, lateral forces and moments, interactions between wind and various aircraft components, control effectiveness, and buffeting. The needed wind tunnel tests and flight dynamics analysis at and beyond critical conditions are considered. V.Z.

A73-44695 F-14. M. Wilson. *Flight International,* vol. 104, Sept. 27, 1973, p. 508-517.

The F-14 Tomcat is intended to replace the Phantom. The aircraft is to be used for escort missions, fleet defense, interdiction, and close support. The top speed called for is a little over Mach 2.2, permitting the use of conventional aluminum-based alloys. By the refuelling technique F-14s can be kept airborne for periods from 4 to 8 hrs, limited only by crew fatigue. Structurally the Tomcat is significant in being the first Western aircraft designed to use composite materials for load-bearing applications. G.R.

A73-44702 # **Piecewise-one-dimensional models of supersonic combustion and pseudoshock in a channel (O kusochno-odnomernykh modeliakh sverkhzvukovogo goreniia i psevdoskachka v kanale).** E. S. Shchetinkov. *Fizika Goreniia i Vzryva,* vol. 9, July-Aug. 1973, p. 473-483. 15 refs. In Russian.

Analysis of the phenomenon of thermal cutoff which limits a one-dimensional heat input to a supersonic flow in a cylindrical channel. It is found that thermal cutoff of a supersonic flow occurs according to different mechanisms in long and short pipes. In long pipes with a developed boundary layer combustion occurs in the presence of a pseudoshock, while in short pipes no pseudoshock is formed. In the case of supersonic combustion in a long pipe it is shown that a one-dimensional calculation of the flow parameters from the measured wall pressure leads to contradictory results in regimes far from thermal cutoff. A calculation of the parameters of a supersonic flame jet from the measured wall pressure in the case of the two-stream Crocco model also leads to contradictory results. Results which are physically more justifiable are obtained for a separation model which assumes the presence of separation zones in the flow. The separation model also makes it possible to give a quantitative description of the flow in an isothermal pseudoshock. A.B.K.

A73-44827 # **Supersonic jet noise generated by large scale disturbances.** C. K. W. Tam (Florida State University, Tallahassee, Fla.). *American Institute of Aeronautics and Astronautics, Aero-Acoustics Conference, Seattle, Wash., Oct. 15-17, 1973, Paper 73-992.* 14 p. 22 refs. Members, $1.50; nonmembers, $2.00. NSF Grant No. GK-35790.

A number of experimental evidence and theoretical arguments are now available to suggest that the dominant part of supersonic jet noise is produced by orderly large scale disturbances in the jet flow. This paper presents a mathematical theory which predicates the total noise power and its directional distribution of a nearly ideally expanded supersonic jet generated by this process. Supersonic jet flows are highly unstable. The amplified large scale disturbances of the flow not only enhance the unsteady entrainment of ambient gas into the jet, but also cause the jet to vibrate laterally. Both of these phenomena result in the emission of acoustic waves to the ambient environment. Numerical calculations on a Mach 2.2 cold supersonic jet based on the present theory compare favorably with experimental measurements. (Author)

A73-44829 # **Acoustic fatigue resistance of aircraft structures at elevated temperatures.** C. W. Schneider (Lockheed-Georgia Co., Marietta, Ga.) and F. F. Rudder (Acoustics and Vibration Associates, Inc., Smyrna, Ga.). *American Institute of Aeronautics and Astronautics, Aero-Acoustics Conference, Seattle, Wash., Oct. 15-17, 1973, Paper 73-994.* 9 p. 11 refs. Members, $1.50; nonmembers, $2.00. Contract No. F33615-72-C-1141.

An analytical and experimental program was conducted to develop acoustic fatigue design criteria for aircraft structures subjected to intense noise in a high temperature environment. Equations for the dynamic response of a buckled panel were formulated for simply supported and clamped boundary conditions using large deflection plate theory. Random amplitude acoustic fatigue testing of representative aircraft structure was accomplished at temperatures up to 600 F to provide data for correlation with the analytical results. Empirical design criteria are presented in the form of design equations and nomographs for predicting the thermal and dynamic response of aircraft structures subjected to combined environments. (Author)

A73-44834 * # **Subsonic and supersonic jets and supersonic suppressor characteristics.** H. T. Nagamatsu and R. E. Sheer, Jr. (GE Research and Development Center, Schenectady, N.Y.). *American Institute of Aeronautics and Astronautics, Aero-Acoustics Conference, Seattle, Wash., Oct. 15-17, 1973, Paper 73-999.* 25 p. 36 refs. Members, $1.50; nonmembers, $2.00. NASA-FAA-supported research.

The flow and acoustic characteristics over a Mach number range of 0.6 to 1.5 were determined for convergent and parallel flow nozzles with room temperature air. Mean velocity and fluctuating impact and static pressure distributions were investigated. Near- and far-field acoustic measurements were obtained, and overall sound power levels were compared with subsonic theory of Lighthill and supersonic theory of Nagamatsu and Horvay. Flow and acoustic characteristics of single and multiple shroud supersonic suppressors were studied. With 191 tubes and shrouds the overall sound power level for a Mach 1.4 jet was reduced 15.3 and 20.5 db respectively. (Author)

A73-44836 * # **Jet noise suppression by swirling the jet flow.** I. R. Schwartz (NASA, Ames Research Center, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Aero-Acoustics Conference, Seattle, Wash., Oct. 15-17, 1973, Paper 73-1003.* 8 p. 6 refs. Members, $1.50; nonmembers, $2.00.

The effect of swirling flow on jet noise suppression was experimentally investigated in a relatively small, low-thrust, fan-jet engine. Measurements of acoustic properties of the near and far fields, jet-flow characteristics, and engine thrust were made with and without stationary swirl vanes installed in the primary exhaust nozzle. Preliminary test results indicate that substantial reductions in jet overall sound pressure levels and overall acoustic power were obtained with minimal thrust losses. Based on preliminary analysis, present results, and previous experiments with swirling hot jets, it is predicted that even greater jet noise reductions can be obtained in higher thrust engines, particularly with afterburning, by swirling jet exhaust. (Author)

A73-44838 * # **A theoretical and experimental study of sound attenuation in an annular duct.** H. E. Plumblee (Lockheed-Georgia Co., Marietta, Ga.). *American Institute of Aeronautics and Astronautics, Aero-Acoustics Conference, Seattle, Wash., Oct. 15-17, 1973, Paper 73-1005.* 12 p. 8 refs. Members, $1.50; nonmembers, $2.00. Contract No. NAS1-10472.

The flow duct used in the experiments for this study was described in an earlier paper by Plumblee and Dean (1972). Angular and radial standing modes were excited in isolation, and the modal attenuation and phase speed were measured in an annular duct with locally reacting liners. Contour maps of constant attenuation and phase speed were computed in the wall impedance plane for no-flow and several flow conditions, and experimental data were compared with some of these calculations. The effect of flow on modal attenuation and phase speed was measured and is theoretically verified. The major result of this study is the verification of theoretical predictions which ultimately can lead to a duct liner design optimization without resort to expensive and lengthy test programs. (Author)

A73-44840 * # **A difference theory for noise propagation in an acoustically lined duct with mean flow.** K. J. Baumeister and E. J. Rice (NASA, Lewis Research Center, Cleveland, Ohio). *American Institute of Aeronautics and Astronautics, Aero-Acoustics Conference, Seattle, Wash., Oct. 15-17, 1973, Paper 73-1007.* 10 p. 12 refs. Members, $1.50; nonmembers, $2.00.

A finite difference formulation is presented for sound propagation in a two-dimensional straight soft-walled duct with uniform flow. The difference analysis is developed in terms of complex notation. The governing acoustic difference equations and the appropriate displacement boundary conditions associated with uniform flow are presented. Example calculations are presented for the sound attenuation in straight hard and soft-walled ducts. At present the finite Mach number case is solved only for the one-dimensional hard walled duct. (Author)

A73-44844 # **Theoretical studies of sound emission from aircraft ducts.** H. D. Hogge and E. W. Ritzi (Douglas Aircraft Co., Long Beach, Calif.). *American Institute of Aeronautics and Astronautics, Aero-Acoustics Conference, Seattle, Wash., Oct. 15-17, 1973, Paper 73-1012.* 12 p. 11 refs. Members, $1.50; nonmembers, $2.00. Research sponsored by the Douglas Aircraft Independent Research and Development Program.

A finite-element solution to the problem of sound propagation in a duct of finite length and with axial variation in cross section and mean flow Mach number is obtained by matching cylindrical and conical duct elements. The effect of reflection from the open end is provided by a simple model of the radiation impedance of the opening. Examples are included to show the effects of (1) reflections from the open end, (2) source impedance, (3) mean flow, (4) cone angle, (5) cross section variation, and (6) finite wall impedance on the propagation of rotating pressure waves in ducts. (Author)

A73-44848 # **The influence of aerodynamic flow noise in turbofan engines.** R. A. Mangiarotty (Boeing Commercial Airplane Co., Seattle, Wash.). *American Institute of Aeronautics and Astronautics, Aero-Acoustics Conference, Seattle, Wash., Oct. 15-17, 1973, Paper 73-1016.* 5 p. 7 refs. Members, $1.50; nonmembers, $2.00.

The component noise sources of advanced technology turbofan engines are reviewed showing that previously unimportant noise sources are unmasked by the lowering of jet noise and the use of acoustic linings for reducing turbomachinery noise. The two main sources unmasked are the engine core noise and aerodynamic noise generated by airflow in the engine nacelle ducts. A review of aerodynamic noise mechanisms show that turbulent flow confined in a duct generates more energy than in free space, particularly at the lower frequencies. Because airflow is continuously generated along a duct whereas turbomachinery noise is attenuated by acoustic linings, aerodynamic noise could limit the attenuation of turbomachinery noise by linings. (Author)

A73-44849 * # **Noise comparisons from full-scale fan tests at NASA Lewis Research Center.** M. F. Heidmann and C. E. Feiler (NASA, Lewis Research Center, Cleveland, Ohio). *American Institute of Aeronautics and Astronautics, Aero-Acoustics Conference, Seattle, Wash., Oct. 15-17, 1973, Paper 73-1017.* 12 p. 11 refs. Members, $1.50; nonmembers, $2.00.

The overall aero and acoustic design features of eight 6-foot-diameter, single-stage fans tested in an outdoor acoustic facility are described. A correlation of the acoustic results for subsonic tip-speed fans showed the total sound power to be proportional to the mechanical power imparted to the fan and the specific work performed on the air to within plus or minus 2 dB. The correlation was relatively insensitive to fan design variables over a broad range of operating conditions. Maximum perceived noise levels were generally proportional to the sound power levels with both noise levels exhibiting a relatively unique increase with fan pressure ratio when normalized by the delivered thrust. The spectra of broadband noise attributed to the fan exhibited a bimodal characteristic for most of the fans. A predominant mode centered near the blade-passage tone and another at 8 to 16 times the tone frequency. (Author)

A73-44850 # **Broadband noise generation by aerofoils and axial flow fans.** B. D. Mugridge (Southampton, University, Southampton, England). *American Institute of Aeronautics and Astronautics, Aero-Acoustics Conference, Seattle, Wash., Oct. 15-17, 1973, Paper 73-1018.* 10 p. 32 refs. Members, $1.50; nonmembers, $2.00. Research supported by the Ministry of Defence.

The generation of broadband noise by aerofoils and fan blades has been investigated and working formulae developed, for cases where the mean flow velocity is subsonic. The derivation of the aero-acoustic transfer function for unsteady flow interactions is the major feature of the paper. New two-dimensional wind tunnel data yield a flow-force relationship for acoustically compact aerofoils for reduced flow frequencies for both random and discrete interactions. Integrated force spectra compare favorably with standard unsteady lift theory although the surface pressure phase relationships do not conform to a Kutta edge criterion. The acoustic calculations utilise established line force models. (Author)

A73-44851 # **Sound generation by wake cutting.** H. Fujita and L. S. G. Kovasznay (Johns Hopkins University, Baltimore, Md.). *American Institute of Aeronautics and Astronautics, Aero-Acoustics Conference, Seattle, Wash., Oct. 15-17, 1973, Paper 73-1019.* 6 p. 7 refs. Members, $1.50; nonmembers, $2.00. Research supported by the United Aircraft Corp.

The sound generated by the interaction of an airfoil and a passing wake was studied experimentally. A square jet was 'cut' periodically by circular rods moving across the flow to produce a row of oblique wakes. A circular arc symmetrical airfoil was placed in the

flow, and by means of periodic sampling and averaging the strictly periodic components of the instantaneous surface pressure fluctuation at different chordwise locations on the airfoil as well as of the radiated sound field were determined. First, the airfoil leading edge was aligned with the wake to obtain a nearly two-dimensional interaction. Later, the airfoil was turned at an angle with respect to the wake so that the wake interaction swept spanwise along the leading edge (three-dimensional flow). All pressure fluctuations as well as the sound radiation were found to be decreasing with increasing skew angle between the airfoil and the wake. (Author)

A73-44852 # **The effects of modulated blade spacing on static rotor acoustics and performance.** P. A. Shahady, C. A. Lyon (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio), J. J. Schauer (Dayton, University, Dayton, Ohio), M. H. Chopin, and M. S. Ewing (USAF, Aeronautical Systems Div., Wright-Patterson AFB, Ohio). *American Institute of Aeronautics and Astronautics, Aero-Acoustics Conference, Seattle, Wash., Oct. 15-17, 1973, Paper 73-1020.* 7 p. Members, $1.50; nonmembers, $2.00.

A method to assess the aural detection possibilities of aircraft was developed in connection with programs designed to provide the technology to quiet military aircraft for reconnaissance/surveillance and special tactical operations. The aural detection of aircraft depends to a large extent on the background noise environment in which the receiver is located. Curves for a comparison of the aircraft acoustic noise signature and detection level criteria are shown in a graph. The effects of blade spacing on acoustic performance are theoretically analyzed. Theoretical findings are compared with the results of experimental studies. G.R.

A73-44853 * # **Multiple pure tone noise generation and control.** M. J. Benzakein, S. B. Kazin, and C. T. Savell (General Electric Co., Evendale, Ohio). *American Institute of Aeronautics and Astronautics, Aero-Acoustics Conference, Seattle, Wash., Oct. 15-17, 1973, Paper 73-1021.* 9 p. 8 refs. Members, $1.50; nonmembers, $2.00. Contract No. NAS3-12430.

The generation of multiple pure tones in supersonic ... discussed. The theoretical results of Kurasaka are reviewed and compared with experimental data obtained on a 36-in. diameter, 1550 ft/sec, 1.6 pressure ratio fan. Detailed measurements on bow shock locations taken with pressure transducers indicate that blade to blade discrepancies are the source of MPT generation. The paper presents some experimental results on an attempt to reduce the shock strength, and subsequently the MPT's, through blade modifications. Other attempts at reducing the MPT's through wall treatment, high inlet flow Mach number, acoustically treated splitters - are discussed. Experimental data is presented on the validity of these noise reduction methods. (Author)

A73-44854 # **Inlet geometry and axial Mach number effects on fan noise propagation.** D. C. Mathews and R. T. Nagel (United Aircraft Corp., Pratt and Whitney Aircraft Div., East Hartford, Conn.). *American Institute of Aeronautics and Astronautics, Aero-Acoustics Conference, Seattle, Wash., Oct. 15-17, 1973, Paper 73-1022.* 11 p. 8 refs. Members, $1.50; nonmembers, $2.00.

Extensions of existing noise propagation theories to three-dimensional inlets are developed and applied to the propagation behavior of both acoustic spinning modes and nonlinear shock waves in typical aircraft inlets operating under a range of conditions. Aspects of the propagation of linear spinning modes in contoured inlets are discussed together with questions of three-dimensional nonlinear shock wave theory. Results of experimental investigations are also considered, giving attention to a powered nacelle model engine, the effect of inlet contour changes at speeds near cutoff, and the study of a full scale high bypass ratio engine. G.R.

A73-44855 # **A review of combustion generated noise.** W. C. Strahle (Georgia Institute of Technology, Atlanta, Ga.). *American Institute of Aeronautics and Astronautics, Aero-Acoustics Conference, Seattle, Wash., Oct. 15-17, 1973, Paper 73-1023.* 9 p. 38 refs. Members, $1.50; nonmembers, $2.00. NSF Grant No. GK-32544; Grant No. AF-AFOSR-72-2365.

The available information on noise generation by turbulent combustion processes is reviewed with the goal in mind to be able to predict its importance in core engine noise in turbopropulsion systems. Noise data from research burners, furnaces and engines are reviewed as are the available theories of combustion noise. Emphasis is placed upon the total sound power output and the spectral content as well as upon the effects of enclosures on the radiated noise. Conclusions are drawn concerning the research required to adequately assess the importance of combustion noise in turbopropulsion systems. (Author)

A73-44857 # **Core engine noise.** E. Grande (Foster-Miller Associates, Inc., Waltham, Mass.). *American Institute of Aeronautics and Astronautics, Aero-Acoustics Conference, Seattle, Wash., Oct. 15-17, 1973, Paper 73-1026.* 6 p. 13 refs. Members, $1.50; nonmembers, $2.00.

This paper considers sources of core noise in a turbofan engine. A brief assessment is made of noise due to obstructions in the flow passage, turbulence level and swirl in the mean flow, turbine noise due to interaction with upstream turbulence, and combustor noise. It is tentatively concluded that combustor noise is the primary source of core noise. A core noise prediction procedure is formulated, considering the noise generation in the combustion chamber and the noise transmission through the turbine and the primary exhaust nozzle. The resulting prediction scheme expresses the far field core noise level as a function of the turbine pressure ratio, the nozzle pressure ratio, the combustor inlet and outlet temperatures and the nozzle temperature, and the combustor configuration and size. Comparison of the measured and predicted core noise levels for two turbofan engines yields satisfactory agreement. (Author)

A73-44858 # **Core engine noise.** R. P. Gerend, H. A. Kumasaka, and J. P. Roundhill (Boeing Commercial Airplane Co., Seattle, Wash.). *American Institute of Aeronautics and Astronautics, Aero-Acoustics Conference, Seattle, Wash., Oct. 15-17, 1973, Paper 73-1027.* 10 p. 5 refs. Members, $1.50; nonmembers, $2.00.

The low frequency noise component of full-scale engines has generally exhibited a significant deviation from that observed for jet noise alone. Tests have indicated that at least a portion of this noise component is generated inside the engine, upstream of the exhaust nozzle. This 'excess' noise, called 'core noise,' has been studied. The studies include a model test, in which an artificial upstream noise source of known level was introduced. A full-scale engine test, involving a JT9D turbofan with an extended, lined tail pipe was also conducted. Other studies were concerned with the development of a preliminary prediction procedure, based on full-scale engine data. G.R.

A73-44859 # **Mechanisms of externally blown flap noise.** M. R. Fink (United Aircraft Research Laboratories, East Hartford, Conn.). *American Institute of Aeronautics and Astronautics, Aero-Acoustics Conference, Seattle, Wash., Oct. 15-17, 1973, Paper 73-1029.* 11 p. 20 refs. Members, $1.50; nonmembers, $2.00.

In the analysis of noise mechanisms, effects of reflection and shielding are considered together with the leading-edge noise, scrubbing noise, trailing-edge noise, and sideline and forward-flight effects. Under-the-wing spectra are discussed along with questions of under-the-wing directivity, over-the-wing spectra, and over-the-wing directivity. Noise beneath over-the-wing configuration models is typified by a sixth-power velocity law and a very small decrease of intensity as the exit direction is approached. G.R.

A73-44860 * # **Acoustic investigation of the engine-over-the-wing concept using a D-shaped nozzle.** M. Reshotko and R. Friedman (NASA, Lewis Research Center, Cleveland, Ohio). *American Institute*

of Aeronautics and Astronautics, Aero-Acoustics Conference, Seattle, Wash., Oct. 15-17, 1973, Paper 73-1030. 10 p. 11 refs. Members, $1.50; nonmembers, $2.00.

Small-model experiments were conducted of the engine-over-the-wing concept using a D-shaped nozzle in order to determine the static-lift and acoustic characteristics at two wing-flap positions. Configurations were tested with the flow attached and unattached to the upper surface of the flaps. Attachment was obtained with a nozzle flow deflector. In both cases, high frequency noise shielding by the wing was obtained. Configurations using the D-shaped nozzle are compared with corresponding ones using a circular nozzle. With flow attached to the flaps, the static lift and acoustic results are almost the same for both nozzles. Without the nozzle flow deflector (unattached flap flow), the D-nozzle is considerably noisier than a circular nozzle in the low and middle frequencies. (Author)

A73-44861 # **Progress in source noise suppression of subsonic tip speed fans.** F. B. Metzger (United Aircraft Corp., Hamilton Standard Div., Windsor Locks, Conn.). *American Institute of Aeronautics and Astronautics, Aero-Acoustics Conference, Seattle, Wash., Oct. 15-17, 1973, Paper 73-1032.* 13 p. 19 refs. Members, $1.50; nonmembers, $2.00.

Work has been proceeding to develop subsonic tip speed fan engines operating at low pressure ratio. The fans considered are inherently quieter than existing turbofans. However, on account of the great number of blades in these fans, there is still a significant amount of noise energy at the higher frequencies that contribute most to annoyance. Effects of new fan designs on the noise characteristics are discussed, giving attention to the incorporation of a few blades only, low tip speed, and low pressure ratios. G.R.

A73-44862 # **Spectral trends in rotor noise generation.** S. E. Wright (Southampton University, Southampton, England). *American Institute of Aeronautics and Astronautics, Aero-Acoustics Conference, Seattle, Wash., Oct. 15-17, 1973, Paper 73-1033.* 12 p. 15 refs. Members, $1.50; nonmembers, $2.00. Research supported by the Science Research Council.

Rotor noise from a range of rotor types is examined, giving attention to propellers, helicopter rotors, and fans. The study assumes that the major radiation properties lie within the rotor, and are not affected to a first order by the presence of a duct. The effect of forward motion on the radiation process is assumed to be small for moderate forward speeds. Aspects of spectral adjustment are discussed together with questions regarding the minimum rotor noise, rotor excess noise, and rotor spectra. G.R.

A73-44863 * # **A study to determine the feasibility of a low sonic boom supersonic transport.** E. J. Kane (Boeing Commercial Airplane Co., Seattle, Wash.). *American Institute of Aeronautics and Astronautics, Aero-Acoustics Conference, Seattle, Wash., Oct. 15-17, 1973, Paper 73-1035.* 11 p. 11 refs. Members, $1.50; nonmembers, $2.00. Contract No. NAS1-11877.

The objective of this study was to determine if a supersonic transport designed to produce a sonic boom signature with low overpressure represented a feasible concept. Two design goals were chosen: an overpressure of 1.0 psf or less for cruise at Mach 2.7 and an overpressure of 0.5 psf for cruise at Mach 1.5. Projected 1985 technology was assumed for the analysis. The principal effort was to develop cruise configurations capable of meeting the sonic boom goals. The Mach 2.7 goal was achieved with a blended arrow wing configuration and the Mach 1.5 design was a low arrow wing configuration with a horizontal tail. The development of these airplanes is summarized and the concept of a low sonic boom SST is evaluated. (Author)

A73-44866 # **A new device for measuring local acoustic power output of subsonic jets.** J. T. Yen (Grumman Aerospace Corp., Bethpage, N.Y.) and T. E. Siddon (British Columbia, University, Vancouver, Canada). *American Institute of Aeronautics and Astronautics, Aero-Acoustics Conference, Seattle, Wash., Oct. 15-17, 1973, Paper 73-1042.* 8 p. 6 refs. Members, $1.50; nonmembers, $2.00.

The use of microphone arrays or collector-microphone systems for the measurement of the total noise power output of a small volume element is discussed. The performance of a circular-arc array with 10 dynamic microphones is considered, taking into account measurements conducted in cases in which speakers operating at 500 and 1000 Hz were used as sources. With the aid of computer computations it is found that an optimal configuration is composed of a 14 feet diameter, semicircular array of 60 microphones. G.R.

A73-44867 * # **Comparison of results obtained with various sensors used to measure fluctuating quantities in jets.** S. P. Parthasarathy, P. F. Massier, and R. F. Cuffel (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). *American Institute of Aeronautics and Astronautics, Aero-Acoustics Conference, Seattle, Wash., Oct. 15-17, 1973, Paper 73-1043.* 8 p. 5 refs. Members, $1.50; nonmembers, $2.00. Contract No. NAS7-100.

An experimental investigation has been conducted to compare the results obtained with six different instruments that sense fluctuating quantities in free jets. These sensors are typical of those that have recently been used by various investigators who are engaged in experimental studies of jet noise. Intensity distributions and two-point correlations with space separation and time delay were obtained. The static pressure, density, and velocity fluctuations are well correlated over the entire cross section of the jet and the cross-correlations persist for several jet diameters along the flow direction. The eddies appear to be flattened in the flow direction by a ratio of 0.4. (Author)

A73-44868 # **Introduction of the viscous force sensing fluctuating probe technique, with measurement in the mixing zone of a circular jet.** D. Y. Cheng (Santa Clara, University, Santa Clara, Calif.). *American Institute of Aeronautics and Astronautics, Aero-Acoustics Conference, Seattle, Wash., Oct. 15-17, 1973, Paper 73-1044.* 6 p. Members, $1.50; nonmembers, $2.00.

A73-44871 * # **Comparison of aircraft noise measured in flight test and in the NASA Ames 40- by 80-foot wind tunnel.** A. Atencio, Jr. (NASA, Ames Research Center, Moffett Field, Calif.) and P. T. Soderman (U.S. Army, Air Mobility Research and Development Laboratory, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Aero-Acoustics Conference, Seattle, Wash., Oct. 15-17, 1973, Paper 73-1047.* 9 p. 8 refs. Members, $1.50; nonmembers, $2.00.

A method to determine free-field aircraft noise spectra from wind-tunnel measurements has been developed. The crux of the method is the correction for reverberations. Calibrated loud speakers are used to simulate model sound sources in the wind tunnel. Corrections based on the difference between the direct and reverberant field levels are applied to wind-tunnel data for a wide range of aircraft noise sources. To establish the validity of the correction method, two research aircraft - one propeller-driven (YOV-10A) and one turbojet-powered (XV-5B) - were flown in free field and then tested in the wind tunnel. Corrected noise spectra from the two environments agree closely. (Author)

A73-44887 **Low-pressure prepregs as structural material for light-construction designs (Niederdruck-Prepregs als Konstruktionswerkstoff für die Leichtbauweise).** H. Schönland, A. Knop, and U. Neumann (*Eltro GmbH und Co., Flensburg; Bakelite Gesellschaft* mbH, Duisburg-Meiderich, West Germany). In: Arbeitsgemeinschaft Verstärkte Kunststoffe, Open Meeting, 10th, Freudenstadt, West Germany, October 3-6, 1972, Reports. Munich,

Carl Hanser Verlag; Hamburg, Verlag Brunke Garrels, 1972, p. 23-1 to 23-8. 7 refs. In German.

A number of novel low-pressure preimpregnated materials are discussed, giving attention to questions of material specifications. Problems of the selection of suitable binders and reinforcement materials are discussed together with details of the manufacture of prepregs and the advantages of the preimpregnation process in comparison to a procedure involving wet lamination. Methods concerning the processing of prepregs are considered along with the tools to be used, questions of the manufacture of structural components, and specific cases illustrating the use of the new manufacturing process. These cases include components for conventional aircraft, the 'Airbus,' and the Sikorsky helicopter. G.R.

A73-44899 # Emission of sound from a rectangular plate vibrating under the action of pressure pulsations in a turbulent boundary layer (Izluchenie zvuka priamougol'noi plastinoi, kolebliushcheisia pod deistviem pul'satsii davleniia v turbulentnom pogranichnom sloe). R. A. Mkhitarov (Akademiia Nauk SSSR, Akusticheskii Institut, Moscow, USSR). *Akusticheskii Zhurnal,* vol. 19, July-Aug. 1973, p. 580-587. In Russian.

A73-44916 # Distribution of losses in an annular cascade of an axial-flow compressor (Rozklad strat w kolowej palisadzie sprezarki osiowej). J. Kral (Instytut Lotnictwa, Warsaw, Poland). *Rozprawy Inzynierskie,* vol. 21, no. 2, 1973, p. 249-277. 28 refs. In Polish.

Published experimental data are analyzed in a study of factors affecting the distribution of total pressure losses in viscous flow of gas through annular cascades of axial-flow compressors. Three-dimensional aspects of the flow are examined along with their effects on boundary layer development and the formation of associated secondary flows resulting in vortices. Existing methods of calculating the magnitudes and radial distributions of pressure losses in axial-flow fans and compressors are reviewed. T.M.

A73-44994 # Program plan to develop airworthiness standards for STOL aircraft. R. A. Chubboy (FAA, Systems and Development Service, Washington, D.C.). *Canadian Aeronautics and Space Journal,* vol. 19, June 1973, p. 289-295.

This paper outlines a joint French/UK/US simulator program to develop criteria for supporting airworthiness standards for powered-lift transport category aircraft. STOL considerations, test methodology and some preliminary results obtained on the Baseline Breguet 941 are discussed. The following impressions are significant. Multiple configuration changes following balked landing and/or one engine inoperative go-around may not pose a problem for STOL aircraft. Thrust response in the landing approach seems to influence man/machine performance more than thrust margin, especially on go-around. Lateral/directional characteristics of the powered-lift aircraft are critical, especially during flare and immediately following touchdown in crosswind and/or turbulence. (Author)

A73-44995 # Some results from tests in the NAE high Reynolds number two-dimensional test facility on shockless and other airfoils. L. H. Ohman, J. J. Kacprzynski, and D. Brown (National Aeronautical Establishment, Ottawa, Canada). *Canadian Aeronautics and Space Journal,* vol. 19, June 1973, p. 297-312. 26 refs.

Results from investigations in the NAE high Reynolds number two-dimensional test facility on two classical NACA airfoils and two contemporary supercritical airfoils are presented. The results are compared with other published experimental data. Comparisons are also made with results from theoretical calculations performed at NAE for subcritical as well as supercritical flow, incorporating boundary-layer displacement effects for some subcritical cases. Experimental and theoretical results compare favorably. Comparisons with other experimental data demonstrate good correspondence in some cases as well as gross discrepancies in other cases. For the latter, the discrepancies are attributed to Reynolds number effects or differences in experimental techniques. (Author)

A73-45076 # Burn-up of the high temperature products of incomplete combustion in a supersonic flow by a second injection of oxidizer (Dozhiganie vysokotemperaturnykh produktov nepolnogo sgoraniia v sverkhzvukovom potoke pri vtorichnom vpryske okislitelia). Z. G. Shaikhutdinov, A. M. Rusak, V. M. Klevanskii, I. S. Saburov, and L. F. Shaikhinurova. *Inzhenerno-Fizicheskii Zhurnal,* vol. 25, Aug. 1973, p. 197-203. In Russian.

A73-45088 # Processing experimental aviation data. R. L. Lackman (National Center for Atmospheric Research, Boulder, Colo.). *Atmospheric Technology,* Sept. 1973, p. 44-48. 5 refs.

The Research Aviation Facility (RAF) provides the atmospheric science community with an aircraft data gathering and data processing service. Several options of an existing computer program are available for processing aircraft data tapes. Aspects of standard data processing are discussed together with problems of special processing, data merging, data enhancement, and future software developments. It is pointed out that the acquisition of the Electra aircraft with its highly sophisticated instrumentation system has itself vastly expanded the RAF's data processing commitments. A new general processing program was developed in connection with new software developments. Aspects of future resource requirements are also considered. G.R.

A73-45144 Toward reliable composites - An examination of design methodology. J. R. Eisenmann, B. E. Kaminski, D. L. Reed, and D. J. Wilkins (General Dynamics Corp., Convair Aerospace Div., Fort Worth, Tex.). *Journal of Composite Materials,* vol. 7, July 1973, p. 298-308. 9 refs.

The current deterministic design approach is reviewed, and an alternate reliability-based design procedure is described which is more appropriate to the distinct behavioral characteristics of composite materials. The proposed procedure treats: load generation, material characterization, reliability apportionment, scaling, and complexity. (Author)

A73-45153 # X-22A - The total in-flight simulator. J. L. Beilman (Calspan Corp., Buffalo, N.Y.). *Aircraft Engineering,* vol. 45, Sept. 1973, p. 8-12.

Recognition of the urgent need for a systematic approach to obtain reliable flying qualities data in advance of design has led to the concept of the variable stability aircraft. By 1970, the original concept of the variable stability aircraft had reached maturity in the Total In-Flight Simulator (TIFS). The TIFS has been used for simulation of the USAF B-1 Bomber, the Concorde SST, and the space shuttle vehicle. The basic characteristics of the new aircraft, called the X-22A, are discussed together with its variable stability system. G.R.

A73-45154 # Alternating current starter generators. D. O. Burns. *Aircraft Engineering,* vol. 45, Sept. 1973, p. 16-18, 21.

An alternator directly coupled to a spool of a jet propulsion engine produces a variable frequency of ac supply. This variable frequency can be converted to a constant (400 Hz) frequency by a switching device known as a cycloconverter. The use of the variable frequency generator as a variable frequency motor with the objective to start up the main engine electrically is considered. Cycloconverter starter-generators are compared with the more conventional methods, such as turbine starters. G.R.

A73-45155 # **The use of single crystal blades.** D. A. Petrov and A. T. Tumanov (Organisation für Internationale Lizenzen, Moscow, USSR). *Aircraft Engineering,* vol. 45, Sept. 1973, p. 20, 21.

Advantages of gas-turbine engines using single-crystal blades are connected with the absence of grain boundaries in the blade metal. In conventional castings grain boundaries are weak lines along which premature damage can occur. At very high temperatures single-crystal blades can operate for about four times as long as conventionally cast blades. The technique developed in the USSR for obtaining single-crystal blades is free from the limitations imposed on the choice of crystallographic orientation in an approach used in the U.S. G.R.

A73-45156 # **Advantages of a fixed ground supply system.** *Aircraft Engineering,* vol. 45, Sept. 1973, p. 30-32, 34.

In March 1972, a new aircraft ground supply system was introduced at London Heathrow, UK, which in its operation to date has clearly indicated the advantages of a fixed installation in this service. The installation supplies ground power to the aircraft using Pier Four, Terminal One. The ground supply system is discussed, giving attention to motor-alternators, plant control cubicles, selector switchboxes, the distribution cubicle, the busbar switchbox, the connector box, and fault protection devices. G.R.

A73-45162 ***Burning rate studies of fuel air mixtures at high pressures.*** J. D. Knapton, I. C. Stobie (U.S. Army, Ballistics Research Laboratories, Aberdeen Proving Ground, Md.), and H. Krier (Illinois, University, Urbana, Ill.). *Combustion and Flame,* vol. 21, Oct. 1973, p. 211-220. 10 refs.

High pressure burning studies of fuel air mixtures (mainly JP4 and air) were carried out in a closed chamber to determine what parameters control the maximum combustion rate and maximum pressure. The fuel was injected through shower-type nozzles into air at initial pressures of 2000-4000 psi. Densities of loading ranged 0.18-0.36 gm/cu cm, and the equivalence ratio ranged 0.6-2.7 fuel to air. A method for evaluating the burning velocity is presented. It was found that a wide variation in the burning velocity could be obtained with maximum burning velocities occurring at minimum fuel air mixing times. The pressure-time history during the closed vessel explosion agrees remarkably well with a time cubed dependence. Such pressure-time data are used to interpret the pressure rise predicted by a simple isothermal model. (Author)

A73-45172 # **Hypersonic flow about a spatial body with an attached shock wave (Giperzvukove obtikannia prostorovogo tila z priednanoiu udarnoiu khvileiu).** L. I. Dzvonik (Kiivs'kii Derzhavnii Universitet, Kiev, Ukrainian SSR). *Akademiia Nauk Ukrains'koi RSR, Dopovidi, Seriia A - Fiziko-Tekhnichni i Matematichni Nauki,* vol. 35, Aug. 1973, p. 717-721. In Ukrainian.

Concepts of the hypersonic theory of small perturbations are applied to solve a Riemann-Poincaré boundary value problem formulated in an analysis of the characteristics of a flow about a slender rhombiform wing with an attached shock wave when the Mach number tends to infinity. Functions describing the shock wave curvature are obtained. V.Z.

A73-45195 # **Increasing the critical rotational speed of the tail rotor drive shaft in SM-1 and SM-2 helicopters (Zwiekszenie liczby obrotow krytycznych walu napedu smigla ogonowego smigiowcow SM-1 i SM-2).** A. Jarczyk (Instytut Techniczny Wojsk Lotniczych, Warsaw, Poland). *Technika Lotnicza i Astronautyczna,* vol. 28, Sept. 1973, p. 6, 7, 41. In Polish.

Several structurally modified versions of the tubular segmented drive shaft used in the tail-rotor drive train of SM-1 and SM-2 helicopters were examined analytically and by full-scale vibration tests in order to select the version providing the highest increase in critical rotational speed subject to tradeoffs involving ease of conversion during scheduled maintenance operations. Modifications evaluated entailed changes in shaft curvature and in the length, diameter, and number of individual shaft segments. The selected final version features an enlarged cross section of one shaft segment and provides a 600 rpm (21%) gain in the critical rotational speed. T.M.

A73-45196 # ***Principal failures of turbines during turbine engine operation (Zasadnicze niesprawnosci turbin w czasie eksploatacji silnikow turbinowych).*** M. Mokrzyszczak and M. Stukonis (Instytut Techniczny Wojsk Lotniczych, Warsaw, Poland). *Technika Lotnicza i Astronautyczna,* vol. 28, Sept. 1973, p. 8-15. 5 refs. In Polish.

Description of the main causes of in-service damage experienced by turbine blades in gas turbine engines. Engine operating conditions resulting in blade failure are defined, and the characteristic aspects and mechanisms of sustained damage are described for fatigue failure of blades at the airfoil section, fatigue fracture in fir-tree root attachments, damage produced by overheating in engines with axial-flow compressors, and damage resulting from overheating in unsteady engine operation. T.M.

A73-45197 # **Reliability calculations for flight vehicles (Obliczanie niezawodnosci obiektow latajacych).** J. Jazwinski, J. Migdalski, and W. Wieremiejczyk (Instytut Techniczny Wojsk Lotniczych, Warsaw, Poland). *Technika Lotnicza i Astronautyczna,* vol. 28, Sept. 1973, p. 16-18. In Polish.

Description of a method for estimating the reliability of repairable and nonrepairable flight vehicles (rockets, airplanes, helicopters, and parachutes). In the context of this article, reliability is understood as the measure of risk in using the particular vehicle at a given time under given physical conditions. The proposed graphical technique permits rapid estimates of (1) the probability that the vehicle will satisfy defined requirements through a given interval of time, (2) the cumulative risk function, and (3) the failure rate function. T.M.

A73-45198 # **Modern structural materials in aviation (Wspolczesne materialy konstrukcyjne w lotnictwie).** E. Gruszczynski (Instytut Techniczny Wojsk Lotniczych, Warsaw, Poland). *Technika Lotnicza i Astronautyczna,* vol. 28, Sept. 1973, p. 23-28. 15 refs. In Polish.

The properties and applications of various structural materials in modern aircraft are discussed together with research and development efforts aimed at new materials and improved technological processes. Relative merits, drawbacks, and typical uses are described for aluminum alloys, steels, titanium alloys, magnesium alloys, beryllium alloys, and laminate composites incorporating single-crystal fibers, polycrystalline fibers, glass fibers, and fibers of complex structure. T.M.

A73-45199 # **Preparation of airport surfaces for heavy and supersonic aircraft (Przygotowanie nawierzchni lotnisk dla samolotow ciezkich i naddzwiekowych).** R. Grzywacz (Instytut Techniczny Wojsk Lotniczych, Warsaw, Poland). *Technika Lotnicza i Astronautyczna,* vol. 28, Sept. 1973, p. 29-31. In Polish.

The need for special modifications of existing airport surfaces to accommodate heavy-load and supersonic aircraft is demonstrated by tabulating typical characteristics (static and dynamic load aspects, landing-gear configurations, and physical dimensions) of specific new cargo and SST airplanes. Attention is given to international regulations detailing length and width requirements as well as structural configurations of runway and taxi surfaces. T.M.

A73-45245 # **Propeller blade vibrations (Drgania lopat smigla).** J. Maryniak, W. Mierzejewski, and J. Krutul (Warszawa, Politechnika, Warsaw, Poland). *Mechanika Teoretyczna i Stosowana,* vol. 11, no. 3, 1973, p. 229-243. 11 refs. In Polish.

Calculated modes and frequencies of natural vibrations for helicopter tail-rotor blades are compared with experimental results. Measured values of mass distribution, moments of inertia, and stiffness are used as the input data for calculations. The rotor blade is represented by eleven segments and is treated as a discrete system. Six mathematical models of the blade are analyzed with allowance for rotational inertia of individual blade segments. Eigenmodes and frequencies of flexural, torsional, and torsional-flexural vibrations calculated for the six models are compared with resonance measurements. T.M.

A73-45264 * **A comparison of the overall and broadband noise characteristics of full-scale and model helicopter rotors.** J. W. Leverton and J. S. Pollard (Westland Helicopters, Ltd., Yeovil, Somerset, England). *Journal of Sound and Vibration,* vol. 30, Sept. 22, 1973, p. 135-152. 14 refs. Research supported by the Ministry of Defence and NASA.

The broadband noise generated by full-scale and model rotors is compared in terms of spectral content and the dependence on tip speed and rotor thrust/pitch angle. Low frequency broadband noise and high frequency broadband noise are studied separately and blade 'scaling' effects are outlined. The degree of agreement between measurements and theoretical and semi-empirical prediction methods is reviewed together with the directionality patterns. The parameters relating to the overall noise are also discussed. It is shown that in general good agreement is obtained between the full-scale and model rotors when considering spectral content and the dependency of the noise levels on tip speed and thrust. The scaling factors usually considered applicable to the low frequency broadband noise do not, however, appear to apply to either the model or full scale rotors. (Author)

A73-45269 **Compressibility and sonic boom (Compresibilidad y estampido sonico).** M. C. Alvarez (IBERIA, Líneas Aéreas de España, Madrid, Spain). *Revista de Aeronáutica y Astronáutica,* vol. 33, Aug. 1973, p. 601-615. 10 refs. In Spanish.

The compressibility characteristics of a fluid can be quantitatively represented with the aid of the Bulk modulus. Differences in sound propagation for incompressible and compressible fluids are considered, giving attention to formulas for the sonic velocity and the effects of various parameters on this velocity. Conditions for the five flight velocity ranges as determined by the Mach numbers are discussed, taking into account the formation of the Mach cone, details of air particle behavior, shock waves, and heating effects. An analysis is conducted of the various factors affecting the sonic boom. The application of general principles is demonstrated by an investigation of three specific hypothetical cases involving aircraft of different types. Sonic boom effects on water, land, and buildings are examined. G.R.

A73-45309 **Stability of a potential vortex with a nonrotating and rigid-body rotating top-hat jet core.** M. Lessen, N. V. Deshpande, and B. Hadji-Ohanes (Rochester, University, Rochester, N.Y.). *Journal of Fluid Mechanics,* vol. 60, Sept. 18, 1973, pt. 3, p. 459-466. 8 refs. NSF-supported research.

The stability of a potential vortex in the presence of a rotating and a nonrotating axial jet core is examined theoretically. The eigenvalue problem has been solved numerically, and the influence of the ratio of the strength of the vortex to the axial velocity of the jet is determined. Numerical values of the growth rates are obtained, and it is shown that the potential vortex becomes unstable in the presence of a rotating axial jet. T.M.

A73-45345 **'Air piracy' and the latest work of ICAO on this subject (La 'piraterie aérienne' et les derniers travaux de l'OACI à ce sujet).** G. Guillaume. *Revue Française de Droit Aérien,* vol. 27, July-Sept. 1973, p. 257-260. In French.

A73-45346 **The development of civil air navigation in the People's Republic of China - Agreements with other states as well as the tasks and the position of the China Civil Aviation Corporation /CAAC/ (Le développement de la navigation aérienne civile en République populaire de Chine - Les accords avec d'autres Etats ainsi que les tâches et la position de la compagnie aérienne CAAC).** J. L. Kneifel. *Revue Française de Droit Aérien,* vol. 27, July-Sept. 1973, p. 261-283. 16 refs. In French.

A73-45358 # **Effect of a slipstream on the acoustic radiation of ultrasonic annular jets (Vpliv suputnogo potoku na akustichne viprominiuvannia nadzvukovimi kil'tsevimi strumeniami).** V. O. Liutii and O. I. Shvets' (Kiivs'kii Derzhavnii Universitet, Kiev, Ukrainian SSR). *Akademiia Nauk Ukrains'koi RSR, Dopovidi, Seriia A - Fiziko-Tekhnichni i Matematichni Nauki,* vol. 35, July 1973, p. 639-642. In Ukrainian.

A setup with changeable nozzles is used in the measurement of slipstream effects on the acoustic radiation of annular jets at M 2.0, 3.1 and 3.6. The depressing effect of a slipstream on the acoustic wave expansion in ultrasonic annular jets is discussed. Decay of acoustic radiation with the increasing slipstream is noted. V.Z.

A73-45373 **Noise - Maplin and the new technology.** P. G. Masefield. *Flight International,* vol. 104, Aug. 16, 1973, p. 301-309.

The history and controversy surrounding the proposed third London airport at Maplin are reviewed. Maplin is seen as a planned development to reduce noise and to add runway capacity. The questions of whether the assumptions are correct about Maplin's potential benefit in relief of noise, whether there is a real requirement for more runway capacity, and Maplin's alleged environmental advantages are evaluated. In general, it is considered that the choice of Maplin would not be satisfactory. F.R.L.

A73-45374 **Hush-kits or new fans.** M. J. T. Smith (Rolls-Royce, Ltd., Engine Div., Derby, England). *Flight International,* vol. 104, Aug. 16, 1973, p. 318, 319.

There are two alternative approaches to noise reduction. That offering the lowest initial cost is the concept of a single 'add-on' suppressor kit. The second approach involves a partial or complete re-engining of the aircraft. Refanning is an attempt to produce the noise signature of the new high-bypass engines without the expense of a complete engine redesign. It has been found possible to provide engine cycles at about half the bypass ratio of the RB.211 with a varying take-off thrust in the region of 14,000 to 16,000 lb according to the fan and turbine design. F.R.L.

A73-45377 # **The combustion process in a pulsejet engine (Proces spalania w silniku pulsacyjnym).** S. Wojcicki (Warszawa, Politechnika, Warsaw, Poland). *Archiwum Procesow Spalania,* vol. 3, no. 1, 1972, p. 51-57. In Polish.

The combustion process in a pulsejet engine is described on the basis of experimental data obtained by direct and schlieren photography and by measurement of pressure distributions in the combustion chamber. It is shown that self-ignition in the combustion chamber is a consequence of the turbulent mixing of the inlet air and

fuel doses with combustion products remaining from the preceding cycle. Ignition by compression waves is not a necessary condition for continuous operation of the engine, and combustion gases containing burning particles from the previous cycle can provide ignition. Continuous operation is conditioned by the requirement for feedback between pressure changes and the combustion rate. T.M.

A73-45381 # **Some comments to mathematical interpretation of performance characteristics of jet engine combustion chambers.** O. Schurek (Vyzkumny a Zkusebni Letecky Ustav, Prague, Czechoslovakia). *Archiwum Procesow Spalania*, vol. 3, no. 2, 1972, p. 133-151.

A survey is presented of the problems in analyzing combustion chambers of jet engines. The solution of the work is divided into partial blocks: analysis of throttling and altitude characteristics, the selection of the form and the type of chamber, and choice of the air-inlet law. The analysis proceeds by designing an atomization device, and then analyzing chamber pressure losses, the combustion efficiency, the ignition and extinguishing characteristics and the temperature profile. For the solution of individual analytical blocks, results of experimental works, some statistical techniques, and a digital computer have been employed. (Author)

A73-45391 **The POHWARO takeoff assist system (Starthilfegerät POHWARO).** P. Küng. *Flug Revue/Flugwelt International*, Oct. 1973, p. 23-26. In German.

The POHWARO (Pulsated Over-Heated WAter ROcket) system, developed in Switzerland, is described. By providing additional thrust, primarily, for military combat aircraft, the system provides higher loading levels, and permits takeoff from shorter runways and under critical temperature and weather conditions. An attractive feature of the system is its low cost of operation. V.P.

A73-45399 **A review of the American RPV scene.** I. Stambler. *Interavia*, vol. 28, Oct. 1973, p. 1070-1073.

The remotely piloted vehicle (RPV) can, in the opinion of its adherents, offer many of the capabilities of manned aircraft for a fraction of the cost. Applications being considered include several reconnaissance roles, electronic warfare systems, target acquisition, weapon delivery, air-to-air combat, and various combinations of these. Vehicles in hardware form include both expendable and nonexpendable systems. A number of current RPV projects undertaken by various manufacturers are reviewed. It is emphasized that electronics are vital to the success of the overall RPV concept. F.R.L.

A73-45443 **Liability and insurance in international air traffic (Haftung und Versicherung im internationalen Luftverkehr).** I. H. P. Diederiks-Verschoor, W. P. Heere, and A. Moll. *Zeitschrift für Luftrecht und Weltraumrechtsfragen*, vol. 22, Oct. 1, 1973, p. 250-257. 15 refs. In German. (Translation). Research supported by the Rijksuniversiteit te Utrecht.

International air-traffic liability agreements (which also have been declared applicable to national air-traffic by most of the signatory states) are examined in some detail. The problem of passenger accident insurance and aircraft (not cargo) insurance in international air-traffic is discussed. V.P.

A73-45444 **Flight safety, air traffic control, and liability (Flugsicherheit, Luftverkehrskonstrolle und Haftung).** E. Ruhwedel. *Zeitschrift für Luftrecht und Weltraumrechtsfragen*, vol. 22, Oct. 1, 1973, p. 258-271. 43 refs. In German.

The changes in aviation laws, resulting from the continuous growth and new developments in air traffic are reviewed. Particular attention is given to liability situations where accidents are caused by flight controller errors or by malfunction of AFC equipment. It is shown that the liability regulations in the field of air traffic control have become obsolete and require a thorough revision. V.P.

A73-45475 **RAT has hydraulic pitch change servo.** P. W. Morris (Dowty Rotol, Ltd., Cheltenham, Glos., England). *Hydraulics and Pneumatics*, vol. 26, Oct. 1973, p. 87-90.

An emergency power source for retaining control of an aircraft in the event of complete main engine failure must become available immediately when needed. The emergency power source must also have an extremely high standard of integrity. The ram air turbine (RAT) meets both requirements. The constant speed features of the turbine are discussed together with aspects of turbine installation, the hydraulic pitch control system, and the governor valve. Questions of RAT operation are considered along with details of hydraulic pump control, in-service testing, and checkout. G.R.

A73-45529 # **Universal equations for the laminar boundary layer on a body of revolution in oblique flow (Universal'nye uravneniia laminarnogo pogranichnogo sloia na tele vrashcheniia v kosom gazovom potoke).** L. I. Bogovaia. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza*, July-Aug. 1973, p. 32-41. 6 refs. In Russian.

The laminar motion of a gas at an angle of incidence in the boundary layer on a body of revolution is examined. A solution is obtained by Loitsianskii's (1965) parametric method, in which the influence of the external flow and of the configuration of the body is taken into account by introducing three series of parameters. The corresponding system of universal equations is integrated numerically over a wide range of parameters and their combinations. V.P.

A73-45540 # **Approximate calculation of the cavitation flow past low-aspect-ratio wings (Priblizhennyi raschet kavitatsionnogo obtekaniia kryl'ev malogo udlineniia).** I. I. Efremov and R. A. Soroka. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza*, July-Aug. 1973, p. 166-170. In Russian.

The system of singular integral equations of a cavitating low-aspect-ratio wing is reduced to one dimensional equations with the aid of the Lawrence (1951) approximation. The equations are solved numerically by the method of discrete singularities. Plots of cavitation number vs the cavity length for various aspect ratios and plots of the lift coefficient vs the aspect ratio for various cavitation numbers are presented. V.P.

A73-45542 # **Determination of the impulses and moments imparted by shock waves to bodies of revolution (Ob opredelenii impul'sov sil i momentov, soobshchaemykh telam vrashcheniia udarnymi volnami).** V. A. Kazakov. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza*, Jul'y-Aug. 1973, p. 186-190. In Russian.

The three-dimensional problem of the unsteady supersonic flow past a body of revolution along which glides a weak incident shock wave is discussed for the case of constant flow parameters behind the shock front and for the case where the pressure gradient vanishes according to a linear law. The total impulses and moments imparted to the body during the transient process are computed. V.P.

A73-45547 **Nonuniform supersonic flow past wedges.** S. Nadir (Northrop Corp., Aircraft Div., Hawthorne, Calif.). *Zeitschrift für angewandte Mathematik und Physik*, vol. 24, May 25, 1973, p. 355-364.

Consideration of the problem of the flowfield over pointed

wedges in an isoenergetic flow of thermally and calorically perfect gases in which the nonuniform incident flow is such that it results in attached shock waves. It is shown that the one-strip approximation of the method of integral equations is capable of predicting physically realistic surface pressure distributions. A comparison is made between theoretical predictions and experimental data in examples involving the determination of ramp surface pressures in two-dimensional inlets. A.B.K.

STAR ENTRIES

N73-31927*# Aeronautical Research Inst. of Sweden, Stockholm.
RESEARCH ON THE SONIC BOOM PROBLEM. PART 1: SECOND-ORDER SOLUTIONS FOR THE FLOW FIELD AROUND SLENDER BODIES IN SUPERSONIC FLOW FOR SONIC BOOM ANALYSIS Final Report
M. Landahl and P. Loefgren Washington NASA Oct. 1973 66 p refs
(Grant NGR-52-120-001)
(NASA-CR-2339; FFA-AU-621-Pt-1) Avail: NTIS HC $3.50 CSCL 20D

A second-order theory for supersonic flow past slender bodies is presented. Through the introduction of characteristic coordinates as independent variables and the expansion procedure proposed by Lin and Oswatitsch, a uniformly valid solution is obtained for the whole flow field in the axisymmetric case and for far field in the general three-dimensional case. For distances far from the body the theory is an extension of Whitham's first-order solution and for the domain close to the body it is a modification of Van Dyke's second-order solution in the axisymmetric case. From the theory useful formulas relating flow deflections to the Whitham F-function are derived, which permits one to determine the sonic boom strength from wind tunnel measurements fairly close to the body. Author

N73-31928*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EXPERIMENTAL INVESTIGATION OF A LARGE-SCALE, TWO-DIMENSIONAL, MIXED-COMPRESSION INLET SYSTEM: INTERNAL PERFORMANCE AND DRAG AT TRANSONIC CONDITIONS, FREE STREAM MACH EQUALS 0.6 TO 1.28
Norman D. Wong and Warren E. Anderson Washington Oct. 1973 47 p refs
(NASA-TN-D-7445; A-4775) Avail: NTIS HC $3.00 CSCL 20D

A large scale, variable-geometry inlet system with a design Mach number of 3.0 was tested at Mach numbers from 0.6 to 1.28. Variable features for off-design operation are an adjustable-height ramp system and a translating cowl. Experimental results are presented for transonic ramp and cowl positions showing the effect of throat boundary layer bleed and vortex generators on engine-face performance. Detailed pressure and force-balance data are used to evaluate transonic drag characteristics. Author

N73-31929*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
INVESTIGATION, AT INLET LOCATIONS, OF FUSELAGE FLOW FIELDS AT TRANSONIC AND SUPERSONIC SPEEDS
Lyndell S. King Washington Aug. 1973 124 p refs
(NASA-TN-D-7364; A-4582) Avail: NTIS HC $4.25 CSCL 01C

Wind tunnel tests were conducted to determine the flow distribution about fuselage configurations at transonic and supersonic speeds and at angles of attack up to 20 degrees. The models tested were approximately one-twelfth scale and consisted of a main fuselage forebody member and several attachable components. The components were mounted in several combinations to represent different possible configurations for tactical aircraft. Flow distribution surveys were conducted at two inlet locations ahead of and under the wing to assess the effects of forebody geometry for the conditions indicated. The data indicate the influence of the canopy, nose droop, and fuselage shape on flow angularities in the forward survey plane. Author

N73-31930*# Pratt and Whitney Aircraft, West Palm Beach, Fla. Research and Development Center.
STUDY OF INDUCED LOAD AND STRESS, VOLUME 3 Final Report
L. L. Coons, J. M. Reddecliff, A. E. Wemmell, and W. E. Young Nov. 1972 134 p refs
(Contract NAS3-11216)
(NASA-CR-72712; PWA-FR-3704-Vol-3) Avail: NTIS HC $8.75 CSCL 20D

An analytical and experimental investigation into the effects of blade tip clearance on inducer performance and of leading edge sweepback on both blade pressure loading and performance was performed. Tip clearance flow was represented with a vortex flow model and measured data from previous inducer tests at three clearances were correlated with model predictions. A leading edge model was added to an existing inducer internal flow analysis, tests with two sweepbacks were conducted, and blade pressure and performance predictions were correlated with measured data. Author

N73-31931*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
WIND TUNNEL TESTS OF A 20 INCH DIAMETER 1.15 PRESSURE RATIO FAN ENGINE MODEL
H. L. Wesoky and F. W. Steffen 1973 32 p refs Presented at the 9th Propulsion Joint Specialist Conf., Las Vegas, Nev., 5-7 Nov. 1973; cosponsored by AIAA and SAE
(NASA-TM-X-71445; E-7705) Avail: NTIS HC $3.75 CSCL 20D

Aerodynamic and acoustic measurements at a typical STOL aircraft takeoff and landing velocity demonstrated that a 1.35 inlet lip area contraction ratio was superior to a 1.26 ratio at high nacelle incidence angles. Reverse thrust, obtained with a variable pitch rotor, was lower at the landing velocity, and the noise level higher, than at the static condition. High speed tests showed that, for the design cruise Mach number of 0.75, internal losses and external drag were 27 percent of the ideal fan net thrust, and propulsive efficiency was estimated to be 59 percent for an 85 percent efficient fan stage. Author

N73-31932*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TWO-DIMENSIONAL ANALYTICAL AND EXPERIMENTAL PERFORMANCE COMPARISON FOR A COMPRESSOR STATOR SECTION WITH D-FACTOR OF 0.47
Nelson L. Sanger Washington Oct. 1973 41 p refs
(NASA-TN-D-7425; E-7280) Avail: NTIS HC $3.00 CSCL 20D

Analytically computed flow parameters were compared to measured values for the midspan double-circular-arc section of a stator in subsonic flow. Analytical procedures included calculations for inviscid flow, blade surface boundary layers, and loss coefficients. Comparisons were made at three incidence angles. Methods for prescribing the exit fluid angle in inviscid flow calculations were investigated. Measured loss coefficients were compared to calculated values. Two methods for predicting performance involving iterative use of ideal flow and boundary layer calculations were investigated. Author

N73-31934# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
IN-PLANE AND OUT OF PLANE STABILITY DERIVATIVES OF SLENDER CONES AT MACH 14

Otto Walchner and Frank M. Sawyer Jul. 1973 27 p refs (AF Proj. 7064)
(AD-765164; ARL-73-0090) Avail: NTIS CSCL 16/3

A 10-deg circular cone with various spherical and conical (45 degrees) nose bluntnesses of 1.7%, 10% and 25% was investigated in ARL's Mach-14 wind tunnel. Test results confirm that the static and dynamic stability coefficients are not equal in pitch and in yaw for nonzero angles of attack if the pitching moment becomes a nonlinear function of angle of attack due to nose blunting. The inequality of the in plane and out of plane stability derivatives was found at small angles of attack which are only fractions of the cone half angle. Author (GRA)

N73-31935 Purdue Univ., Lafayette, Ind.
OPTIMAL MULTIPLE AIRCRAFT CONTROL FOR TERMINAL AREA APPROACH Ph.D. Thesis
David Kelso Schmidt 1972 176 p
Avail: Univ. Microfilms Order No. 73-15862

The specification of the curved approach paths and landing sequence for a group of aircraft desiring to land in a terminal area such that the terminal-area system performance is maximized was investigated. The multiple-aircraft problem includes the aspect of competition or cooperation between the vehicles by formulating the problem as a set of disconnected optimal trajectories. The flight paths are governed by kinematic equations of motion while in-flight and terminal-time separation inequality constraints between trajectories are imposed. The performance criterion for the system is the sum of the flight durations plus the integrated weighted accelerations of the aircraft. The solution approach employs penalty functions for the treatment of the inequality contraints and is based on the steepest descent algorithm. Dissert. Abstr.

N73-31936 Rhode Island Univ., Kingston.
AN ANALYSIS OF THE RELATIONSHIP BETWEEN THE PARACHUTE SYSTEM PARAMETERS AND THEIR EFFECT ON THE SYSTEM IN FLIGHT Ph.D. Thesis
Gregory C. DeSantis 1973 219 p
Avail: Univ. Microfilms Order No. 73-16332

The cause and effect relationships which exist among the parameters associated with a parachute-payload system during the deployment and trajectory are analyzed. A computer simulation model with the capability of providing a wide range of flexibility in predicting the characteristics of full-scale and model systems in flight was developed. Prior to the study, most research was concentrated on the analysis of individual areas of parachute technology such as parachute inflation, snatch force, parachute filling time and steady state trajectories. The simulation integrates the specific characteristics of the parachute-payload system, airdrop aircraft and drop zone into a conglomerate analysis which can be exercised as many times as needed to evaluate the various parameters. Dissert. Abstr.

N73-31937*# Boeing Vertol Co., Philadelphia, Pa.
NOISE REDUCTION OF A TILT-ROTOR AIRCRAFT INCLUDING EFFECTS ON WEIGHT AND PERFORMANCE
J. Gibs, W. Stepniewski, R. Spencer, and G. Kohler Jun. 1973 223 p refs Sponsored in part by Army Air Mobility R and D Lab., Ames Directorate
(Contract NAS2-6784)
(NASA-CR-114648; D222-10062-1) Avail: NTIS HC $13.25 CSCL 20A

Various methods for far-field noise reduction of a tilt-rotor acoustic signature and the performance and weight tradeoffs which result from modification of the noise sources are considered in this report. In order to provide a realistic approach for the investigation, the Boeing tilt-rotor flight research aircraft (Model 222), was selected as the baseline. This aircraft has undergone considerable engineering development. Its rotor has been manufactured and tested in the Ames full-scale wind tunnel. The study reflects the current state-of-the-art of aircraft design for far-field acoustic signature reduction and is not based solely on an engineering feasibility aircraft. This report supplements a previous study investigating reduction of noise signature through the management of the terminal flight trajectory. Author

N73-31938# Defence and Civil Inst. of Environmental Medicine, Downsview (Ontario).
EJECTION CLEARANCES IN CANADIAN FORCES AIRCRAFT
P. W. Cressman May 1973 12 p refs
(DCIEM-936) Avail: NTIS HC $3.00

The knee clearance ejection envelopes are reported for all Canadian Forces aircraft presently in service. The effects of clothing, posture and restraint harness on ejection clearances are discussed in some detail. The maximum safe thigh length for each aircraft and the percentage of Canadian Forces pilots affected is presented for each aircraft. Author

N73-31939*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
ANALYTICAL STUDY OF TAKEOFF AND LANDING PERFORMANCE FOR A JET STOL TRANSPORT CONFIGURATION WITH FULL-SPAN, EXTERNALLY BLOWN, TRIPLE-SLOTTED FLAPS
Harold P. Washington and John T. Gibbons Washington Oct. 1973 49 p refs
(NASA-TN-D-7441; H-709) Avail: NTIS HC $3.00 CSCL 01C

Takeoff and landing performance characteristics and field length requirements were determined analytically for a jet STOL transport configuration with full-span, externally blown, triple-slotted flaps. The configuration had a high wing, high T-tail, and four pod-mounted high-bypass-ratio turbofan engines located under and forward of the wing. One takeoff and three approach and landing flap settings were evaluated. The effects of wing loading, thrust-to-weight ratio, weight, ambient temperature, altitude on takeoff and landing field length requirements are discussed. Author

N73-31940*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
LOW-SPEED WIND-TUNNEL INVESTIGATION OF THE LONGITUDINAL CHARACTERISTICS OF A LARGE-SCALE VARIABLE WING-SWEEP FIGHTER MODEL IN THE HIGH-LIFT CONFIGURATION
William T. Eckert and Ralph L. Maki Aug. 1973 85 p Prepared in cooperation with Army Air Mobility R and D Lab., Moffett Field, Calif.
(NASA-TM-X-62244) Avail: NTIS HC $6.75 CSCL 01C

The low-speed characteristics of a large-scale model of the U. S. Navy/Grumman F-14A aircraft were studied in tests conducted in the Ames Research Center 40- by 80-Foot Wind Tunnel. The primary purpose of the program was the determination of lift and stability levels and landing approach attitude of the aircraft in its high-lift configuration. Tests were conducted at wing angles of attack between minus 2 deg and 30 deg with zero yaw. Data were taken at Reynolds numbers ranging from 3.48 million to 9.64 million based on a wing mean aerodynamic chord of 7.36 ft. The model configuration was changed as required to show the effects of glove slat, wing slat leading-edge radius, cold flow ducting, flap deflection, direct lift control (spoilers), horizontal tail, speed brake, landing gear and missiles. Author

N73-31941*# Lockheed-California Co., Burbank.
STUDY OF QUIET TURBOFAN STOL AIRCRAFT FOR SHORT HAUL TRANSPORTATION
T. P. Higgins, E. G. Stout, and H. S. Sweet Washington NASA Jul. 1973 76 p refs Prepared in cooperation with Lockheed-Georgia Co., Marietta
(Contract NAS2-6995)

(NASA-CR-135481) Avail: NTIS HC $6.00 CSCL 01C

A study of quiet turbofan short takeoff aircraft for short haul air transportation was conducted. The objectives of the study were to: (1) define representative aircraft configurations, characteristics, and costs associated with their development, (2) identify critical technology and technology related problems to be resolved in successful introduction of representative short haul aircraft, (3) determine relationships between quiet short takeoff aircraft and the economic and social viability of short haul, and (4) identify high payoff technology areas. Author

N73-31942# National Transportation Safety Board, Washington, D.C.

AIRCRAFT ACCIDENT REPORTS: BRIEF FORMAT, US CIVIL AVIATION, ISSUE NO. 5 OF 1972 ACCIDENTS

9 Jul. 1973 344 p

(NTSB-BA-73-7) Avail: NTIS HC $19.25

Aircraft accidents occurring in U.S. Civil Aviation during calendar year 1972 are reported. The reports concern 542 General Aviation and 13 U.S. Carrier accidents. The format presents the facts, conditions, circumstances, and probable cause for each accident. Author

N73-31943# National Transportation Safety Board, Washington, D.C.

AIRCRAFT ACCIDENT REPORT: JUGOSLOVENSKI AEROTRANSPORT (JAT) BOEING 707-321, YU-AGA, JOHN F. KENNEDY INTERNATIONAL AIRPORT, JAMAICA, NEW YORK, 13 AUGUST 1972

4 Apr. 1973 30 p

(NTSB-AAR-73-7) Avail: NTIS HC $3.50

An aircraft accident involving a Boeing 707 aircraft which ran off the runway following an aborted takeoff at John F. Kennedy Airport, New York, on 13 August 1972 is reported. The pilot elected to abort the takeoff when the right cockpit window came open during the takeoff run. The speed and weight of the aircraft made it impossible to stop within the distance remaining and the aircraft impacted a blast fence at the end of the runway. Author

N73-31944# Tennessee Univ. Space Inst., Tullahoma.

FUNDAMENTAL RESEARCH ON ADVANCED TECHNIQUES FOR SONIC SUPPRESSION Final Report

B. H. Goethert, Y. S. Pan, S. N. Chaudhuri, R. Kohl, H. Gruschka, and Philip Kessel Nov. 1972 209 p refs

(Contract DOT-FA70WA-2260)

(FAA-RD-73-4) Avail: NTIS HC $12.50 CSCL 20A

A multiphase theoretical investigation on predicting and alleviating sonic boom intensity is described. A new theory to predict sonic boom intensity on the ground from wind tunnel tests using normal size models (as opposed to the very small models presently used) was developed. A relatively easy method to determine aircraft contours with desirable finite pressure rise times is presented, as is a method to determine phantom body shapes with desirable pressure rise times which can be simulated by heat addition to the flow upstream of the aircraft. It is shown that a slotted nozzle engine exhaust has the unique capability to shift lift from the solid surface of the wing to the region behind the wing, with a resulting reduction in sonic boom intensity. Author

N73-31945*# Boeing Commercial Airplane Co., Seattle, Wash.

AIRCRAFT NOISE SOURCE AND CONTOUR ESTIMATION

D. G. Dunn and N. A. Peart Jul. 1973 233 p refs

(Contract NAS2-6969)

(NASA-CR-114649; D6-60233) Avail: NTIS HC $13.75 CSCL 20A

Calculation procedures are presented for predicting the noise-time histories and noise contours (footprints) of five basic types of aircraft: turbojet, turofan, turboprop, V/STOL, and helicopter. The procedures have been computerized to facilitate prediction of the noise characteristics during takeoffs, flyovers, and/or landing operations. Author

N73-31946*# Boeing Commercial Airplane Co., Seattle, Wash.

AIRCRAFT NOISE SOURCE AND COMPUTER PROGRAMS - USER'S GUIDE

K. C. Crowley, M. A. Jaeger, and D. F. Meldrum Jul. 1973 112 p refs

(Contract NAS2-6969)

(NASA-CR-114650; D6-60234) Avail: NTIS HC $7.75 CSCL 20A

The application of computer programs for predicting the noise-time histories and noise contours for five types of aircraft is reported. The aircraft considered are: (1) turbojet, (2) turbofan, (3) turboprop, (4) V/STOL, and (5) helicopter. Three principle considerations incorporated in the design of the noise prediction program are core effectiveness, limited input, and variable output reporting. Author

N73-31947*# Boeing Vertol Co., Philadelphia, Pa.

V/STOL TILT ROTOR AIRCRAFT STUDY MATHEMATICAL MODEL FOR A REAL TIME SIMULATION OF A TILT ROTOR AIRCRAFT (BOEING VERTOL MODEL 222), VOLUME 8

H. Rosenstein, M. A. McVeigh, and P. A. Mollenkof Apr. 1973 570 p refs

(Contract NAS2-6598)

(NASA-CR-114601; D222-10061-1-Vol-8) Avail: NTIS HC $30.50 CSCL 01C

A mathematical model for a real time simulation of a tilt rotor aircraft was developed. The mathematical model is used for evaluating aircraft performance and handling qualities. The model is based on an eleven degree of freedom total force representation. The rotor is treated as a point source of forces and moments with appropriate response time lags and actuator dynamics. The aerodynamics of the wing, tail, rotors, landing gear, and fuselage are included. Author

N73-31949*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

A FIXED-BASE SIMULATION STUDY OF TWO STOL AIRCRAFT FLYING CURVED, DESCENDING INSTRUMENT APPROACH PATHS

Margaret S. Benner, Richard H. Sawyer, and Milton D. McLaughlin Washington Oct. 1973 35 p

(NASA-TN-D-7298; L-8868) Avail: NTIS HC $3.00 CSCL 01C

A real-time, fixed-base simulation study has been conducted to determine the curved, descending approach paths (within passenger-comfort limits) that would be acceptable to pilots, the flight-director-system logic requirements for curved-flight-path guidance, and the paths which can be flown within proposed microwave landing system (MLS) coverage angles. Two STOL aircraft configurations were used in the study. Generally, no differences in the results between the two STOL configurations were found. The investigation showed that paths with a 1828.8 meter turn radius and a 1828.8 meter final-approach distance were acceptable without winds and with winds up to at least 15 knots for airspeeds from 75 to 100 knots. The altitude at roll-out from the final turn determined which final-approach distances were acceptable. Pilots preferred to have an initial straight leg of about 1 n. mi. after MLS guidance acquisition before turn intercept. The size of the azimuth coverage angle necessary to meet passenger and pilot criteria depends on the size of the turn angle: plus or minus 60 deg was adequate to cover all paths execpt ones with a 180 deg turn. Author

N73-31950*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

FLIGHT INVESTIGATION OF A STRUCTURAL MODE

CONTROL SYSTEM FOR THE XB-70 AIRCRAFT
Wilton P. Lock, Eldon E. Kordes, James M. McKay, and John H. Wykes (N. Am. Rockwell Corp., Los Angeles) Washington Oct. 1973 83 p refs
(NASA-TN-D-7420; H-732) Avail: NTIS HC $3.75 CSCL 01C

A flight investigation of a structural mode control system termed identical location of accelerometer and force (ILAF) was conducted on the XB-70-1 airplane. During the first flight tests, the ILAF system encountered localized structural vibration problems requiring a revision of the compensating network. After modification, successful structural mode control that did not adversely affect the rigid body dynamics was demonstrated. The ILAF system was generally more effective in supersonic than subsonic flight, because the conditions for which the system was designed were more nearly satisfied at supersonic speeds. The results of a turbulence encounter at a Mach number of 1.20 and an altitude of 9754 meters indicated that the ILAF system was effective in reducing the vehicle's response at this flight condition. An analytical study showed that the addition of a small canard to the modal suppression system would greatly improve the automatic control of the higher frequency symmetric modes Author

N73-31951*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
SIMULATOR EVALUATION OF THE LOW-SPEED FLYING QUALITIES OF AN EXPERIMENTAL STOL CONFIGURATION WITH AN EXTERNALLY BLOWN FLAP WING OR AN AUGMENTOR WING
Bruce G. Powers and David A. Kier Washington Oct. 1973 74 p refs
(NASA-TN-D-7454; H-780) Avail: NTIS HC $3.50 CSCL 01C

The low-speed flying qualities of an experimental STOL configuration were evaluated by using a fixed-base six-degree-of-freedom simulation. The configuration had either an externally blown flap (EBF) wing or an augmentor wing (AW). The AW configuration was investigated with two tails, one sized for the AW configuration and a larger one sized for the EBF configuration. The emphasis of the study was on the 70-knot approach task. The stability and control characteristics were compared with existing criteria. Several control systems were investigated for the normal four-engine condition and for the engine-out transient condition. Minimum control and stall speeds were determined for both the three- and four-engine operation. Author

N73-31953*# Rockwell International Corp., Downey, Calif.
A METHODOLOGY FOR HYPERSONIC TRANSPORT TECHNOLOGY PLANNING
E. M. Repic, G. A. Olson, and R. J. Milliken Washington NASA Sep. 1973 284 p refs
(Contract NAS1-6024)
(NASA-CR-2286; SD-73-SA-0019) Avail: NTIS HC $6.50 CSCL 01A

A systematic procedure by which the relative economic value of technology factors affecting design, configuration, and operation of a hypersonic cruise transport can be evaluated is discussed. Use of the methodology results in identification of first-order economic gains potentially achievable by projected advances in each of the definable, hypersonic technologies. Starting with a baseline vehicle, the formulas, procedures and forms which are integral parts of this methodology are developed. A demonstration of the methodology is presented for one specific hypersonic vehicle system Author

N73-31954# Advisory Group for Aerospace Research and Development, Paris (France).
ESCAPE MEASURES FOR COMBAT HELICOPTER CREWS
Aug. 1973 39 p refs
(AGARD-AR-62) Avail: NTIS HC $4.00

A study was conducted to determine the requirements and characteristics of escape systems for use with helicopters. It was stated that escape systems are feasible, but that the rotary wing creates the greatest obstacle to emergency seat ejection. It was recommended that helicopter escape concepts be considered under the following categories: (1) an escape system for retrofit into helicopters already in production or in service, (2) an escape system for a near-term solution, and (3) an escape system for a far-term solution. The conclusion of the study was that a retrofittable escape system is practical only if it requires an absolute minimum of development time and does require major changes to the helicopter. The only likely canidates to satisfy the requirement are manual bailout or sideward ejection. Author

N73-31956*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
FLIGHT CALIBRATION TESTS OF A NOSE-BOOM-MOUNTED FIXED HEMISPHERICAL FLOW-DIRECTION SENSOR
Katharine H. Armistead and Lannie D. Webb Washington Oct. 1973 29 p refs
(NASA-TN-D-7461; H-779) Avail: NTIS HC $3.00 CSCL 01C

Flight calibrations of a fixed hemispherical flow angle-of-attack and angle-of-sideslip sensor were made from Mach numbers of 0.5 to 1.8. Maneuvers were performed by an F-104 airplane at selected altitudes to compare the measurement of flow angle of attack from the fixed hemispherical sensor with that from a standard angle-of-attack vane. The hemispherical flow-direction sensor measured differential pressure at two angle-of-attack ports and two angle-of-sideslip ports in diametrically opposed positions. Stagnation pressure was measured at a center port. The results of these tests showed that the calibration curves for the hemispherical flow-direction sensor were linear for angles of attack up to 13 deg. The overall uncertainty in determining angle of attack from these curves was plus or minus 0.35 deg or less. A Mach number position error calibration curve was also obtained for the hemispherical flow-direction sensor. The hemispherical flow-direction sensor exhibited a much larger position error than a standard uncompensated pitot-static probe. Author

N73-31957*# United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft Div.
APPLICATION OF COMPOSITES TO HELICOPTER AIRFRAME AND LANDING GEAR STRUCTURES Technical Report, Jul. 1972 - Feb. 1973
M. J. Rich, G. F. Ridgley, and D. W. Lowry Sep. 1973 138 p refs Sponsored in part by Army
(Contract NAS1-11688)
(NASA-CR-112333) Avail: NTIS HC $9.00 CSCL 01C

A design study has indicated that advanced composite helicopter airframe structures can provide significant system cost advantages. The most successful concept was found to be all-molded composite modular panels which provide integral skin/stringer and frame subassemblies. Based on present information it is estimated that a prototype composite airframe would cost approximately four percent more than a protoype metal frame. The difference is due primarily to the higher engineering design time, as the increased materials cost is largely offset by reduction of fabrication labor costs. Author

N73-31958*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
SUMMARY OF STABILITY AND CONTROL CHARACTERISTICS OF THE XB-70 AIRPLANE
Chester H. Wolowicz and Roxanah B. Yancey Washington Oct. 1973 56 p refs
(NASA-TM-X-2933; H-781) Avail: NTIS HC $3.50 CSCL 01C

The stability and control characteristics of the XB-70 airplane were evaluated for Mach numbers up to 3.0 and altitudes up to 21,300 meters (70,000 feet). The airplane's inherent longitu-

dinal characteristics proved to be generally satisfactory. In the lateral-directional modes, the airplane was characterized by light wheel forces, low static directional stability beyond approximately 2 deg of sideslip, adverse yaw response to aileron inputs throughout the entire Mach number range, and negative effective dihedral with wingtips full down. At subsonic Mach numbers, with the flight augmentation control system off, the light wheel forces and adverse yaw response to aileron inputs caused the pilots to minimize use of the ailerons. At supersonic Mach numbers, with the augmentation system off, the adverse yaw due to aileron and the negative effective dihedral were conducive to pilot-induced oscillations. Author

N73-31959*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

COMPARISON OF GROUND AND FLIGHT TEST RESULTS USING A MODIFIED F106B AIRCRAFT

Fred A. Wilcox 1973 20 p refs Presented at 9th Propulsion Joint Specialist Conf., Las Vegas, Nev., 5-7 Nov. 1973; sponsored by AIAA and SAE

(NASA-TM-X-71439; E-7695) Avail: NTIS HC $3.00 CSCL 01C

Two aft underwing nacelles housing afterburning J85 engines were added to an F106 to study exhaust nozzles in flight at Mach numbers up to 1.3. Installation effects were determined for several nozzles by comparing flight data to data from an isolated wind tunnel model. Reynolds number effects were studied at subsonic flight speeds for nozzles intended for use with afterburning turbofan engines. A wide range of Reynolds number was obtained by flying the F106 over a range of altitude and by using 5 and 22% wind tunnel models of the F106. A contoured nozzle had a boattail drag as low as that of a longer circular arc nozzle over the Reynolds number range studied. Author

N73-31960# Royal Netherlands Aircraft Factories Fokker, Amsterdam.

RATIONAL CALCULATION OF DESIGN GUST LOADS IN RELATION TO PRESENT AND PROPOSED AIRWORTHINESS REQUIREMENTS

J. Yff [1973] 12 p refs Presented at AGARD Symp. on Flight in Turbulence, Bedfordshire, United Kingdom

(Fok-K66) Avail: NTIS HC $3.00

Accurately calculated gust loads for three short haul aircraft have been used to: (1) Compare PSD and discrete gust methods; (2) compare PSD mission analysis and design envelope results; (3) compare PSD results for vertical and lateral gusts; and (4) study in detail the specific problems of T-tails. Author

N73-31961# Technische Univ., Berlin (West Germany). Inst. fuer Luft- und Raumfahrt.

DESIGN STUDY OF AN ELECTRONIC LANDING DISPLAY FOR STOL AIRCRAFT [GEDANKEN ZUR AUSLEGUNG EINES ELEKTRONISCHEN LANDEDISPLAYS FUER STOL-FLUGZEUGE]

Wolfgang Holstein 1973 37 p refs In GERMAN Presented at the DGLR-DGON Symp. on Neue Anflug- und Landeverfahren, Duesseldorf, 2-4 May 1973

(DGLR-Paper-73-038) Avail: NTIS HC $4.00

The design of landing display devices for STOL aircraft, was investigated on the basis of information presentation and information content. A proposal is made for a contact analogous landing display, which includes the perspective representation of the mean flight path, information about the actual flight status, predisplay of flight path coordinates, and boundary values for the flight parameters. An approach procedure using the improved display is described. ESRO

N73-31962# Technische Universitaet, Brunswick (West Germany). Inst. fuer Verkehr, Eisenbahnwesen und Verkehrssicherheit-Sonderforschungsbereich Flugfuehrung.

FLIGHT CONTROL PROBLEMS REGARDING STEEP APPROACH [FLUGFUEHRUNGSPROBLEME DES STEILANFLUGES]

R. Brockhaus 1973 35 p refs In GERMAN Presented at the DGLR-DGON Symp. of Neue Anflug- und Landeverfahren, Duesseldorf, 2-4 May 1973

(DGLR-Paper-73-027) Avail: NTIS HC $3.75

Some problems concerning steep approach landings and in particular flight control, are discussed. The flight control problem was one of the main reasons the extreme requirements of vertical landing was relaxed, and why, with respect to flight equipment and flight methods, little difference is to be found between steep landing and conventional jet landing. Although all equipment necessary for steep landing is available, STOL traffic will be limited to approach angles of 6 deg, for economic reasons. ESRO

N73-31963# Technische Universitaet, Brunswick (West Germany). Lehrstuhl fuer Flugmechanik.

LONGITUDINAL MOTION OF AN AIR LINER DURING STEEP APPROACH [ZUR LAENGSBEWEGUNG EINES VERKEHRSFLUGZEUGS BEI STEILEN ANFLUEGEN]

G. Bruening, J. Lademann, and D. Schafranek 1973 24 p ref In GERMAN Presented at the DGLR-DGON Symp. on Neue Anflug- und Landeverfahren, Duesseldorf, 2-4 May 1973

(DGLR-Paper-73-023) Avail: NTIS HC $3.25

Calculations were carried out on a Boeing 707 aircraft in order to assess the effects on longitudinal stability of steep approach landings. The investigations point out that the present passenger aircraft can perform steeper than usual landings. The sinking velocity will increase as the path velocity remains unchanged. In order to avoid too much throttling of the engines, the air brakes should be lowered. The dynamic longitudinal stability is only slightly disturbed. The angle of attack oscillation will be slightly undampened, the phugoid dampened. A glide path of 3 deg is recommended. ESRO

N73-31964# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugfuehrung.

MONITOR DISPLAY FOR AUTOMATICALLY CONTROLLED STEEP APPROACH [EIN MONITORDISPLAY FUER AUTOMATISCH GEREGELTE STEILANFLUEGE]

Hans-Dieter Schenk and Josef Thomas 1973 8 p refs In GERMAN Presented at the DGLR-DGON Symp. on Neue Anflug- und Landeverfahren, Duesseldorf, 2-4 May 1973

(DGLR-Paper-73-031) Avail: NTIS HC $3.00

A display for monitoring automatic steep approach was designed. This display shows a sideways view of the curved approach profile with a mobile aircraft symbol and a rotating flight path vector. The equipment was investigated in a flight simulator, and improved. A flight test, as well as further investigations concerning the operational usefulness of the equipment, are in preparation. ESRO

N73-31965# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugmechanik.

FLIGHT MECHANICAL PROBLEMS IN LANDING APPROACH WITH DIRECT LIFT CONTROL, EXEMPLIFIED BY HFB 320 HANSA [FLUGMECHANISCHE PROBLEME BEIM LANDEANFLUG MIT DIREKTER AUFTRIEBSSTEUERUNG AM BEISPIEL DER HFB 320 HANSA]

D. Hanke and H.-H. Lange 1973 32 p refs In GERMAN Presented at the DGLR-DGON Symp. on Neue Anflug- und Landeverfahren, Duesseldorf, 2-5 May 1973

(DGLR-Paper-73-024) Avail: NTIS HC $3.75

A possibility for reducing flight control problems in steep approach landing by direct lift control is discussed. The possibilities and limitations of direct lift controls are presented for the HFB 320 Hansa aircraft, by means of simulation and flight results. The first experiences with steep, noise-reducing, 2 segment approaches, using the HFB 320, are reported. ESRO

N73-31966# Messerschmitt-Boelkow-Blohm G.m.b.H., Hamburg (West Germany).
EFFECTS, AND THEIR SIGNIFICANCE OF NEW APPROACH METHODS ON COCKPIT DESIGN [AUSWIRKUNGEN NEUER ANFLUGVERFAHREN AUF DIE COCKPITAUSLEGUNG UND MOEGLICHKEITEN IHRER BERUECKSICHTIGUNG]
Haeuser 4 May 1973 23 p In GERMAN Presented at the DGLR-DGON Symp. on Neue Anflug- und Landeverfahren, Duesseldorf, 2-4 May 1973
(MBB-UH-07-73-O; DGLR-Paper-73-033) Avail: NTIS HC $3.25

The layout of cockpits is discussed in view of new landing approach methods. Parameters for cockpit layouts, based on the flight control functions to be executed, are developed, and modifications are introduced as a result of new approach methods. ESRO

N73-31967# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensbereich Flugzeuge.
CONTROL TECHNIQUE IN STEEP APPROACH OF ROTARY WING AIRCRAFT [REGELUNGSTECHNIK BEI STEILANFLUEGEN VON DREHFLUEGLERN]
Wolfgang Kubbat May 1973 26 p In GERMAN Presented at the DGLR-DGON Symp. on Neue Anflug- und Landeverfahren, Duesseldorf, 2-4 May 1973
(MBB-UFE-1021-O; DGLR-Paper-73-029) Avail: NTIS HC $3.50

Feedback control for flexible landing approach profiles of rotary wing aircraft was investigated. The feedback control circuit, in which the state vector contains 8 variables, is described. Solutions to the linearized state equation are illustrated by examples with results of simulation, during which straight-line, curved, and spatially curved approaches were investigated. ESRO

N73-31968# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).
NOISE REDUCING METHODS FOR STOL AIRCRAFT APPROACH AND TAKE-OFF [LAERMREDUZIERENDE AN- UND ABFLUGVERFAHREN FUER STOL-FLUGZEUGE]
K. Weise and H. Anders 3 May 1973 43 p refs In GERMAN Presented at the DGLR-DGON Symp. on Neue Anflug- und Landeverfahren, Duesseldorf, 2-4 May 1973
(MBB-UH-06-73-O; DGLR-Paper-73-039) Avail: NTIS HC $4.25

The noise propagation of three projected STOL aircraft was investigated during takeoff and approach flight. It was shown that takeoff noise can be reduced a few dB by thrust reduction (three segment takeoff profile) near airports. As with CTOL aircraft, the landing paths should be as steep as possible, and landing flaps and gear should be lowered at low altitude. By using all possibilities during landing, obtainable noise reduction can be considerable. Keeping to the exact flight path was also found to be noise reducing. ESRO

N73-31969# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).
STEEP APPROACH LIMITS FOR ROTARY WING AIRCRAFT [UEBER DIE GRENZEN VON STEILANFLUEGEN MIT DREHFLUEGLERN]
M. Rade 1973 8 p refs In GERMAN Presented at the DGLR-DGON Symp. on Neue Anflug- und Landeverfahren, Duesseldorf, 2-4 May 1973
(MBB-UD-101-73-O; DGLR-Paper-73-026) Avail: NTIS HC $3.00

The flight characteristics and boundary conditions which affect a steep approach are described for rotary wing aircraft. The limits for steep instrument approach are presented, and experiences in flight operation are depicted. Essential advantages are shown for a flight path angle of 15 deg over the ILS approach. Some necessary prerequisites for a steep landing approach by instruments are briefly considered. ESRO

N73-31970# Bodenseewerk Geraetetechnik G.m.b.H., Ueberlingen (West Germany).
PROBLEMS INVOLVED IN DEVELOPING AN INTEGRATED FLIGHT CONTROL SYSTEM WITH EMPHASIS ON CURVED FLIGHT PATH PROFILES [REALISIERUNGSPROBLEME EINES INTEGRIERTEN FLUGREGELUNGSSYSTEMS UNTER BESONDERER BERUECKSICHTIGUNG GEKRUEMMTER FLUGBAHNPROFILE]
H. Boehret 1973 32 p refs In GERMAN Presented at the DGLR-DGON Symp. on Neue Anflug- und Landeverfahren, Duesseldorf, 2-4 May 1973
(DGLR-Paper-73-030) Avail: NTIS HC $3.75

An integrated flight control system, FRG 70, which is especially adapted to curved flight path profiles, is presented. The feedback control parameters are coupled to elevators and thrust, which limitation facilitates the realization of this principle. The system is characterized by a precise matching to the aerodynamic flow conditions and high passenger comfort. The exact path guidance is supported by a path angle dependent thrust control, allowing for larger thrust rest. The properties of the integrated system were analyzed during over 500 automatic approaches and landings. They can be improved by direct lift controls and by using a monitor display. ESRO

N73-31971# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
COMPARISON OF METHODS FOR FLIGHT TESTS AND THEIR EVALUATION FOR THE DETERMINATION OF CHARACTERISTICS AND PERFORMANCE OF MODERN JET AIRCRAFT [VERGLEICH VON VERFAHREN ZUR DURCHFUEHRUNG UND AUSWERTUNG VON FLUGVERSUCHEN ZUR BESTIMMUNG VON EIGENSCHAFTEN UND LEISTUNGEN MODERNER STRAHLFLUGZEUGE]
U. VonMeier, H. Ruf, H. Friedrich, W. Kohl, H. J. Munser, and H. Wuennenberg Bonn Bundeswehramt 1973 169 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. Fuer Verteidigung
(BMVg-FBWT-73-12) Avail: NTIS HC $10.50; Bundeswehramt 25 DM

Five techniques for analyzing the stability derivatives of a G91T aircraft were compared. They included manual evaluation of special flight maneuvers, time vector method, forced oscillation method, analog matching, and regression analysis. Parameters taken into account were elapsed time, equipment for flight tests, data reduction, and result quality. It was shown that several measuring and evaluation techniques should be used in parallel. The advantages and disadvantages of the different techniques are discussed. ESRO

N73-31972# Calspan Corp., Buffalo, N.Y.
DEVELOPMENT AND EVALUATION OF AN AUTOMATIC DEPARTURE PREVENTION SYSTEM AND STALL INHIBITOR FOR FIGHTER AIRCRAFT Final Report
Robert T. N. Chen, Fred D. Newell, and Arno E. Schelhorn Wright-Patterson AFB, Ohio AFFDL Apr. 1973 126 p refs (Contract F33615-72-C-1162; AF Proj. 8225; AF Proj. 8219) (AD-764767; CALSPAN-AK-5112-F-1; AFFDL-TR-73-29) Avail: NTIS CSCL 01/3

The report documents the conceptual design, breadboard development and pilot-in-the-loop evaluation of an automatic departure prevention system and a stall inhibitor for fighter aircraft. Using the A-7D as the study aircraft, a departure boundary characterized by alpha and beta was determined from the available data. This departure boundary was then used to help design an

automatic departure preventer and a stall inhibitor. An automatic departure prevention device as described in the report works smoothly and will benefit the A-7 aircraft. With just the departure preventer, the pilots could maneuver freely, with great confidence and use the full capability of the airplane, well beyond the present departure boundary. (Modified author abstract) GRA

N73-31973# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
PREDICTING HEADING TASK FLYING QUALITIES WITH PAPER PILOT M.S. Thesis
Calvin Ronald Taylor Jun. 1973 136 p refs
(AD-764695; GE/MA/73-1) Avail: NTIS CSCL 01/3

A mathematical model for predicting the pilot rating of a fighter aircraft in a precision heading task is described. The model includes the lateral-directional aircraft equations of motion, a stochastic gust model, a pilot model with four free pilot parameters, and a pilot rating expression that is a function of rms heading angle, rms yaw rate, and rms roll rate. The pilot gains and lead time constants are selected to minimize the pilot rating expression. The resulting minimum is used to compute a heading paper pilot rating. The heading paper pilot rating was computed for 32 flight conditions at different gust intensities for the F-5 and A-7 aircraft. Heading paper pilot ratings agree well with the actual ratings for the F-5, but are low for the A-7. In addition, there is good correlation between computed and actual rms heading angle, rms yaw rate, and rms slideslip. Author (GRA)

N73-31974# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
AN IMPROVED METHOD OF PREDICTING AIRCRAFT LONGITUDINAL HANDLING QUALITIES BASED ON THE MINIMUM PILOT RATING CONCEPT M.S. Thesis
John D. Arnold Jun. 1973 152 p refs
(AD-764696; GGC/MA/73-1) Avail: NTIS CSCL 01/3

A fixed-base simulation of some of the flight tests in the USAF/CAL variable stability T-33 aircraft was performed. The task was maintaining pitch attitude in the presence of vertical turbulence. The root-mean-square state data and parameters in a linear pilot model were determined from the simulation. These items were correlated with the Cooper-Harper Pilot Ratings. This led to the development of a pilot-rating expression based on rms state errors and pilot workload. This rating expression was used in a digital computer program to accurately predict pilot ratings and rms state errors using only the aircraft stability derivatives, airspeed, and altitude as inputs. Author (GRA)

N73-31975# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
DESIGN AND INVESTIGATION OF A WIND-SHEAR-PROOF CONTROL SYSTEM FOR AUTOMATIC LANDING M.S. Thesis
Louis G. Trivett Jun. 1973 91 p refs
(AD-764697; GGC/MA/73-4) Avail: NTIS CSCL 01/2

An analog computer simulation of the longitudinal portion of an All-Weather Landing System is presented. The linearized longitudinal equations of motion of a DC-8 aircraft during landing approach are converted to state-variable form to facilitate the analog simulation. An Advanced Automatic Flight Control System is added and the approach phase of an automatic landing is simulated. A severe turbulence atmospheric environment consisting of wind gusts and wind shears is an integral part of the simulation. A systematic method is presented for developing a Kalman Filter based wind-shear-proofing system to reduce deviations from glide slope caused by wind shears. (Modified author abstract) GRA

N73-31976# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
PREDICTING PITCH TASK FLYING QUALITIES USING PAPER PILOT M.S. Thesis
Robert B. Johnson Jun. 1973 155 p refs
(AD-764698; GGC/MA/73-2) Avail: NTIS CSCL 01/3

A mathematical model for predicting the pilot rating of an aircraft in a pitch tracking task is described. The model includes the longitudinal-directional aircraft equations of motion, a stochastic gust model, a pilot model with two free parameters, and a pilot rating expression that is a function of rms pitch angle, rms pitch rate, and the pilot lead time constant. The pilot parameters are then adjusted to provide at least a 20% stability margin, and the adjusted pilot parameters are used to compute a Flypaper Pilot rating of the aircraft/gust configuration. The Flypaper Pilot rating was computed for 32 aircraft/gust configurations. A range of actual ratings from 2 to 8 was encountered and the Flypaper Pilot ratings agree quite well with the actual ratings. Author (GRA)

N73-31977# Uniroyal Tire Co., Detroit, Mich.
CONTINUOUS WOUND TOROIDAL AIRCRAFT TIRE Final Report, 17 Mar. 1970 - 9 Feb. 1973
Edwin Sj English and Jerome J. Wojciechowski Mar. 1973 35 p
(Contract F33615-70-C-1775; AF Proj. 1369)
(AD-764888; AFFDL-TR-73-35) Avail: NTIS CSCL 01/3

The primary objective of the program was to establish basic design requirements for a toroidal continuous wound aircraft tire concept. Using these basic design requirements, tires were fabricated and shipped to the Flight Dynamics Laboratory at WPAFB for their evaluation so as to aid in determining the performance characteristics of the toroidal tire concept on military aircraft applications. Author (GRA)

N73-31979# Naval Aerospace Medical Research Lab., Pensacola, Fla.
HUMAN FACTORS APPROACH TO AIRCRAFT ACCIDENT ANALYSIS
Richard H. Shannon and Wayne L. Waag 18 Jun. 1973 46 p refs
(AD-764868; NAMRL-1184) Avail: NTIS CSCL 01/2

Naval Accident reports involving the P-3 and F-4 aircraft were examined over seven and five-year periods, respectively. The critical incident technique was used to catalogue, describe, and analyze operational flight crew errors in both aircraft. An in-depth study was performed in order to identify those problems which were common as well as specific to both aircraft. The P-3 and F-4 aircraft were selected because of their completely different fleet missions and handling characteristics. From the F-4 accident reports, 437 human errors were isolated while the P-3 reports contained 345 errors. Twenty-eight major error categories emerged from the analysis of these errors. The accident reports were further analyzed for the errors which both aircraft had in common. Twenty common error groups were found to occur in the P-3 and the F-4, representing 22.9% and 18.8% of the total errors, respectively. The flight segment of Takeoff/Landing, and the error type of Procedures, shared the most commonality across the two aircraft. The results of this investigation suggest that although common errors can be isolated across highly dissimilar aircraft with highly different flight missions, they comprise a relatively small percentage of total errors. By far, the majority of errors concerned characteristics unique to the particular aircraft in question. Implications in the remedial areas of crew coordination, training, discipline and design are discussed. Author (GRA)

N73-31980# CADCOM, Inc., Annapolis, Md.
SIMULATION OF THE COMPATIBILITY OF AN AIR CAPABLE SHIP AND A VTOL AIRCRAFT Final Report, 16 Jun. 1972 - Mar. 1973
George H. Daffer and David F. Rogers Mar. 1973 208 p refs

(Contract N00014-72-C-0531; NR Proj. 215-208)
(AD-764865; CADCOM-73-6) Avail: NTIS CSCL 01/3

An interactive computer simulation, LARC-I, has been designed to solve the non-linear equations of motion of a generalized VTOL aircraft taking off from or landing on the deck of a ship moving in an irregular or random seaway. This version of LARC-I is limited to longitudinal motions, but is designed for eventual expansion to all degrees of freedom. The LARC-I programs makes use of ship motion amplitudes and frequencies derived separately in a ship motions program, wherein the forcing functions of the seaway are based on a stochastic representation of the waves for any given sea state. The pitching and heaving motions of the ship are transmitted to the aircraft by a realistic simulation of the landing gear. (Modified author abstract) GRA

N73-31981# Defense Documentation Center, Alexandria, Va.
HELICOPTER ENGINES AND ROTORS Report, Bibliography, Jan. 1968 - Mar. 1973
Jul. 1973 454 p refs
(AD-764900; DDC-TAS-73-48) Avail: NTIS CSCL 01/3

The bibliography comprises annotated citations of 300 unclassified reports dealing with helicopter engines and rotors. The following references are on some of the topics dealing with the subject: helicopter engines, rotor materials, rotor hover, rigid rotors, hot cycle rotors, rotor blades, heavy-lift rotors, rotor noise, and flight control systems. Corporate Author-Monitoring Agency, Subject, Title, Personal Author, Contract, and Report Number Indexes are included. Author (GRA)

N73-31984# Naval Ship Research and Development Center, Bethesda, Md. Aviation and Surface Effects Dept.
HIGHER HARMONIC CIRCULATION CONTROL ROTOR MODEL - MODEL INSTRUMENTATION AND DATA ACQUISITION
Michael B. Stone Apr. 1973 44 p refs
(AD-765320; TN-AL-288) Avail: NTIS CSCL 01/3

A higher harmonic circulation control rotor was tested in the 8 ft x 10 ft subsonic wind tunnel at various advance ratios, blade tip Mach numbers, blowing air pressures, shaft angles and collective angles. The model was instrumented with strain gages, pressure transducers, thermocouples, magnetic pick-ups and a pitch-roll trim resolver. This information was recorded on an analog to digital acquisition system and on F.M. tape recorders for later digitization. The purpose of the report is to provide descriptive documentation of the model instrumentation and data acquisition portion of the test, and there is no attempt made to elaborate on helicopter or higher harmonic theory.
Author (GRA)

N73-31985# San Diego Aircraft Engineering, Inc., Calif.
CONCEPTUAL DESIGN OF A AIR CUSHION LANDING SYSTEM FOR AN UNMANNED AIRCRAFT Final Report, 27 Mar. - 11 Aug. 1972
Henry B. McCudden, Paul D. Sorensen, George R. Lutz, William H. Stewart, and Donald R. Walborn 3 Jan. 1973 126 p refs
(Contract F33615-72-C-1769; AF Proj. 1369)
(AD-764774; SAE-72-031; AFFDL-TR-72-155) Avail: NTIS CSCL 01/3

The problems associated with existing recovery systems include difficulty in mid-air retrieval of RPV's in excess of 1500 lbs; high operations and support costs of parachutes, recovery helicopters, other aircraft and their crews; long recycle time; paving quality requirements for wheeled or skid type landing gear; and frequent damage of RPV's recovered by parachute/attenuation bag or parachute/mid-air recovery systems. Accordingly, this preliminary design study report describes an air cushion landing system (ACLS) applied to the 3,000 lb Jindivik Mk 3A unmanned aircraft. The ACLS is stowed for cruise flight in a clean aerodynamic fairing on the underfuselage, resulting in a minimum performance degradation. For recovery, hinged clam-shell type doors are unlatched, and open, permitting inflation/deployment of an inelastic type elongated toroid-shaped trunk. The trunk is inflated and blown with bleed air tapped off an existing port on the Jindivik's Viper Mk 201 engine. After landing, the aircraft is placed on a fixture and the trunk is manually restowed in the fairing. (Modified author abstract) GRA

N73-31986# Lockheed-California Co., Burbank.
EXPERIMENTAL PROGRAM FOR THE DEVELOPMENT OF IMPROVED HELICOPTER STRUCTURAL CRASHWORTHINESS ANALYTICAL AND DESIGN TECHNIQUES. VOLUME 2: TEST DATA AND DESCRIPTION OF AN UNSYMMETRICAL CRASH ANALYSIS COMPUTER PROGRAM, INCLUDING A USER'S GUIDE AND SAMPLE CASE
Gilbert Wittlin and Max A. Gamon May 1973 251 p refs
(Contract DAAJ02-71-C-0066; DA Proj. 1F1-62203-A-529)
(AD-764986; USAAMRDL-TR-72-72B) Avail: NTIS CSCL 01/2

Volume 2 contains supporting data for the details presented in Volume I. The report contains abstracts for the 32 technical reports reviewed during the program. Included in the literature survey section is a matrix categorization of the reports by subject and applicable areas of interest. A brief description is presented on STAGS, the LMSC computer program used to perform the analysis of the P2V-4 fuselage bumper. A comprehensive description of program KRASH is presented, including the theory, initial conditions, the User's Guide, and a sample problem. Twenty-six channels of recorded test data and film data are presented in another section. Additional analytical data are presented in the last section. Author (GRA)

N73-32058 Magnavox Research Labs., Torrance, Calif.
SPREAD SPECTRUM APPLICATIONS AND STATE OF THE ART EQUIPMENTS
Charles R. Cahn *In* AGARD Spread Spectrum Commun. Jul. 1973 111 p refs

The applications of spread spectrum communications to avionics systems are described. The following topics are discussed: (1) multiple access capabilities, (2) interference rejection, (3) identification characteristics, and (4) distance measuring and position location capabilities. The characteristics and uses of current spread spectrum equipment are reported. Recent technology discoveries, such as acoustic surface wave and charge coupled devices are explained. Author

N73-32131# Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.
A LIGHTWEIGHT, LOW-PROFILE ANTENNA FOR AIRBORNE STATION-KEEPING APPLICATION Physical Sciences Research Papers
William G. Mavroides, Raymond A. Schofield, and Robert J. Mailloux 12 Jan. 1973 27 p
(AF Proj. 4600)
(AD-764685; AFCRL-TR-73-0047; AFCRL-PSRP-527) Avail: NTIS CSCL 09/5

The report describes a low-profile, all dielectric lightweight antenna array to replace the directional antenna for the AN/APN 169 Aircraft Station-Keeping Antenna. The array consists of eight (LEXAN) polycarbonate channel guide elements partially plated with copper enabling the antenna system to be reduced from the present 8 inches in height to less than 2 inches. Design data and radiation patterns are given for the individual elements as well as for the eight-element array. Author (GRA)

N73-32135# Air Force Materials Lab., Wright-Patterson AFB, Ohio.
THERMAL AGING OF SILVER-PLATED COPPER AIRCRAFT

ELECTRICAL WIRE Technical Report, Aug. 1971 - Jan. 1973
Lawrence R. Bidwell May 1973 58 p refs
(AF Proj. 7351)
(AD-764731; AFML-TR-73-113) Avail: NTIS CSCL 09/1

FEP/Polyimide insulated silver-plated copper aircraft electrical wire was thermally aged at temperatures of 150-230C for periods of up to 1000 hrs. The wires were examined for evidence that the insulation contributed to strand blocking during high temperature exposure. No evidence for a reaction between the insulation and the metal conductors was found. The phenomenon can be attributed entirely to the interstrand diffusion of silver. Two types of conductor degradation, unrelated to strand blocking, were identified. The nature, possible cause and probable effect of each is discussed and a change in the current temperature rating procedure is recommended. Author (GRA)

N73-32141# Joint Army-Navy Aircraft Instrumentation Research Project, Washington, D.C.
COCKPIT SWITCHING STUDY: LOGIC AND DESIGN PROCEDURE DEVELOPMENT FOR MULTIFUNCTION MODE SWITCHING CONTROLS Final Report
D. K. Graham May 1973 76 p refs
(Contract N00014-72-C-0191; NR Proj. 213-088)
(AD-764617; D180-15335-1; JANAIR-730501) Avail: NTIS CSCL 09/1

The purpose of the cockpit switching study was to develop a procedure for design and application of multifunction switching concepts to cockpit controls, and thereby reduce both the number of cockpit switches required and the switching workload of the pilot or aircrew. Such a procedure was developed and is printed under separate cover in a self-guiding handbook format. The procedure is a logical, step-by-step method of consolidating many switching functions on relatively few multifunction switches. The procedure handbook includes appendices containing a review of multifunction switching hardware, and human-engineering design considerations. (Modified author abstract) GRA

N73-32153 Purdue Univ., Lafayette, Ind.
THE APPLICATION OF ENERGY CONCEPTS TO PAVEMENTS Ph.D. Thesis
William Henry Highter 1972 178 p
Avail: Univ. Microfilms Order No. 73-15817

Pavement engineers have not been able to predict the performance of pavement systems prior to their actual construction and operational utilization. A solution to this problem was obtained by verifying the following hypothesis: There is a functional relationship between the cumulative energy as measured by cumulative peak deflections imparted to a given pavement system and the condition of that system. The hypothesis was tested by applying it to load-deflection and performance trend data gathered in the AASHO Road Test. Regression analysis was performed to find a relationship that predicted the level of the Present Serviceability Index (PSI) as a function of the pavement profile and a measure of the cumulative energy imparted to the pavement. Because of the paucity of airfield condition and deflection data, indirect means had to be used to test the working hypothesis for airfield pavement. Traffic records and construction histories for two Air Force Bases were analyzed. The analysis indicated there is a threshold cumulative total peak deflection at which cracking develops in airfield pavements.
Dissert. Abstr.

N73-32158# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
THE S-4 MODANE HYPERSONIC WIND-TUNNEL: ITS USE FOR AIR BREATHING ENGINE TESTS
Jean Laverre and Christian Soulier [1973] 10 p refs In FRENCH; ENGLISH summary Presented at 1st Intern. Symp. on Air Breathing Engines, Marseille, 19-23 Jun. 1972
Avail: NTIS HC $3.00

The S4-MA hypersonic wind tunnel is equipped with a Mach 6 nozzle, working at maximum stagnation conditions of 40 bars and 1650 K. The diameter of the free jet test section is 0.68 m. The possibilities offered by the high pressure and temperature air supply system were used for studying the operation of a ramjet supersonic combustion chamber, fed with hydrogen, in the flight conditions. The Mach 6 nozzle was replaced by a duct of appropriate shape, directly connected to the annual intake. Apart from this type of test in closed duct, the wind tunnel permits, with its Mach 6 nozzle, the study of the aerodynamic behavior of large size air intakes, under the actual flight conditions of pressure and temperature. The model may be set in pitch and/or yaw, up to plus or minus 15 deg. The study of a complete airbreathing engine, with its intake and diffusor and with actual flight conditions (Mach 6, 25 km altitude) at intake is possible. The downstream conditions are obtained by using an adequate exhaust system for the combustion gases, either towards spherical vacuum tanks (4000 or 5000 cu m at 0.02 bar) or to atmosphere through a compressed air ejector. Author

N73-32159# Minister fuer Wirtschaft, Mittelstand und Verkehr des Landes Nordrhein, Westfalen (West Germany).
TASKS OF REGIONAL AIRPORTS AND RESULTING GROUND FACILITIES REQUIREMENTS [AUFGABEN DER REGIONALFLUGPLAETZE; DARAUS RESULTIERENDE ANFORDERUNGEN UND DIE BODENANLAGEN]
G. Ruff 1973 14 p In GERMAN Presented at the DGLR-DGON Symp. on Neue Anflug- und Landeverfahren, Duesseldorf, 2-4 May 1973
(DGLR-Paper-73-035) Avail: NTIS HC $3.00

The role of regional airports is described, and the requirements for ground facilities are surveyed from a sociological and economic point of view. ESRO

N73-32161# Calspan Corp., Buffalo, N.Y.
SELF-CORRECTING WIND TUNNELS
W. R. Sears Jul. 1973 48 p refs
(Contract N00014-72-C-0102; NR Proj. 061-199)
(AD-764957; CALSPAN-RK-5070-A-2) Avail: NTIS CSCL 14/2

The familiar technique of accounting for wind-tunnel boundary effects by correcting measured data fails in some of the most important flight regimes, such as the transonic and V/STOL. In such domains, typically strongly nonlinear, it seems necessary that the wind tunnel provide the same flow conditions in the vicinity of the model as in flight, since corrections are virtually impossible. Present-day slotted and perforated tunnels, for example, are intended to do this, but are often inadequate. However, unconfined flow is characterized by certain functional relationships among the flow variables at points on a surface within the tunnel; it is always possible to ascertain whether unconfined-flow conditions are actually present, by measuring such quantities and verifying that these relationships are indeed satisfied. These relationships are independent of the configuration being tested. It is proposed here that wind tunnels be provided with sensors to measure such selected quantities on a convenient surface and means to vary wall geometry so as to approach such conditions in an iterative process. (Modified author abstract) GRA

N73-32162# Illinois Univ., Savoy. Aviation Research Lab.
A DIGITAL COMPUTER-GENERATED CONTACT ANALOG LANDING DISPLAY
Terry L. Hummel May 1973 92 p refs
(Contract F44620-70-C-0105)
(AD-764764; ARL-73-9/AFOSR-73-5; AFOSR-73-1258TR)

Avail: NTIS CSCL 17/7

A flexible display device was constructed to present a visual landing and navigation display to a pilot. The device makes use of a small digital computer, a flight simulator, and display equipment. A contact analog visual representation of external world objects plus control information is displayed to the pilot. The system is capable of simulating a nighttime approach to an airport and various types of enroute visual information.

Author (GRA)

N73-32166 Iowa State Univ. of Science and Technology, Ames.

NUMERICAL CALCULATION OF FLOW FIELDS ABOUT RECTANGULAR WINGS OF FINITE THICKNESS IN SUPERSONIC FLOW Ph.D. Thesis

Jerald Milo Vogel 1973 178 p

Avail: Univ. Microfilms Order No. 73-16985

The inviscid flow fields about a three dimensional rectangular wing of finite thickness at angle of attack with a subsonic tip in a supersonic flow are determined by applying a second order finite difference technique to the gas dynamic equations of motion in their conservative form. The analysis includes a comparison of the second order technique with a current third order method.

Dissert. Abstr.

N73-32193# Kyushu Univ., Fukuoka (Japan).

SMALL DISTURBANCE THEORY OF ROTATING SUBSONIC AND TRANSONIC CASCADES

M. Namba 23 Jun. 1972 45 p refs Presented at 1st Intern. Symp. on Air Breathing Engines, Marseille, 19-23 Jun. 1972; sponsored by Army and AF European Res. Offices, London, by Roy. Soc. of London, and by Cambridge Univ.

Avail: NTIS HC $4.25

A linearized inviscid, isentropic, three-dimensional flow theory for a rotating thin blade row in a cylindrical duct with subsonic axial flow velocity and subsonic or supersonic relative tip velocity was developed on the basis of pressure dipole representations. A new method of approximation to Fourier Bessel double series was employed to evaluate the singularities. The theory was successfully applied to the inverse problem. Some numerical examples are provided. The validity of the blade element concept is discussed. The essential flow features for transonic compressors are demonstrated.

Author

N73-32194# Aeronautical Research Labs., Melbourne (Australia).

VISCOUS INTERACTION IN INTEGRATED SUPERSONIC INTAKES

Murdoch Culley 23 Jun. 1972 33 p refs Presented at 1st Intern. Symp. on Air Breathing Engines, Marseille, 19-23 Jun. 1973

Avail: NTIS HC $3.75

An experimental investigation has been conducted into the nature of the flow interference which occurs between a supersonic intake and an airframe in an integrated design of aircraft. It has been shown that an intake pressure field is of ample strength to cause three dimensional separation of a boundary-layer within its influence. The most energy deficient portion of the separated boundary layer is diverted by the separation, to be spilled into the airstream as vortices. A shock wave is generated by the three dimensional separation, and through this the boundary layer is able to influence the intake flow. There is good evidence that the separation shock is not steady.

Author

N73-32196# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

STUDY OF SHOCK WAVES PATTERNS IN AN AXIAL SUPERSONIC COMPRESSOR

Jacques Paulon 19/2 8 p refs In FRENCH; ENGLISH summary Presented at 1st Intern. Symp. on Air Breathing Engines, Marseille, 19-23 Jun. 1973

Avail: NTIS HC $3.00

Performance and operation stability of a transonic or supersonic compressor are conditioned by the intensity of the shock waves and their position in the blade channels. An experimental facility which, in a small height annular channel, simulates a rotating cascade at supersonic speed, provides optimum conditions to study the shock wave pattern and stability. This facility, using Freon 114 as working gas, includes a window for visualization through which one records instantaneous schlieren shock wave configurations. Outer wall pressure taps give mean pressure repartitions in blade channels and check indications taken from schlieren pictures. Thus, it is possible to show that in function of back pressure, several flow patterns are obtained which extend from entirely supersonic operation in blade channels to rotating stall operation.

Author

N73-32208# Bell Aerospace Co., New Orleans, La.

WATER-AUGMENTED VEHICLE (WAVE) STUDY - PHASE 1 Final Report, 5 Jun. - 31 Dec. 1972

Charles D. Hope-Gill, George Rudinger, Stephen W. Zelazny, and John H. Morgenthaler 1 Mar. 1973 134 p refs

(Contract N00014-72-C-0306; NR Proj. 259-097)

(AD-765332) Avail: NTIS CSCL 13/10

The report deals with the analytical investigation of the thrust augmentation, lift forces and mixing properties of a two-phase flow propulsion/lift system which has application to Air Cushion Vehicles (ACV) and Surface Effect Ships (SES). The results of Water-Augmented Vehicles (WAVE) computer program investigations show that significant thrust augmentation can be obtained by the injection of spray inherently produced through the interaction of ACV's and SES's with water surfaces. In addition propulsive efficiencies of 60% can be obtained with relatively quiet operation. The flow model I analysis conducted was based on a modified, one-dimensional duct flow and considered the transverse injection of spray and cushion air into the propulsion duct. Flow pressure losses, leakage of propulsion air from the propulsion duct, droplet breakup and the penetration of spray droplets into the propulsion duct where taken into account. (Modified author abstract)

GRA

N73-32209# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE EFFECT OF REAL PROPERTIES OF AIR ON PARAMETERS OF FLOW NEAR AN ELLIPTIC CONE. AERODYNAMIC CHARACTERISTICS OF ELLIPTIC CONES AT LARGE ANGLES OF ATTACK

A. P. Bazzhin, O. N. Trusova, and I. F. Chelysheva 27 Jul. 1973 16 p refs Transl. into ENGLISH from Uch. Zap. Tsagi, Tsent. Aerogidrodinam. Inst. (USSR), v. 1, no. 2, 1970 p 46-52

(AD-764945; FTD-HT-23-708-73) Avail: NTIS CSCL 20/4

The calculation results of a flow around a family of elliptic cones by a flow of ideal gas at large angles of attack were presented in previous reports. Subsequently, several variants of flow were calculated taking into account the real properties of air, which are in a state of thermodynamic equilibrium. These calculation results permit one to evaluate the effect of real gas properties, which proves to be insignificant for the variants of flow. The first part of this report is devoted to this problem. Calculated aerodynamic characteristics of elliptic cones over the angle of attack range from 30 degrees to 50 degrees in the case of an ideal gas are presented in the second part of this report.

GRA

N73-32298# California Univ., Livermore. Lawrence Livermore Lab.

DOT-CIAP PROGRAM Annual Report
M. C. MacCracken 13 Feb. 1973 220 p refs
(Contract W-7405-eng-48)
(UCRL-51336; AR-1) Avail: NTIS HC $7.60

Research projects to determine the effects of large numbers of aircraft operating in the stratosphere on global and local climatic conditions are discussed. The projects are concerned with developing models to show: (1) global kinetics and transport, (2) zonal atmospheric conditions, (3) stratospheric conditions, (4) radiation transport, and (5) meteorological conditions. Mathematical models are developed to analyze the dispersion of the aircraft exhaust plume under various conditions. The chemical reactions of the exhaust plume with atmospheric constituents are discussed. Author (NSA)

N73-32298# Istituto di Fisica Dell Atmosfera, Rome (Italy).
THERMAL SURVEYS ON GARDA LAKE USING INFRARED EQUIPMENT
M. Giorgi, M. Colacino, and F. M. Vivona Jan. 1973 54 p refs In ITALIAN; ENGLISH summary
(IFA-STR-23) Avail: NTIS HC $4.75

Annual variations of the Garda Lake surface temperature were studied by bolometric measurements using helicopter-borne devices. Superficial isotherms were derived for two sets of flights performed in different months. Thermal anomalies of morning-evening inversions were analyzed. Earth based thermograms obtained by using the thermovision instrument are presented and compared to bolometer measurements. ESRO

N73-32354# Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.
FLIGHT TESTING OF A CRYOGENICALLY COOLED HYGROMETER
James F. Church and Russell M. Peirce 4 May 1973 30 p refs
(AF Proj. 6670)
(AD-764718; AFCRL-TR-73-0292; AFCRL-IP-188) Avail: NTIS CSCL 04/2

The cryogenically cooled, optical dew/frost point hygrometer was developed to provide a fast response aircraft instrument for the measurement of very low frost-point temperatures encountered at the higher altitudes. A detailed description of the device is presented, along with a discussion of the laboratory and flight tests performed to date. Problems encountered during the tests are outlined, and recommended changes to the instrument are made for the benefit of those contemplating its use in the future. Author (GRA)

N73-32357# Naval Academy, Annapolis, Md. Michelson Physical Lab.
AVRG: A PDP 8/I DATA ACQUISITION AND AVERAGING PROGRAM FOR SYNCHRONOUS HOT WIRE MEASUREMENTS
Samuel A. Elder 31 May 1973 28 p refs
(AD-764851; E-7302) Avail: NTIS CSCL 14/2

The program, in function-modified FOCAL, is specifically designed to enable measurements to be performed on oscillating vertical velocity profiles in the mouth of a flow-excited cavity resonator. Simultaneous hot wire and pressure microphone data samples are recorded at an exact multiple (20X) of the oscillation frequency so as to obtain a synchronous record of the cyclic variation of longitudinal stream velocity at many points in the mouth region. Data is automatically averaged over 100-cycle intervals to remove turbulent background variation. From the stored data, either two or three dimensional velocity profile information can be reconstructed, using sound pressure at the base of the cavity as a phase reference. Options are provided for Fourier analysis, real time (oscilloscope) display, and TTY printout. Author (GRA)

N73-32374*# Virginia Univ., Charlottesville.
NONLINEAR TRANSIENT ANALYSIS OF MULTI-MASS FLEXIBLE ROTORS - THEORY AND APPLICATIONS
R. Gordon Kirk and Edgar J. Gunter Washington NASA Sep. 1973 265 p refs
(Grant NGL-47-005-050)
(NASA-CR-2300; ME-4040-112-72U) Avail: NTIS HC $6.35 CSCL 13I

The equations of motion necessary to compute the transient response of multi-mass felxible rotors are formulated to include unbalance, rotor acceleration, and flexible damped nonlinear bearing stations. A method of calculating the unbalance response of flexible rotors from a modified Myklestad-Prohl technique is discussed in connection with the method of solution for the transient response. Several special cases of simplified rotor-bearing systems are presented and analyzed for steady-state response, stability, and transient behavior. These simplified rotor models produce extensive design information necessary to insure stable performance to elastic mounted rotor-bearing systems under varying levels and forms of excitation. The nonlinear journal bearing force expressions derived from the short bearing approximation are utilized in the study of the stability and transient response of the floating bush squeeze damper support system. Both rigid and flexible rotor models are studied, and results indicate that the stability of flexible rotors supported by journal bearings can be greatly improved by the use of squeeze damper supports. Results from linearized stability studies of flexible rotors indicate that a tuned support system can greatly improve the performance of the units from the standpoint of unbalanced response and impact loading. Extensive stability and design charts may be readily produced for given rotor specifications by the computer codes presented in this analysis. Author

N73-32375*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
BALL MOTION AND SLIDING FRICTION IN AN ARCHED OUTER RACE BALL BEARING
Bernard J. Hamrock [1973] 41 p refs Proposed for submittal to ASME for presentation at the ASME-ASLE Joint Lubrication Conf., Montreal, 8-10 Oct. 1974
(NASA-TM-X-71442; E-7607) Avail: NTIS HC $4.25 CSCL 13I

The motion of the ball and sliding friction in an arched outer race ball bearing under thrust loads is determined. Fatigue life evaluations were made. The analysis is applied to a 150 millimeter bore ball bearing. The results indicated that for high speed-light load applications the arched bearing has significant improvement in fatigue life over that of a conventional bearing. An arching of 0.254 mm (0.01 in.) was found to be an optimal. For an arched bearing it was also found that a considerable amount of spinning occurs at the outer race contacts. Author

N73-32381# George Washington Univ., Washington, D.C.
PERFORMANCE EVALUATION OF FOA INTERNAL ENERGY SEPARATORS Final Report, 3 Jan. - 30 Nov. 1972
R. Whitney and S. Smith Dec. 1972 65 p refs Prepared by Columbia Res. Corp.)
(Contract N00019-72-C-0122)
(AD-764585; R-116A) Avail: NTIS CSCL 13/1

The report details the work performed by a contractor to evaluate the actual performance of model energy separators, including a variable geometry device fabricated specifically for this purpose. Tests were conducted on a single rotor energy separator with fixed geometry and a double rotor energy separator with interchangeable collectors and center sections. The latter device is referred to as the variable geometry model. Test results are presented in graphic form and evaluated to reveal preferred Foa energy separators geometry. Fabrication and test procedures are also outlined. GRA

N73-32382# Army Engineer Waterways Experiment Station, Vicksburg, Miss.
NONDESTRUCTIVE TESTING OF PAVEMENTS: FINAL TEST RESULTS AND EVALUATION PROCEDURE Technical Report, Jan. 1971 - Apr. 1972
J. W. Hall, Jr. Kirtland AFB, N. Mex. AFWL Jun. 1973 84 p refs
(Contract F29601-71-X-0004; AF Proj. 683M)
(AD-764787; AFWL-TR-72-151) Avail: NTIS CSCL 13/2

The report presents results for an investigation to develop techniques of nondestructive evaluation of the load-carrying capacity of airfield pavements. Tests were performed with vibratory equipment on pavements where conventional pavement parameters were also measured. Two evaluation approaches, deflection-extrapolation and stiffness methods, are discussed. The nondestructive stiffness method was found to relate to conventional pavement evaluation criteria. Results of the study showed the reliability of the nondestructive pavement evaluation, and a proposed nondestructive evaluation procedure was developed. The equipment used is described in detail, and recommendations are given for improvements to the equipment. Author (GRA)

N73-32383# Boeing Commercial Airplane Co., Seattle, Wash.
APPLICATION OF RELIABILITY ANALYSIS TO AIRCRAFT STRUCTURES SUBJECT TO FATIGUE CRACK GROWTH AND PERIODIC STRUCTURAL INSPECTION. Final Report, 16 Jul. 1972 - 31 Mar. 1973
I. C. Whittaker and S. C. Saunders Wright-Patterson AFB, Ohio AFML Jun. 1973 47 p refs
(Contract F33615-71-C-1134; AF Proj. 7351)
(AD-764775; AFML-TR-73-92) Avail: NTIS CSCL 01/3

A method of simulating crack growth has been investigated. The proposed model, which is based on linear elastic fracture mechanics theory, allows for the variability in crack growth behavior found in the experimental data of various materials. Given a reference stress intensity factor range and central tendency values for the crack growth rate and the exponent of the stress intensity factor excursions of a material in a specified configuration, Monte Carlo simulation is used to select various combinations of parameters. These are then used to generate fatigue cracks, on the assumption that crack growth rate is a power function of the stress intensity factor range. The residual strength of the cracked structure is considered to be a decreasing function of the induced crack length. The probability of crack detection also depends on the generated crack and is assumed to improve with increasing crack length. However, this improved detection probability is modified by the probability that the crack location is not the one being inspected. (Modified author abstract) GRA

N73-32384# Illinois Univ., Chicago. Dept. of Materials Engineering.
PRINCIPLES OF INCREMENTAL FORGING: PHASE 3 Final Report, Nov. 1971 - May 1973
T. F. Restivo, A. H. Lonn, and J. A. Schey Jul. 1973 70 p refs
(Contract N00019-72-C-0084)
(AD-764618; Rept-73-4) Avail: NTIS CSCL 13/8

The principles of deformation and of equipment design established in the first two phases formed the basis of development in this third phase of the program. A subpress was designed and built, in which wedge-actuated side rams assured complete synchronization of the vertical (indenting) and horizontal (rib-forming) anvils. Interconnection of the controls of the hydraulic press with those of an electrically actuated manipulator allowed rapid and precise sequencing of deformation increments. The practicability of the process was demonstrated by hot forging 7075 Al and commercial purity titanium into parts with H-sections of 1/4 in. thick ribs and webs, incorporating stiffening cross-ribs. Lubrication became critical in hot forging; on the basis of solid film durability tests, a commercial resin-bonded graphite film was chosen for lubricating the anvils in forging 7075 Al, and in conjunction with a glass coating applied to the workpiece, also for Ti. (Modified author abstract) GRA

N73-32390# Grumman Aerospace Corp., Bethpage, N.Y.
MECHANICAL RELIABILITY PREDICTION PILOT STUDY Final Report
L. Kutin and A. Durner Jun. 1973 157 p refs
(Contract N00600-73-C-0562)
(AD-765367; R/M-73-R-2) Avail: NTIS CSCL 14/4

Grumman Aerospace Corporation performed a pilot study for the Naval Weapons Engineering Support Activity to determine the feasibility of developing mechanical equipment reliability prediction techniques. The results of this study substantiate the feasibility of establishing a standard for mechanical equipment reliability prediction. Continued studies are recommended on additional and varied aircraft mechanical equipment, to expand the scope and data for the eventual development of a mechanical equipment reliability handbook. Author (GRA)

N73-32470# CIBA-GEIGY (UK) Ltd., Cambridge (England). Bonded Structures Div.
THE APPLICATION OF ADHESIVE BONDED STRUCTURES AND COMPOSITE MATERIALS ON ADVANCED TURBOFAN ENGINES
E. M. Pendlebury 23 Jun. 1972 33 p Presented at 1st Intern. Symp. on Air Breathing Engines, Marseille, 19-23 Jun. 1972
Avail: NTIS HC $3.75

The aero engine industry has a special interest in high temperature adhesives which will withstand environmental exposure more rigorous than most other applications. It is also essential that such systems, be they of glass, carbon, prepreg form, or standard adhesives, are capable of easy production handling and have realistic shelf life properties. There is continuing development in this area and manufacturers of structural adhesives and honeycomb collaborate to a considerable extent with aero engine manufacturers on these subjects. It should be possible in the not too distant future to replace, on a cost basis, existing brazing and welding techniques by bonding, but not until sufficient confidence is gained, which can only be achieved by extensive long term development testing and in-service experience.
Author

N73-32511 Purdue Univ., Lafayette, Ind.
INTERMITTENT POSITIVE CONTROL OF AIR TRAFFIC IN A HORIZONTAL PLANE Ph.D. Thesis
Alvin Leroy McFarland 1972 280 p
Avail: Univ. Microfilms Order No. 73-15835

The task of selecting a horizontal resolution maneuver is approached from the point of view of optimal control theory, choosing as a performance index to be minimized, the maneuver duration. One aircraft in the conflict maintains a constant velocity path. The problem reduces to that of selecting for the other aircraft the optimum flight path consisting of three circular arcs and two straight legs, which allows the two aircraft to pass with a separation no less than a specific value. The complete theoretical solution to the optimal control problem is stated. Because this exact solution is much too complex for use in practice, a suboptimal solution is proposed, and a means for evaluating the loss of optimality devised. The conflict resolution model and solution could also find application in an automated positive control environment, in a nationwide flow control system, and, with some adaptation, in terminal area metering and spacing schemes. Dissert. Abstr.

N73-32512# Mitre Corp., McLean, Va.
EVALUATION OF ATCRBS PERFORMANCE IN AN IN-

TERFERENCE ENVIRONMENT Final Report
Stanley R. Jones Washington FAA Aug. 1972 218 p refs
(Contract DOT-FA70WA-2448)
(MTR-6239; FAA-EM-73-4) Avail: NTIS HC $13.00

Uplink and downlink ATCRBS interference measurements in terminal areas were coordinated with assessments of the sources of these mutual interference conditions. The average values of these observations as well as many burst characteristics corroborated the results of an analytical model coupling the environmental features to their effects on the surveillance system. Simulation efforts based on statistical representation of the input conditions enabled an association of these interference levels with deterioration in performance of the ARTS III and TPX-42 processors. Results of these modeling efforts indicate that the performance of both processors is degraded for transponder reply probabilities below 0.85. Forecasts based on these results indicate that ARTS III performance degradation due to asynchronous interference may limit the terminal area traffic count to about 600 aircraft when approximately 40 interrogators are within view. Author

N73-32513# Collins Radio Co., Cedar Rapids, Iowa.
EVALUATION OF EXISTING VOR, LOCALIZER AND GLIDESLOPE RECEIVING EQUIPMENT, VOLUME 2, BOOK 2 Final Report
W. O. Ashby Feb. 1973 300 p refs
(Contract DOT-FA72WA-2772)
(FAA-RD-73-1-Vol-2-Bk-2;
Rept-523-0764695-00111M-V2-Bk2) Avail: NTIS HC $17.00

Tests of VHF Omnirange navigation system, localizer, and glideslope receiving equipment were conducted to determine performance under various conditions of radio frequency interference. The basic test results for each of the sixty one receivers tested are presented. The purpose of the test was to provide data on which to base geographic facility separations to avoid mutual electromagnetic interference. Author

N73-32515*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FLIGHT RESULTS FROM A STUDY OF AIDED INERTIAL NAVIGATION APPLIED TO LANDING OPERATIONS
Leonard A. McGee, Gerald L. Smith, Daniel M. Hegarty, Thomas M. Carson, Robert B. Merrick, S. F. Schmidt (Anal. Mech. Assoc., Inc., Mt. View, Calif.), and B. Conrad (Anal. Mech. Assoc., Inc., Mt. View, Calif.) Washington Oct. 1973 42 p refs
(NASA-TN-D-7302; A-4584) Avail: NTIS HC $3.00 CSCL 17G

An evaluation is presented of the approach and landing performance of a Kalman filter aided inertial navigation system using flight data obtained from a series of approaches and landings of the CV-340 aircraft at an instrumented test area. A description of the flight test is given, in which data recorded included: (1) accelerometer signals from the platform of an INS; (2) three ranges from the Ames-Cubic Precision Ranging System; and (3) radar and barometric altimeter signals. The method of system evaluation employed was postflight processing of the recorded data using a Kalman filter which was designed for use on the XDS920 computer onboard the CV-340 aircraft. Results shown include comparisons between the trajectories as estimated by the Kalman fiter aided system and as determined from cinetheodolite data. Data start initialization of the Kalman filter, operation at a practical data rate, postflight modeling of sensor errors and operation under the adverse condition of bad data are illustrated. Author

N73-32516# National Aviation Facilities Experimental Center, Atlantic City, N.J.
FIELD EVALUATION OF ARTS 2 B (TRACAB) Interim Report, Feb. - Apr. 1973
Robert A. Clark and James F. Zakers Oct. 1972 46 p
(FAA-NA-73-54; FAA-RD-73-119) Avail: NTIS HC $4.50

A programmable ARTS II B, non-tracking, beacon alphanumeric system was installed in a TRACAB configuration in a live air traffic control tower environment. Operational suitability and techniques to be used in the automation program for low-density terminal/towers were evaluated. The system was evaluated over a six-week period through collection of subjective data obtained from controller questionnaries. It was concluded that while suitable for application in a TRACAB environment and compatible with the controller, extensive modification to both display subsystem and software were required to improve its usefulness. Author

N73-32517# Flight Inspection National Field Office, Oklahoma City, Okla.
EVALUATION OF CLOSE-IN/SHORT TURN ON PATTERNS (ILS) Final Report
Harold R. Richards, Jr. and Frank Parr Washington Aug. 1973 41 p
(AFS Proj. 600-72-3)
(FAA-AFS-500-1) Avail: NTIS HC $4.25

It was suggested that increased IFR traffic could be accepted at an airport if it were possible for traffic controllers to feed some of the smaller aircraft into gaps in the flow of normal traffic. Flight tests were flown in a Cessna 310 to intercept an ILS localizer at distances of 1.0, 1.5, 2.0, 2.5 and 3.0 NM from the runway threshold to evaluate flyability factors. Nominal airspeed used in maneuvering and on the approach was 110 MPH (100 knots), giving a margin of 9 knots for turbulence over the maximum Category A airspeed of 91 knots. Intercept angles were 45 and 90 degrees to the localizer centerline. Glide slope interception altitude was 500 feet above ground level. All flight tracks were recorded by an APTAR radar system. It was found that ILS intercepts inside the outer marker caused full scale localizer needle deflection during the intercept maneuver, and that pilot opinion did not support implementation of the procedure as a standard operation. Author

N73-32518# National Aviation Facilities Experimental Center, Atlantic City, N.J.
SYSTEM INTEGRATION AND SYSTEM SHAKEDOWN TESTS, NAS ENROUTE STAGE A MODEL A3d1 Final Report, Sep. 1972 - Apr. 1973
Joseph Levy and Victor Crawford Oct. 1973 77 p
(FAA-NA-73-55; FAA-RD-73-135) Avail: NTIS HC $5.75

A series of tests of the national Air Space (NAS) Enroute Stage A Model A3dl System were conducted in a total system environment. Simulated and live radar inputs to evaluate the total system capability to accomplish the air traffic control task and to provide guidance for conduct of System Integration and System Shakedown tests at field facilities were conducted. The tests and the results obtained are described. Author

N73-32519# Technische Universitaet, Brunswick (West Germany). Inst. fuer Verkehr, Eisenbahnwesen und Verkehrssicherung-Sonderforschungsbereich Flugfuehrung.
DIGITAL SYNCHRONIZATION FOR TIME SYNCHRONOUS COLLISION AVOIDANCE SYSTEMS IN AVIATION [DIGITALE SYNCHRONISATION FUER ZEITSYNCHRONE KOLLISIONSSCHUTZSYSTEME DER LUFTFAHRT]
Peter Form 1973 18 p refs In GERMAN Presented at the DGLR-DGON Symp. on Neue Anflug- und Landeverfahren, Duesseldorf, 2-4 May 1973
(DGLR-Paper-73-012) Avail: NTIS HC $3.00

Some problems in the digital synchronization of airborne collision avoidance systems are discussed. The economies of such existing time synchronous systems were investigated, and replacement of the relatively expensive onboard precision reference

source by a synchronization of corresponding accuracy is proposed. This completion of time-synchronous systems is explained by describing the present state of the art. ESRO

N73-32520# Technische Universitaet, Brunswick (West Germany). Inst. fuer Verkehr, Eisenbahnwesen und Verkehrssicherung-Sonderforschungsbereich Flugfuehrung.

PRESENT STATUS OF ALL-WEATHER LANDING: PROBLEMS AND LIMITS [SCHLECHTWETTERLANDUNG HEUTE-IHRE PROBLEME UND GRENZEN]

Dirk Brunner 1973 13 p In GERMAN Presented at the DGLR-DGON Symp. on Neue Anflug- und Landeverfahren, Duesseldorf, 2-4 May 1973

(DGLR-Paper-73-015) Avail: NTIS HC $3.00

The problems in aircraft landing under low visibility weather conditions are discussed. Most of these problems are based on the fact that ILS is not a landing system, but an approach aid. Its incompleteness has to be compensated with auxiliary equipment, such as radio altitude measurement, optical landing aids, ect. The decision of the pilot of land or not to land under certain weather conditions should be supported more than by present displayed information. The aritificial improvement of optical visibility is an interesting consequence. ESRO

N73-32521# Technische Universitaet, Brunswick (West Germany). Abteilung fuer Fernmelde- und Hochfrequenztechnik in der Verkehrssicherung.

POSSIBILITIES FOR IMPROVING THE CONVENTIONAL INSTRUMENT LANDING SYSTEM (ILS) [VERBESSERUNGSMOEGLICHKEITEN DES KONVENTIONELLEN INSTRUMENTENLANDESYSTEMS (ILS)]

H. Frilke 1973 18 p In GERMAN Presented at the DGLR-DGON Symp. on Neue Anflug- und Landeverfahren, Duesseldorf, 2-4 May 1973

(DGLR-Paper-73-017) Avail: NTIS HC $3.00

Two possibilities for improving instrument landing systems were investigated. These deal with interferences during aircraft landing and gliding as a result of multipath propagation and variations of earth surface signal reflectivity. To minimize multipath propagation effects, which can be felt 12 km before touching ground, interference should be detected, and consequently suppressed. Methods to realize these steps are briefly described. Two methods to suppress the variable surface reflection, especially on the glide path are discussed; the formation of quotients in antenna reception signals, and the use of circular polarization. ESRO

N73-32522# Bundesanstalt fuer Flugsicherung, Frankfurt am Main (West Germany).

FLIGHT OPERATIONS AND GUIDE BEAM SYSTEMS [FLUGBETRIEB UND LEITSTRAHLSYSTEM]

T. Bohr 1973 13 p In GERMAN Presented at the DGLR-DGON Symp. on Neue Anflug- und Landeverfahren, Duesseldorf, 2-4 May 1973

(DGLR-Paper-73-011) Avail: NTIS HC $3.00

The history and perspectives of the instrument landing system are presented. The present operational requirements for these systems, as endorsed by the ICAO, are formulated and discussed. ESRO

N73-32523# Standard Electrik Lorenz A.G., Stuttgart (West Germany).

DETAILS OF DLS AND SETAC LANDING AIDS [EINIGE BESONDERHEITEN DER LANDENHILFEN DLS UND SETAC]

K. D. Eckert and G. Peuker Apr. 1973 34 p In GERMAN Presented at the DGLR-DGON Symp. on Neue Anflug- und Landeverfahren, Duesseldorf, 2-4 May 1973

(DGLR-73-019) Avail: NTIS HC $3.75

Two new instrument landing systems are described. These systems replace ILS, in view of its inherent problems, such as multipath propagation, increasing traffic, equipment volume, and application both in military and civil aviation. The SETAC system, short for sector-Tacan, is based on the military medium range navigation system Tacan and consists of two ground stations and a onboard ancillary device of Tacan equipment. The DLS system is based on DME in the L-band, from which the DME-supported landing system originated. The system allows distance measurements as follows: onboard request, ground transponder, and reply after exactly 50 microsec. The requests are received with special antenna arrays, allowing determination of azimuthal incidence angle, and elevation incidence angle. ESRO

N73-32524# Standard Electrik Lorenz A.G., Stuttgart (West Germany). Erzeugnisgebiet Navigation.

IMPROVEMENT OF STANDARD ILS WHILE RETAINING COMPATIBILITY [VERBESSERUNG DES STANDARD-ILS UNTER BEIBEHALTUNG DER KOMPATIBILITAET]

G. Hoefgen 1973 7 p In GERMAN Presented at the DGLR-DGON Symp. on Neue Anflug- und Landeverfahren, Duesseldorf, 2-4 May 1973

(DGLR-Paper-73-018) Avail: NTIS HC $3.00

Two methods of improving the standard instrument landing system, while retaining compatibility, are presented. The compatible instrument landing system (CILS) consists of the following components: (1) standard ILS for clearance, and (2) microwave ILS 5 GHz, based on conventional priciple (90/150 Hz) only for approach sector. To be compatible with the existing two carrier systems with 9 kHz difference carrier frequency, the microwave oscillator frequency is also radiated. The precision instrument landing system (PILS), necessitates more onboard equipment and includes linear antenna arrays, consisting of elements sequentially radiating signals. An advantage over standard ILS is that the glide angle can be selected at random onboard. ESRO

N73-32525# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).

MIXED CTOL/QTOL TRAFFIC [GEMISCHTER CTOL/QTOL-VERKEHR]

F. Schoenberger 15 Apr. 1973 30 p In GERMAN Presented at the DGLR-DGON Symp. on Neue Anflug- und Landeverfahren, Duesseldorf, 2-4 May 1973

(MBB-UH-05-73-O; DGLR-Paper-73-014) Avail: NTIS HC $3.50

The results of the transition period when conventional air traffic (CTOL) will be replaced by quiet takeoff and landing (QTOL) traffic, are reviewed. The introduction of QTOL aircraft from about the year 1978 will entail the simultaneous operation of present CTOL and QTOL aircraft types. The effects of this transition period, to be felt by introduction of microwave instrument landing systems and area navigation, are surveyed. ESRO

N73-32526# Bodenseewerk Geraetetechnik G.m.b.H., Ueberlingen (West Germany).

FLIGHT PATH CONTROL EQUIPMENT FOR PRODUCING CURVED FLIGHT PATH PROFILES IN MICROWAVE LANDING SYSTEMS [FLUGBAHNFUEHRUNGSGERAET ZUM ERZEUGEN GEKRUEMMTER FLUGBAHNPROFILE AN MIKROWELLEN-LANDESYSTEMEN]

G. Schaenzer 1973 36 p refs In GERMAN Presented at the DGLR-DGON Symp. on Neue Anflug- und Landeverfahren, Duesseldorf, 2-4 May 1973

(DGLR-Paper-73-016) Avail: NTIS HC $4.00

The properties of a flight control display device for producing curved approach profiles, and the flight control along these profiles, are discussed in the case of a microwave instrument landing system. The prolems of maneuverability, accuracy, and the stability of aircraft motions are treated, and the requirements of the guide beam system and flight control system are formulated. Flight tests have shown that the methods discussed contribute to reduction of pilot workload. ESRO

N73-32540*# Pennsylvania State Univ., University Park.

THE DESIGN AND DEVELOPMENT OF AN AUTOMATIC CONTROL SYSTEM FOR THE IN-DUCT CANCELLATION OF SPINNING MODES OF SOUND M.S. Thesis

Walter W. Harrington Jun. 1973 249 p refs

(Grant NGL-39-009-121)

(NASA-CR-132317) Avail: NTIS HC $14.50 CSCL 20A

The reduction is discussed of the discrete tones generated by jet engines which is essential for jet aircraft to meet present and proposed noise standards. The discrete tones generated by the blades and vanes propagate in the inlet and exhaust duct in the form of spiraling acoustic waves, or spinning modes. The reduction of these spinning modes by the cancellation effect of the combination of two acoustic fields was investigated. The spinning mode synthesizer provided the means for effective study of this noise reduction scheme. Two sets of electrical-acoustical transducers located in an equally-spaced circular array simultaneously generate a specified spinning mode and the cancelling mode. Analysis of the wave equation for the synthesizer established the optimum cancelling array acoustic parameters for maximum sound pressure level reduction. The parameter dependence of the frequency ranges of propagation of single, specified circumferential modes generated by a single array, and of effective cancellation of the modes generated by two arrays, was determined. Substantial sound pressure level reduction was obtained for modes within these limits. Author

N73-32543# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Luftsaugende Antriebe.

SOME EXPERIMENTS ON THE NOISE EMISSION OF COAXIAL JETS

Helmut W. Dahlen 23 Jun. 1972 18 p refs Presented at 1st Intern. Symp. on Air Breathing Engines, Marseille, 19-23 Jun. 1972

Avail: NTIS HC $3.00

The noise emission of coaxial jets or the reduction of jet noise by surrounding a circular primary jet with an annular flow is discussed. Acoustic experiments have been performed with a model hot primary jet which had a Mach number very close to one surrounded by a secondary cold annular flow of variable velocity and area ratios of the coplanar convergent nozzles. The experiments show that the reduction of high frequency noise emission depends on secondary flow velocity. In most cases this reduction seems to be not compensated by an increase in low frequency noise power. The small reduction in the total emitted noise power is uprated by weighting for perceived noise, so that the effects are not more negligible in view of the noise control of jet engines with fair by-pass ratios for SST and military aircraft. Author

N73-32605# Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.

PHYSICAL AND CHEMICAL PROPERTIES OF JP-4 JET FUEL FOR 1972

James R. McCoy Jun. 1973 119 p

(AF Proj. 3048)

(AD-764690; AFAPL-TR-73-15) Avail: NTIS CSCL 21/4

Test reports on 3610 samples of JP-4 fuel purchased in 1972 were analyzed to determine the average properties and distribution of values for eight geographical districts. As required by the JP-4 specification, MIL-T-5624H, 21 of the inspection tests were selected for analysis. Although since 1964, the API Gravity has gradually increased, no other significant trends were noted. Author (GRA)

N73-32608*# General Electric Co., Evendale, Ohio.

ACOUSTIC TESTING OF A SUPERSONIC TIP SPEED FAN WITH ACOUSTIC TREATMENT AND ROTOR CASTING SLOTS. QUIET ENGINE PROGRAM SCALE MODEL FAN C

S. B. Kazin Oct. 1973 98 p refs

(Contract NAS3-12430)

(NASA-CR-134501; R73AEG148) Avail: NTIS HC $7.00 CSCL 21E

Acoustic tests were conducted on a high tip speed (1550 ft/sec, 472.44 m/sec) single stage fan with varying amounts of wall acoustic treatment and with circumferential slots over the rotor blade tips. The slots were also tested with acoustic treatment placed behind the slots. The wall treatment results show that the inlet treatment is more effective at high fan speeds and aft duct treatment is more effective at low fan speeds. Maximum PNL's on a 200-foot (60.96 m) sideline show the untreated slots to have increased the rear radiated noise at approach. However, when the treatment was added to the slots inlet radiated noise was decreased, resulting in little change relative to the solid casing on an EPNL basis. Author

N73-32609*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

NOISE COMPARISON OF TWO 1.2-PRESSURE-RATIO FANS WITH 15 AND 42 ROTOR BLADES

Richard P. Woodward, Frederick W. Glaser, and Joseph A. Wazyniak Washington Oct. 1973 76 p refs

(NASA-TM-X-2891; E-7477) Avail: NTIS HC $3.75 CSCL 21E

Two 1.829-m-(6-ft-) diameter fans suitable for a quiet engine for future short-takeoff-and-landing (STOL) aircraft were compared. Both fans were designed for a 1.2 pressure ratio with similar weight flows, thrusts, and tip speeds. The first fan, designated QF-9, had 15 rotor blades and 11 stator blades. The rotor was highly loaded and the tip solidity was less than 1. The QF-9 rotor blades had an adjustable pitch feature which can be used for thrust reversal. The second fan, designated QF-6, operated at a moderate loading with a rotor tip solidity greater than 1. Fan QF-6 had 42 rotor blades and 50 stator blades. The low number of rotor blades for QF-9 reduced the frequency of the blade-passage tone below the range of maximum annoyance. In addition to this difference, the QF-9 fan had a somewhat smaller rotor-stator separation than the QF-6 fan. In terms of sound pressure level and sound power level, QF-9 was the noisier fan, with the power level results for QF-9 being about 1 db above those for QF-6 at equivalent operating points as determined by similar stage pressure ratios. At the same equivalent operating points, the maximum perceived noise along a 152.5-m (500-ft) sideline for QF-9 was about 2.5 PNdb below that for QF-6, which indicated that QF-9 was less objectionable to human hearing. Author

N73-32610*# AiResearch Mfg. Co., Phoenix, Ariz.

ADVANCED TWO-STAGE COMPRESSOR PROGRAM DESIGN OF INLET STAGE

C. A. Bryce, C. J. Paine, A. R. S. McCutcheon, R. K. Tu, and G. L. Perrone Aug. 1973 301 p refs

(Contract NAS3-15324)

(NASA-CR-120943; AT-6133-R) Avail: NTIS HC $17.25 CSCL 21E

The aerodynamic design of an inlet stage for a two-stage, 10/1 pressure ratio, 2 lb/sec flow rate compressor is discussed. Initially a performance comparison was conducted for an axial, mixed flow and centrifugal second stage. A modified mixed flow configuration with tandem rotors and tandem stators was selected for the inlet stage. The term conical flow compressor was coined to describe a particular type of mixed flow compressor configuration which utilizes axial flow type blading and an increase in radius to increase the work input potential. Design details of the conical flow compressor are described. Author

N73-32613*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

ODOR INTENSITY AND CHARACTERIZATION STUDIES OF EXHAUST FROM A TURBOJET ENGINE COMBUSTOR

Helmut F. Butze and David A. Kendall 1973 12 p refs Presented at 9th Propulsion Conf., Las Vegas, Nev., 5-7 Nov. 1973; sponsored by AIAA and Soc. of Automotive Engr.

(NASA-TM-X-71429; E-7680) Avail: NTIS HC $3.00 CSCL 21E

Sensory odor tests of the exhaust from a turbojet combustor operating at simulated idle conditions were made by a human panel sniffing diluted exhaust gas. Simultaneously, samples of undiluted exhaust gas were collected on adsorbent substrates, subsequently removed by solvent flushing, and analyzed chemically by liquid chromatographic methods. The concentrations of the principal malodorous species, the aromatic (unburned fuel-related) and the oxygenated (partially burned fuel) fractions, as determined chromatographically, correlated well with the intensity of the odor as determined by sniffing. Odor intensity increased as combustion efficiency decreased. Combustor modifications which increased combustion efficiency decreased odor intensity.

Author

N73-32614*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

THE EFFECTS OF INLET TEMPERATURE AND PRESSURE DISTORTION ON TURBOJET PERFORMANCE

Willis M. Braithwaite, Edwin J. Graber, Jr., and Charles M. Mehalic 1973 16 p refs Presented at 9th Propulsion Joint Specialists Conf., Las Vegas, Nev., 5-7 Nov. 1973; sponsored by AIAA and Soc. of Automotive Engr.

(NASA-TM-X-71431; E-7302) Avail: NTIS HC $3.00 CSCL 21E

The effects on stability of steady-state, 180 degree extent circumferential distortions of inlet total temperature and pressure were experimentally determined for a turbojet engine. Results for both individual and combined temperature and pressure distortions are presented showing the losses incurred in stall pressure ratio and are compared with results predicted using a simplified parallel compressor model. The loss due to combined distortions was dependent upon the relative orientation between the low pressure and high temperature regions. Reasonable agreement was achieved between the predicted and observed loss in stall pressure ratio when based on a constant corrected speed relationship. Author

N73-32620*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

THE EFFECT OF NOISE CONSTRAINTS ON ENGINE CYCLE OPTIMIZATION FOR LONG-HAUL TRANSPORTS

Robert J. Antl 1973 11 p refs Presented at the 9th Propulsion Joint Specialist Conf., Las Vegas, Nev., 5-7 Nov. 1973; sponsored by AIAA and SAE

(NASA-TM-X-71447; E-7712) Avail: NTIS HC $3.00 CSCL 21A

Results are presented of NASA studies to determine optimum engine cycles for noise levels of 10, 15, and 20 EPNdb below current FAA regulations. The study aircraft were 200-passenger trijets flying over ranges of 5,556 and 10,200 km at cruise speeds of Mach 0.90 to 0.98. The economic impact of reducing noise, the identification of needed advanced technology and the effect of these advances are presented. The studies showed that the noise constraints imposed compromises on the optimum cycle with resulting economic penalties. The application of advanced engine technologies, however, could effectively offset these economic penalties. Author

N73-32622*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

THRUST AND PUMPING CHARACTERISTICS OF CYLINDRICAL EJECTORS USING AFTERBURNING TURBOJET GAS GENERATOR

Nick E. Samanich and Sidney C. Huntley 1969 44 p refs (NASA-TM-X-52565) Avail: NTIS HC $4.25 CSCL 21E

Static tests of cylindrical ejectors having ejector to primary diameter ratios from 1.1 to 1.6 and ejector length to primary nozzle diameter ratios from 0.9 to 2.1 are reported. Power setting of the J85-13 turbojet engine was varied from part power to maximum afterburning. Corrected secondary weight flow ratio was varied from 0.02 to 0.08 over a range of exhaust nozzle pressure ratios from 2.0 to 9.0. Secondary flow temperature rise and pressure drop characteristics through the nacelle secondary flow passage were also obtained. Author

N73-32624*# Santa Clara Univ., Calif.

REVERSED COWL FLAP INLET THRUST AUGMENTOR Patent Application

Dah Yu Cheng, inventor (to NASA) Filed 17 Sep. 1973 18 p (Grant NGR-05-017-033)

(NASA-Case-ARC-10754-1; US-Patent-Appl-SN-398886) Avail: NTIS HC $3.00 CSCL 21E

An adjustable airfoil is described for varying the geometry of a jet inlet and an ejector inlet in a jet engine for providing thrust augmentation and noise reduction. The airfoil comprises essentially a plurality of segments which are extended radially outwardly and retracted relative to the longitudinal axis of the engine as a function of a change in the pressure differential between the upstream and downstream surfaces of the airfoil. A servo mechanism responsive to the change in the pressure differential is coupled to the airfoil to extend and retract the airfoil segments to maintain the pressure at a maximum on the downstream side of the airfoil relative to the pressure on the upstream side of the airfoil. At low speeds, such as at take-offs and landings, the airfoil is fully extended while at high speeds it is fully retracted. NASA

N73-32626# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

PERFORMANCE OPTIMIZATION FOR SUPERSONIC RAMJET THEORETICAL AND EXPERIMENTAL STUDIES

Francis Hirsinger 1972 12 p refs In FRENCH; ENGLISH summary Presented at 1st Intern. Symp. on Air Breathing Engines, Marseille, 19-23 Jun. 1972

Avail: NTIS HC $3.00

Simple theoretical studies show off a combustion process called transition combustion, which is of interest for airbreathing propulsion by means of fixed geometry ramjets, and permits emphasis on some principles for the performance, optimization. During this combustion, which is initiated at subsonic speed, the stream is accelerated, through a thermal throat, up to a supersonic speed. Experimental tests were run which confirm the existence of this phenomenon and have helped to elaborate a mathematical pattern fitted to a proper description of the flow.

This pattern may be used successfully for the prediction of the optimal performances. Computed results show that the so defined configuration leads to competitive performances in a wide domain of flight velocity. Author

N73-32628# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany). Inst. fuer Luftstrahlantriebe.

A NON-CONTACT METHOD FOR SUPERVISION AND MEASUREMENT OF THE EFFECTIVE GAP BETWEEN ROTOR BLADES AND CASING OF TURBOMACHINE DURING OPERATION [UEBER EIN BERUEHRUNGSLOSES VERFAHREN ZUR UEBERWACHUNG UND MESSUNG DER EFFEKTIVEN SPALTE ZWISCHEN DEN LAUFRADSCHAUFELN UND DEM GEHAEUSE VON TURBOMASCHINEN WAEHREND DES BETRIEBS]

Hans Hungenberg and Heinrich Weyer 27 Jun. 1972 33 p refs In GERMAN; ENGLISH summary

(DLR-FB-72-40) Avail: NTIS HC $3.75; DFVLR, Porz, West Ger. 11,30 DM

A contactless, capacitive method for measuring the gaps between the rotor blades and the casing of a running turbomachine is discribed. The main parameters affecting this method are explained. From this, the most practical calibration of the probe was derived and the limits of the measuring accuracy are shown. Directions for the construction of the probe are given, and some results from measurements of the tip clearance in an axial flow compressor are presented. Author (ESRO)

N73-32631# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

APPLICATION OF THE THEORY OF SIMILITUDE TO THE DESIGN OF CONTROL SYSTEMS FOR GAS TURBINE ENGINES

Yu. V. Lyubomudrov 25 May 1973 267 p refs Transl. into ENGLISH from Mono. "Primenenie Teorii Podobiya pri Gazoturbinnykh Dvigatelei" Moscow, 1971 p 1-20

(AD-764683; FTD-HC-23-1340-72) Avail: NTIS CSCL 21/5

The report discusses the questions related to optimum design using the theory of similitude of automatic control systems for aircraft gas turbine engines (GTE) considered as objects with characteristics varying during flight. The equation of motion of the controlled object, expressed in terms of reduced variables, is unique for all conditions of its operation and may be represented as a graph of the dynamic characteristic of a GTE that can be used as a basis to determine the required control laws. The selection of the optimal formula for the control system is done by using power complexes of GTE parameters. A foundation is provided for the principles of designing a single control system that combines higher reliability of control in the entire range of flight conditions with reliability of control. GRA

N73-32632# ARO, Inc., Arnold Air Force Station, Tenn.

MEASUREMENT OF EXHAUST EMISSIONS FROM A 185-GE-5B ENGINE AT SIMULATED HIGH-ALTITUDE SUPERSONIC FREE-STREAM FLIGHT CONDITIONS Technical Report, 15 Dec. 1972 - 10 Jan. 1973

R. C. German, M. D. High, and C. E. Robinson AEDC Jul. 1973 140 p refs

(Contract DOT-AS-20024; ARO Proj. PA038; ARO Proj. PB038)

(AD-764717; ARO-PWT-TR-73-49; AEDC-TR-73-103; FAA-RD-73-92) Avail: NTIS CSCL 21/5

Exhaust emissions were measured in the plume of a J85-GE-5 turbojet engine as part of an investigation to determine the impact on the climate of a fleet of supersonic aircraft flying in the stratosphere. Measurements were made for both military and partial afterburning power at Mach numbers and simulated altitudes of Mach 1.6/55,000 ft and Mach 2.0/65,000 ft. A continuous sampling technique was used to measure carbon dioxide, carbon monoxide, total unburned hydrocarbons, oxides of nitrogen, and particulates. The experimental results were compared with the calculated emission profiles and were in good agreement. The results represent the only available full-scale turbojet engine emission data to date which have been obtained at simulated high altitude with a supersonic external stream. (Modified author abstract) GRA

N73-32633# Dayton Univ. Research Inst., Ohio.

A COMPUTER PROGRAM FOR AXIAL COMPRESSOR DESIGN. VOLUME 1: THEORY DESCRIPTIONS, AND USERS INSTRUCTIONS Final Technical Report, 16 Jun. 1972 - 15 Jun. 1973

Richard M. Hearsey Jul. 1973 96 p refs 2 Vol.

(Contract F33615-72-C-2026; AF Proj. 3066; AF Proj. 7065) (AD-764733; AFAPL-TR-73-66-Vol-1) CSCL 21/5

A computer program for the design of axial compressors is presented. It comprises of three principal sections, two alternative means of determining blade geometry, and an aerodynamic computation for the flow through the compressor. One method of determining blade geometry revolves around the use of various analytic meanlines for the blade sections, and leads to the aerodynamic analysis of the flow through specified blading. The other method consists of creating arbitrary blade sections to follow the flow directions previously determined in an aerodynamic design calculation. The aerodynamic design section incorporates a loss calculation routine that may be used to estimate the design point performance of the compressor. The report describes the computer program, and gives all information necessary to use it. (Modified author abstract) GRA

N73-32634# Dayton Univ. Research Inst., Ohio.

A COMPUTER PROGRAM FOR AXIAL COMPRESSOR DESIGN. VOLUME 2: PROGRAM LISTING AND PROGRAM USE EXAMPLE Final Technical Report, 16 Jun. 1972 - 15 Jun. 1973

Richard M. Hearsey Aug. 1973 160 p 2 Vol.

(Contract F33615-72-C-2026; AF Proj. 3066; AF Proj. 7065) (AD-764734; AFAPL-TR-73-66-Vol-2) Avail: NTIS CSCL 21/5

A computer program for the design of axial compressors is presented. It comprises of three principal sections; two alternative means of determining blade geometry, and an aerodynamic computation for the flow through the compressor. The report shows the FORTRAN program listing and an example of the use of the program. (Modified author abstract) GRA

N73-32636# Aerospace Research Labs., Wright-Patterson AFB, Ohio.

THE DESIGN OF AXIAL COMPRESSOR AIRFOILS USING ARBITRARY CAMBER LINES Final Report

George R. Frost and Arthur J. Wennerstrom Jul. 1973 106 p refs

(AF Proj. 7065)

(AD-765165; ARL-73-0107) Avail: NTIS CSCL 21/5

The report describes a technique which has been developed for use in the design of axial compressor airfoils with camber lines of arbitrary shape. The slope of the camber line at several points on a streamsurface is determined from the air angles at these points as well as the incidence and deviation angle distributions for the blade. A camber line is produced by fitting a smooth curve segment through each pair of points from the leading to the trailing edge. A thickness distribution is applied to this camber line to produce the blade element. A computer program, which uses this technique to produce blade elements, stacks them, and then determines coordinates for plane surfaces through the resultant blade is also described.

Author (GRA)

N73-32638# General Motors Corp., Indianapolis, Ind. Diesel Allison Div.
INVESTIGATION OF AIRCRAFT GAS TURBINE COMBUSTOR HAVING LOW MASS EMISSIONS Final Report
D. L. Troth, A. J. Verdouw, and F. J. Verkamp Fort Eustis, Va. Army Air Mobility Res. and Develop. Lab. Apr. 1973 730 p refs
(Contract DAAJ02-72-C-0005; DA Proj. 1G1-62207-AA-71) (AD-764987; ERD-7725; USAAMRDL-TR-73-6) Avail: NTIS CSCL 13/2

The objective of this one-year program was to develop and demonstrate emission abatement technology sufficient to obtain a 50% overall reduction in gas turbine engine mass emissions (CO, CxHy, NOx and smoke) with no increase in any individual pollutant when tested over a typical Army light observation helicopter (LOH) duty cycle. The selected baseline was the Army T63-A-5A gas turbine engine combustor. Seventeen potential low-emission combustors, each incorporating one or more of the selected concepts, were tested to determine their emission performance. Experimental results indicated that several designs had the potential for meeting the program objectives. Two combustors selected for final experimental evaluation were the Prechamber and Modified Conventional. The low-emission feature in the Prechamber combustor was premix/prevaporization. The Modified Conventional combustor incorporated four low-emission features: airblast fuel atomization, delayed dilution, convection cooling, and variable geometry. Both of these combustors met the emission reduction objectives. Experimental results indicated that both of these liners can be developed to meet all other conventional T63 combustor requirements, i.e., light-off, temperature profile, durability, etc. The estimated development time for the Prechamber is longer than for the Modified Conventional. However, the Prechamber combustor has better emission reduction potential when both combustors are designed as either fixed or variable geometry combustors. (Modified author abstract) GRA

N73-32735*# Dudley Observatory, Albany, N.Y.
FEASIBILITY STUDY FOR THE USE OF A YF-12 AIRCRAFT AS A SCIENTIFIC INSTRUMENT PLATFORM FOR OBSERVING THE 1970 SOLAR ECLIPSE Final Technical Report
Robert D. Mercer 18 Sep. 1973 284 p refs
(Grant NGR-33-011-009)
(NASA-CR-135482) Avail: NTIS HC $16.25 CSCL 03A

The scientific and engineering findings are presented of the feasibility study for the use of a YF-12 aircraft as a scientific instrument platform for observing the 1970 solar eclipse. Included in the report is the computer program documentation of the solar eclipse determination; summary data on SR-71A type aircraft capabilities and limitations as an observing platform for solar eclipses; and the recordings of an informal conference on observations of solar eclipses using SR-71A type aircraft. K.M.M.

N73-32822*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF INLET-AIR HUMIDITY, TEMPERATURE, PRESSURE, AND REFERENCE MACH NUMBER ON THE FORMATION OF OXIDES OF NITROGEN IN A GAS TURBINE COMBUSTOR
Nicholas R. Marchionna, Larry A. Diehl, and Arthur M. Trout Washington Oct. 1973 34 p refs
(NASA-TN-D-7396; E-7465) Avail: NTIS HC $3.00 CSCL 21B

Tests were conducted to determine the effect of inlet air humidity on the formation of oxides of nitrogen (NOx) from a gas turbine combustor. Combustor inlet air temperature ranged from 506 K (450 F) to 838 K (1050 F). The tests were primarily run at a constant pressure of 6 atmospheres and reference Mach number of 0.065. The NOx emission index was found to decrease with increasing inlet air humidity at a constant exponential rate: NOx = NOx0e-19H (where H is the humidity and the subscript 0 denotes the value at zero humidity). the emission index increased exponentially with increasing normalized inlet air temperature to the 1.14 power. Additional tests made to determine the effect of pressure and reference Mach number on NOx showed that the NOx emission index varies directly with pressure to the 0.5 power and inversely with reference Mach number. Author

N73-32842*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
STUDIES IN SHORT HAUL AIR TRANSPORTATION IN THE CALIFORNIA CORRIDOR: EFFECTS OF DESIGN RUNWAY LENGTH; COMMUNITY ACCEPTANCE; IMPACT OF RETURN ON INVESTMENT AND FUEL COST INCREASES, VOLUME 1
Richard S. Shevell and David W. Jones, Jr. Jul. 1973 207 p refs 2 Vol.
(Contract NAS2-7199)
(NASA-CR-114634; SUDAAR-460-Vol-1) Avail: NTIS HC $12.50 CSCL 01E

The impact of design runway length on the economics and traffic demand of a 1985 short haul air transportation system in the California Corridor was investigated. The community acceptance of new commercial airports for short haul service was studied. The following subjects were analyzed: (1) travel demand, (2) vehicle technology, (3) infrastructure, (4) systems analysis, and (5) effects on the community. The operation of the short haul system is compared with conventional airline operations. Author

N73-32843*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
STUDIES IN SHORT HAUL AIR TRANSPORTATION IN THE CALIFORNIA CORRIDOR: EFFECTS OF DESIGN RUNWAY LENGTH; COMMUNITY ACCEPTANCE; IMPACT OF RETURN ON INVESTMENT AND FUEL COST INCREASES. VOLUME 2: APPENDICES
Richard S. Shevell and David W. Jones, Jr. Jul. 1973 194 p refs 2 Vol.
(Contract NAS2-7199)
(NASA-CR-114634(1); SUDAAR-460-Vol-2-App) Avail: NTIS HC $11.75 CSCL 01E

The development of a forecast model for short haul air transportation systems in the California Corridor is discussed. The factors which determine the level of air traffic demand are identified. A forecast equation for use in airport utilization analysis is developed. A mathematical model is submitted to show the relationship between population, employment, and income for indicating future air transportation utilization. Diagrams and tables of data are included to support the conclusions reached regarding air transportation economic factors. Author

N73-32848*# Massachusetts Inst. of Tech., Cambridge. Flight Transportation Lab.
PROCEEDINGS OF THE NASA/MIT WORKSHOP ON AIRLINE SYSTEMS ANALYSIS, VOLUME 1
Joseph F. Vittek, ed. Jul. 1972 744 p refs Workshop held at Waterville Valley, New Hampshire, 10-21 Jul. 1972 2 Vol.
(Contract NASw-2412)
(NASA-CR-135634; FTL-R72-7-Vol-1) Avail: NTIS HC $39.25 CSCL 05C

Economic principles, financial aspects, forecast and demand, and marketing in the development of an air transport industry are considered.

N73-32849* Massachusetts Inst. of Tech., Cambridge.
DEVELOPMENT OF THE AIR TRANSPORT INDUSTRY
Nawal Taneja *In its* Proc. of the NASA/MIT Workshop on

Airline Systems Analysis, Vol. 1 Jul. 1972 p 1-44 refs

CSCL 05C

The major developments are outlined in the U.S. scheduled air transport industry both domestic and international, together with a brief history of the European air transport system. The role and formulation of the U.S. Civil Aeronautics Board, International Civil Aviation Organization, and International Air Transport Association are also covered. Author

N73-32850* Massachusetts Inst. of Tech., Cambridge. Flight Transportation Lab.

THE ROLE OF THE FEDERAL GOVERNMENT IN THE DEVELOPMENT OF THE US AIR TRANSPORTATION SYSTEM

Joseph F. Vittek *In its* Proc. of the NASA/MIT Workshop on Airline Systems Analysis, Vol. 1 Jul. 1972 27 p

CSCL 05A

Reviewed are the roles of the various Federal agencies in the regulation, control, and development of the Air System, with major emphasis on the Department of Transportation (Office of the Secretary, Federal Aviation Administration, and National Transportation Safety Board) and the Civil Aeronautics Board. Author

N73-32851* Massachusetts Inst. of Tech., Cambridge. Flight Transportation Lab.

AN ANALYSIS OF AIRLINE COSTS. LECTURE NOTES FOR MIT COURSES. THE 16.73 AIRLINE MANAGEMENT AND MARKETING

Robert W. Simpson *In its* Proc. of the NASA/MIT Workshop on Airline Systems Analysis, Vol. 1 Jul. 1972 43 p refs

CSCL 05A

The cost analyst must understand the operations of the airline and how the activities of the airline are measured, as well as how the costs are incurred and recorded. The data source is usually a cost accounting process. This provides data on the cumulated expenses in various categories over a time period like a quarter, or year, and must be correlated by the analyst with cumulated measures of airline activity which seem to be causing this expense. Author

N73-32852* Massachusetts Inst. of Tech., Cambridge.

THE ATA-67 FORMULA FOR DIRECT OPERATING COST

Henry B. Faulkner *In its* Proc. of the NASA/MIT Workshop on Airline Systems Analysis, Vol. 1 Jul. 1972 18 p refs

CSCL 05C

The ATA formulas for direct operating cost were developed for the purpose of comparing different aircraft, existing or not, on the same route or the same aircraft on different routes. Such characteristics of the airline as crew pay, maintenance procedures, and depreciation schedules are kept constant. In air transportation systems analysis the 1967 ATA formula is usually used with appropriate exceptions or modifications, such as: different maintenance labor rate, total maintenance multiplied by a factor, maintenance burden deleted, different depreciation schedule, or different spares percentages. Author

N73-32853* Massachusetts Inst. of Tech., Cambridge. Flight Transportation Lab.

TECHNOLOGY FOR DESIGN OF TRANSPORT AIRCRAFT. LECTURE NOTES FOR MIT COURSES: SEMINAR 1.61 FRESHMAN SEMINAR IN AIR TRANSPORTATION AND GRADUATE COURSE 1.201, TRANSPORTATION SYSTEMS ANALYSIS

Robert W. Simpson *In its* Proc. of the NASA/MIT Workshop on Airline Systems Analysis, Vol. 1 Jul. 1972 50 p

CSCL 01C

The design parameters which determine cruise performance for a conventional subsonic jet transport are discussed. It is assumed that the aircraft burns climb fuel to reach cruising altitude and that aeronautical technology determines the ability to carry a given payload at cruising altitude. It is shown that different sizes of transport aircraft are needed to provide the cost optimal vehicle for different given payload-range objectives. G.G.

N73-32854* Harvard Univ., Cambridge, Mass. Dept. of Economics.

BASIC ECONOMIC PRINCIPLES

T. Nicholaus Tideman *In* MIT Proc. of the NASA/MIT Workshop on Airline Systems Analysis, Vol. 1 Jul. 1972 7 p refs

CSCL 05C

An economic approach to design efficient transportation systems involves maximizing an objective function that reflects both goals and costs. A demand curve can be derived by finding the quantities of a good that solve the maximization problem as one varies the price of that commodity, holding income and the prices of all other goods constant. A supply curve is derived by applying the idea of profit maximization of firms. The production function determines the relationship between input and output. G.G.

N73-32855* Massachusetts Inst. of Tech., Cambridge.

BASIC TRANSPORTATION ECONOMICS

James T. Kneafsey *In its* Proc. of the NASA/MIT Workshop on Airline Systems Analysis, Vol. 1 Jul. 1972 18 p refs

CSCL 05C

Transportation economics is an integral part of all transportation activities. Refined, detailed, and careful economic analyses consider conduct-performance methodology and the specifications of production, cost and demand functions. Author

N73-32856* Texas A&M Univ., College Station.

DETERMINATION OF FARES: PRICING THEORY AND ECONOMIC EFFICIENCY

James C. Miller, III *In* MIT Proc. of the NASA/MIT Workshop on Airline Systems Analysis, Vol. 1 Jul. 1972 30 p refs

CSCL 05C

The concept of economic efficiency is described, its application to the pricing of air transport services, and its relevance as a policy objective are outlined. The first two sections discuss economic efficiency in general terms, whereas the third applies this norm to several airline pricing problems. The final section emphasizes the importance of industry behavior as a parameter in policy analysis. Author

N73-32857* United Air Lines, Inc., Chicago, Ill.

DIFFERENTIAL PRICING POLICY

J. B. Gebhardt *In* MIT Proc. of the NASA/MIT Workshop on Airline Systems Analysis, Vol. 1 Jul. 1972 15 p

CSCL 05C

Differential pricing is a valid means of improving profits, keeping the total cost of air transportation down, and making it possible for more people to use air transportation. Author

N73-32858* United Air Lines, Inc., Chicago, Ill.
THE ECONOMIC EFFECT OF COMPETITION IN THE AIR TRANSPORTATION INDUSTRY
Herbert B. Hubbard *In* MIT Proc. of the NASA/MIT Workshop on Airline Systems Analysis, Vol. 1 Jul. 1972 25 p

CSCL 05C

The air transportation industry has been described as a highly-competitive, regulated oligopoly or as a price-regulated cartel with blocked entry, resulting in excessive service and low load factors. The current structure of the industry has been strongly influenced by the hypotheses that increased levels of competition are desirable per se, and that more competing carriers can be economically supported in larger markets, in longer haul markets, with lower unit costs, and with higher fare levels. An elementary application of competition/game theory casts doubt on the validity of these hypotheses, but rather emphasizes the critical importance of the short-term non-variable costs in determining economic levels of competition. Author

N73-32859* Massachusetts Inst. of Tech., Cambridge. Flight Transportation Lab.
BASIC FINANCE
Joseph F. Vittek *In its* Proc. of the NASA/MIT Workshop on Airline Systems Analysis, Vol. 1 Jul. 1972 66 p

CSCL 05C

A discussion of the basic measures of corporate financial strength, and the sources of the information is reported. Considered are: balance sheet, income statement, funds and cash flow, and financial ratios. Author

N73-32860* Air Transport Association of America, Washington, D.C.
CAPITAL REQUIREMENTS FOR THE AIR TRANSPORT INDUSTRY
George W. James *In* MIT Proc. of the NASA/MIT Workshop on Airline Systems Analysis, Vol. 1 Jul. 1972 13 p

CSCL 05C

In recent years the U.S. scheduled airline industry has been involved in the largest re-equipment program that involves the addition of hundreds of new aircraft to the airline fleet. The costs associated with the purchase of this new equipment, along with the other costs involving such matters as the environment and security, are presenting the carriers with significant financial challenges. Author

N73-32861* American Airlines, Inc., New York.
FINANCING THE AIR TRANSPORTATION INDUSTRY
D. J. Lloyd-Jones *In* MIT Proc. of the NASA/MIT Workshop on Airline Systems Analysis, Vol. 1 Jul. 1972 50 p

CSCL 05C

The basic characteristics of the air transportation industry are outlined and it is shown how they affect financing requirements and patterns of production. The choice of financial timing is imperative in order to get the best interest rates available and to insure a fair return to investors. The fact that the industry cannot store its products has a fairly major effect on the amount of equipment to purchase, the amount of capital investment required, and the amount of return required to offset industry depriciation. G.G.

N73-32862* Export-Import Bank, Washington, D.C.
THE ROLE OF THE EXPORT-IMPORT BANK IN DEVELOPING THE EXPORT POTENTIAL OF AIRCRAFT SALES
Chosei Kuge *In* MIT Proc. of the NASA/MIT Workshop on Airline Systems Analysis, Vol. 1 1972 11 p

CSCL 05C

A description of the current patterns, terms, and conditions of Eximbank commercial jet aircraft export financing is given. Some discussion of the factors affecting export financing will be noted. Author

N73-32863* Massachusetts Inst. of Tech., Cambridge. Flight Transportation Lab.
THE MARKET DEMAND FOR AIR TRANSPORTATION
Nawal Taneja *In its* Proc. of the NASA/MIT Workshop on Airline Systems Analysis, Vol. 1 Jul. 1972 65 p refs

CSCL 05C

Although the presentation will touch upon the areas of market for air transportation, the theoretical foundations of the demand function, the demand models, and model selection and evaluation, the emphasis of the presentation will be on a qualitative description of the factors affecting the demand for air transportation. The presentation will rely heavily on the results of market surveys carried out by the Port of New York Authority, the University of Michigan, and Census of Transportation. Author

N73-32864* Massachusetts Inst. of Tech., Cambridge. Flight Transportation Lab.
TECHNIQUES FOR FORECASTING AIR PASSENGER TRAFFIC
Nawal Taneja *In its* Proc. of the NASA/MIT Workshop on Airline Systems Analysis, Vol. 1 Jul. 1972 16 p refs

CSCL 05A

The basic techniques of forecasting the air passenger traffic are outlined. These techniques can be broadly classified into four categories: judgmental, time-series analysis, market analysis and analytical. The differences between these methods exist, in part, due to the degree of formalization of the forecasting procedure. Emphasis is placed on describing the analytical method. Author

N73-32865* International Civil Aviation Organization, Montreal (Quebec).
AVIATION FORECASTING IN ICAO
James McMahon *In* MIT Proc. of the NASA/MIT Workshop on Airline Systems Analysis, Vol. 1 Jul. 1972 20 p

CSCL 05A

Opinions or plans of qualified experts in the field are used for forecasting future requirements for air navigational facilities and services of international civil aviation. ICAO periodically collects information from Stators and operates on anticipated future operations, consolidates this information, and forecasts the future level of activity at different airports. Author

N73-32866* American Airlines, Inc., New York.
AMERICAN AIRLINES PROPELLER STOL TRANSPORT ECONOMIC RISK ANALYSIS
Bob Ransone *In* MIT Proc. of the NASA/MIT Workshop on Airline Systems Analysis, Vol. 1 Jul. 1972 27 p

CSCL 05C

A Monte Carlo risk analysis on the economics of STOL transports in air passenger traffic established the probability of

making the expected internal rate of financial return, or better, in a hypothetical regular Washington/New York intercity operation. G.G.

N73-32869* Harvard Univ., Cambridge, Mass.
DETERMINANTS OF MARKET STRUCTURE AND THE AIRLINE INDUSTRY
William Raduchel *In* MIT Proc. of the NASA/MIT Workshop on Airline Systems Analysis, Vol. 1 Jul. 1972 20 p

CSCL 05A

The general economic determinants of market structure are outlined with special reference to the airline industry. Included are the following facets: absolute size of firms; distributions of firms by size; concentration; entry barriers; product and service differentiation; diversification; degrees of competition; vertical integration; market boundaries; and economies of scale. Also examined are the static and dynamic properties of market structure in terms of mergers, government policies, and economic growth conditions. Author

N73-32870* Massachusetts Inst. of Tech., Cambridge.
OBJECTIVES OF THE AIRLINE FIRM: THEORY
James T. Kneafsey *In its* Proc. of the NASA/MIT Workshop on Airline Systems Analysis, Vol. 1 Jul. 1972 14 p

CSCL 05A

Theoretical models are formulated for airline firm operations that revolve around alternative formulations of managerial goals which these firms are persuing in practice. Consideration is given to the different objective functions which the companies are following in lieu of profit maximization. G.G.

N73-32871* North Carolina Univ., Chapel Hill.
PROBLEMS OF EXCESS CAPACITY
George Douglas *In* MIT Proc. of the NASA/MIT Workshop on Airline Systems Analysis, Vol. 1 Jul. 1972 15 p

CSCL 05A

The problems of excess capacity in the airline industry are discussed with focus on the following topics: load factors; fair rate of return on investment; service-quality rivalry among airlines; pricing (fare) policies; aircraft production; and the impacts of excess capacity on operating costs. Also included is a discussion of the interrelationships among these topics. Author

N73-32872* Douglas Aircraft Co., Inc., Long Beach, Calif.
THE ROLE OF THE MANUFACTURER IN AIR TRANSPORTATION PLANNING
James MacKenzie *In* MIT Proc. of the NASA/MIT Workshop on Airline Systems Analysis, Vol. 1 Jul. 1972 40 p

CSCL 05A

The role of the aircraft manufacturer in the airline industry is considered. The process is illustrated by using a fictitious airline as an example--that is, a case study approach with Mid-Coast Airways serving as the example. Both in slide form and with supporting papers, a brief history of the airline, a description of its route structure and a forecast based on econometric analysis are presented. Once the forecast rationale is explained, information outlines the requirements for additional aircraft and the application of new aircraft across the system using alternative fleet plan options. The fleet plan is translated into financial summaries which indicate the relative merit of alternative aircraft types or operating plans. Author

N73-32873* Pan American World Airways, Inc., New York.
CONSUMER MARKETING AND THE AIRLINE INDUSTRY
William R. Roy *In* MIT Proc. of the NASA/MIT Workshop on Airline Systems Analysis, Vol. 1 Jul. 1972 21 p

CSCL 05A

The fundamentals of consumer marketing as applied to the airline industry are considered. An attempt is made to boil down the mystique and jargon which frequently surround the subject of marketing. Topics covered include: (1) The marketing concept; (2) consumer expectations from airlines; (3) planning of marketing strategy; and (4) the roles of advertising, sales, and middlemen. Author

N73-32874* Pan American World Airways, Inc., New York.
FUTURE DIRECTION IN AIRLINE MARKETING
Dan A. Colussy *In* MIT Proc. of the NASA/MIT Workshop on Airline Systems Analysis, Vol. 1 Jul. 1972 20 p

CSCL 05A

The rapid growth and broadening of the air travel market, coupled with a more sophisticated consumer, will dramatically change airline marketing over the next decade. Discussed is the direction this change is likely to take and its implications for companies within the industry. New conceptualization approaches are required if the full potential of this expanding market is to be fully realized. Marketing strategies are developed that will enable various elements of the travel industry to compete not only against each other but also with other products that are competing for the consumer's discretionary income. Author

N73-32875*# Massachusetts Inst. of Tech., Cambridge. Flight Transportation Lab.
MIT-NASA WORKSHOP AIRLINE SYSTEMS ANALYSIS, VOLUME 2
Jul. 1972 602 p refs
(Contract NASw-2412)
(NASA-CR-135635; FTL-R72-7-Vol-2) Avail: NTIS HC $32.25 CSCL 05A

The proceedings of a conference on the Air Transport Industry are presented. The subjects discussed are: (1) analysis of airline costs, (2) transportation economics, (3) airline financing, (4) market demand for air transportation, (5) planning, management, and economics of airport operation, (6) air cargo operations, (7) commuter aircraft operations, (8) regulation of air traffic rates, (9) airline merger policies, and (10) international air transportation operations.

N73-32876* Massachusetts Inst. of Tech., Cambridge.
CONCENTRATION OF AIRLINE OPERATIONS AT INDIVIDUAL AIRPORTS
W. Gelerman and R. DeNeufville *In its* MIT-NASA Workshop on Airline Systems Analysis, Vol. 2 Jul. 1972 29 p refs

CSCL 01E

It is shown that it is a natural property of air transportation networks for competitive airlines to concentrate their operations at individual airports serving a given market. This implies that a strategy of developing satellite airports is doomed to failure unless the competitives behavior of the airlines is restricted. The results are demonstrated by tracing out the implications of observed patterns of traveller behavior as regards choice of carrier on the optimal game strategy for any particular airline. Analytic results for a two airline, two airport situation are extrapolated to the more general case, and specific supportive evidence from current operations are cited. Author

N73-32877* Massachusetts Inst. of Tech., Cambridge.
PLANNING, MANAGEMENT, AND ECONOMICS OF AIRPORT OPERATION
John Wiley *In its* MIT-NASA Workshop on Airline Systems Analysis, Vol. 2 Jul. 1972 18 p

CSCL 05A

An overview of the role of the airport in the transportation complex and in the community is presented. The establishment of the airport including its requirements in regional planning and the operation of the airport as a social and economic force are discussed. Author

N73-32878* Port of New York Authority, N.Y.
AIRPORT ECONOMICS: MANAGEMENT CONTROL FINANCIAL REPORTING SYSTEMS
Allen Buchbinder *In* MIT MIT-NASA Workshop on Airline Systems Analysis, Vol. 2 Jul. 1972 16 p

CSCL 05B

The development of management control financial reporting systems for airport operation is discussed. The operation of the system to provide the reports required for determining the specific revenue producing facilities of airports is described. The organization of the cost reporting centers to show the types of information provided by the system is analyzed. Author

N73-32879* Port of New York Authority, N.Y. Aviation Economics Div.
AIR TRAFFIC FORECASTING AT THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY
Johannes G. Augustine *In* MIT MIT-NASA Workshop on Airline Systems Analysis, Vol. 2 Jul. 1972 23 p refs

CSCL 05A

Procedures for conducting air traffic forecasts with specific application to the Port Authority of New York and New Jersey are discussed. The procedure relates air travel growth to detailed socio-economic and demographic characteristics of the U.S. population rather than to aggregate economic data such as Gross National Product, personal income, and industrial production. Charts are presented to show the relationship between various selected characteristics and the use of air transportation facilities. Author

N73-32880* Massachusetts Port Authority, Boston.
ROUTE AWARD CONSIDERATIONS
Wilson D Rogers, Jr. *In* MIT MIT-NASA Workshop on Airline Systems Analysis, Vol. 2 Jul. 1972 22 p

CSCL 05A

The organization, responsibilities, and functions of the Civil Aeronautics Board are discussed. Several examples of decisions made by the Civil Aeronautics Board on the award of specific air routes to competing air lines are presented. The manner in which route proceedings are initiated and examined is explained. Recommendations are made concerning actions which can be taken to improve the services provided to the flying public. Author

N73-32881* Eastern Air Lines, Inc., Miami, Fla. Cargo Sales and Services.
THE ECONOMICS OF AIR CARGO
John W. Kersey *In* MIT MIT-NASA Workshop on Airline Systems Analysis, Vol. 2 Jul. 1972 14 p

CSCL 05A

The economic factors involved in air cargo operations and air cargo marketing development are discussed. Specific steps which are followed by various airports to reduce operating costs are described. The economics of cargo handling within an airline are analyzed with respect to: (1) paperwork costs, (2) terminal costs, (3) line haul costs, and (4) claims costs. Author

N73-32882* Eastern Air Lines, Inc., Miami, Fla.
AIR CARGO MARKETING DEVELOPMENT
John W. Kersey *In* MIT MIT-NASA Workshop on Airline Systems Analysis, Vol. 2 Jul. 1972 12 p

CSCL 05A

The factors involved in developing a market for air cargo services are discussed. A comparison is made between the passenger traffic problems and those of cargo traffic. Emphasis is placed on distribution analyses which isolates total distribution cost, including logistical costs such as transportation, inventory, materials handling, packaging, and processing. Specific examples of methods for reducing air cargo costs are presented. Author

N73-32883* Civil Aeronautics Board, Washington, D.C.
CURRENT PROBLEMS AND ISSUES IN AIR FREIGHT RATES
Alfred R. Stout *In* MIT MIT-NASA Workshop on Airline Systems Analysis, Vol. 2 Jul. 1972 21 p

CSCL 05C

Actions of the Civil Aeronautics Board in determining air freight rates are discussed. The tariff filings by domestic airlines for making basic changes in domestic fares and rates are reported. The roles of the carriers and the Civil Aeronautics Board in establishing freight rates are defined. Specific examples of areas of controversy in establishing freight rates are included. Methods for improving the air cargo and freight rate situation are proposed. Author

N73-32884* Massachusetts Inst. of Tech., Cambridge. Flight Transportation Lab.
THE FUTURE OF THE US DOMESTIC AIR FREIGHT INDUSTRY
Lewis M. Schneider *In its* MIT-NASA Workshop on Airlines Systems Analysis, Vol. 2 Jul. 1972 21 p refs

CSCL 05A

A research project on the future of U.S. domestic air freight operations was conducted. The two main subjects of the project were: (1) during the 1965 to 1969 time period, when the airlines introduced jet freighters into domestic service and air freight traffic growth continued at a high rate, what strategies were employed by management and with what results and (2) what are the opportunities and problems confronting the domestic air freight industry during the 1970 and 1980 time period. The results of the analysis are presented in the form of graphs and tables. Author

N73-32885* Massachusetts Inst. of Tech., Cambridge.
TRENDS IN COMMUTER AIR CARRIER OPERATIONS
William Swan *In its* MIT-NASA Workshop on Airline Systems Analysis, Vol. 2 Jul. 1972 17 p

CSCL 05B

The market for commuter air service is analyzed. Methods for reducing the costs of short haul air transportation are discussed. The problems facing the operators of short haul air transport services are identified. Proposed changes in commuter air carrier regulation are submitted. Author

N73-32886* Civil Aeronautics Board, Washington, D.C.
SERVICE TO SMALL COMMUNITIES
Monte Lazarus *In* MIT MIT-NASA Workshop on Airline Systems Analysis, Vol. 2 Jul. 1973 10 p

CSCL 05A

The problems involved in the operation of low cost local service air carriers are analyzed. Four specific situations which created the operating difficulties of the local air carriers are defined. Proposals of federal and local subsidies for short haul air transportation are presented. Author

N73-32887* Charles River Associates, Inc., Cambridge, Mass.
THE SHORT HAUL AIR TRAVEL MARKET: EVALUATION OF NEW FORMS OF SERVICE
David A. Couts *In* MIT MIT-NASA Workshop on Airline Systems Analysis, Vol. 2 Jul. 1972 28 p refs

CSCL 05C

Aspects of the demand for air travel and an approach for incorporating them in evaluations of new services are discussed. The approach as described here is being used to evaluate the market for STOL aircraft in the 1980's but it could just as well be used to evaluate the market effects of schedule changes, equipment changes, and new routes, if certain basic data relating these changes to demand are available. A most important change in the market which is likely to take place in the next fifteen years, and which is already underway, is the increasing availability of alternative airports in major cities. Author

N73-32888* George Washington Univ., Washington, D.C.
THIRD LEVEL AIR CARRIER SERVICE
George Eads *In* MIT MIT-NASA Workshop on Airline Systems analysis, Vol. 2 Jul. 1972 28 p

CSCL 05A

A proposed Civil Aviation Board approach to regulating commuter air transportation services is discussed. Operating problems of specific air lines are used as examples. Inadequacies in the present service for short haul commuter air transportation are defined. Methods by which improvements in the commuter air transport service are proposed. Author

N73-32894* Harvard Univ., Cambridge, Mass. Harvard Business School.
THE FUTURE OF REGULATION IN THE AIRLINE INDUSTRY
Paul W. Cherington and James J. Hill *In* MIT MIT-NASA Workshop on Airline Systems Analysis, Vol. 2 21 Jul. 1972 5 p
CSCL 05A

The Federal regulation of airlines is analyzed to predict the amount of regulation to be expected in the future. It is stated that the regulatory powers will increase because of the advantages that such regulation provides to the airlines. Six propositions are submitted as guidelines for future airlines regulation. The loss of revenue experienced by the airlines is examined and methods for improving the economic situation are defined. Author

N73-32895* Civil Aeronautics Board, Washington, D.C.
MERGERS AND ANTI-TRUST ISSUES IN RECENT CAB CASES
A. M. Andrews *In* MIT MIT-NASA Workshop on Airline System Analysis, Vol. 2 19 Jul. 1972 10 p

CSCL 05A

The airline industry is surveyed-particularly domestic trunk-lines-in relation to collective approaches to industry concerns. These actions are classified by the apparent degree of anti-trust issue present. Recent route merger cases are considered from the CAB staff viewpoint. Author

N73-32899* Civil Aeronautics Board, Washington, D.C.
INTERNATIONAL AIR TRANSPORT POLICY
Charles Butler *In* MIT MIT-NASA Workshop on Airline System Analysis, Vol. 2 21 Jul. 1972 31 p

CSCL 05A

The actions of the Civil Aviation Board in providing assistance and advice to the State Department regarding international air transport policy are discussed. The policies and guidelines of the Civil Aviation Board are defined. The relationship with the policies of the Executive Branch of the Government and the interpretations of the Department of Transportation are reported. Author

N73-32900* Aerospace Industries Association of America, Inc., Washington, D.C.
COMMERCIAL AIRCRAFT DEVELOPMENT AND THE EXPORT MARKET
Joseph Snodgrass *In* MIT MIT-NASA Workshop on Airline Systems Analysis, Vol. 2 20 Jul. 1972 20 p refs

CSCL 05C

The various factors which endanger the future of commercial aircraft development are defined. The factors discussed are: (1) a decline in federally funded research and development programs, (2) a general decline in the economic health of the domestic airlines, (3) the increased cost of development which may be several times the net worth of the company, (4) the development overseas of common market and manufacturing consortia, and (5) foreign manufacturers receiving significant financial support from their national governments. It is stated that unless immediate and innovative solutions to combat these factors are found, the commercial aviation industry will be in serious difficulty. Author

N73-32902* Department of Transportation, Washington, D.C.
INTERNATIONAL AIR TRANSPORT AND FEDERAL POLICY
Robert Henri Binder *In* MIT MIT-NASA Workshop on Airline Systems Analysis, Vol. 2 21 Jul. 1972 12 p

CSCL 05A

The Federal policy which establishes guidelines for future U.S. participation in the international air transportation industry is discussed. The policy issues discussed include the following: (1) aircraft hijacking, both foreign and domestic, (2) relationship of scheduled services and charter services, (3) capacity problems, and (4) rate regulation. Author

N73-32903* Air Transport Association of America, Washington, D.C.
UNITED STATES INTERNATIONAL AIR TRANSPORT POLICY, THE PROMISE AND THE REALITY
James E. Landry and Gabriel Phillips *In* MIT MIT-NASA Workshop

on Airline Systems Analysis, Vol. 2 21 Jul. 1972 32 p

CSCL 05A

The United States international air transportation policy is discussed. The major departure of the current policy lies in the relationship between scheduled and charter services. Various provisions of the transportation charter are analyzed to show the restrictions as well as the benefits the legislation holds for commercial aviation. It is stated that a group of full service carriers can meet the full spectrum of demands for air transportation more efficiently than two or more groups. Author

N73-32905*# Aerospace Corp., El Segundo, Calif. Air Transportation Group.
SYSTEMS EVALUATION OF LOW DENSITY AIR TRANSPORTATION CONCEPTS
R. W. Bruce and H. M. Webb Jul. 1972 96 p refs
(Contract NAS2-6473)
(NASA-CR-114484; ATR-73(9981)-1) Avail: NTIS HC $7.00 CSCL 01E

Methods were studied for improving air transportation to low-density population regions in the U.S. through the application of new aeronautical technology. The low-density air service concepts are developed for selected regions, and critical technologies that presently limit the effective application of low-density air transportation systems are identified. F.O.S.

N73-32907# Joint Publications Research Service, Arlington, Va.
ECONOMIC EVALUATION OF AIRCRAFT AND SPACECRAFT
S. A. Sarkisyan and E. S. Minayev 24 Sep. 1973 188 p refs Transl. into ENGLISH from the book "Ekonomicheskaya Otsenka Letatel'nykh Apparatov" Moscow, Izdatel'stvo Mashinostroyeniye, 1972 177 p
(JPRS-60104) Avail: NTIS HC $11.50

The report contains a study of the economic problems of the analysis and selection of optimal versions of complex technical systems (in the example of systems of aircraft and spacecraft). The characteristics features and significance of technical progress in the aerospace industry are discussed, and problems of systems analysis when forecasting technical progress are analyzed. Author

N73-32917# Army Foreign Science and Technology Center, Charlottesville, Va.
TECHNOLOGY AND ARMAMENT. NO. 1, JANUARY 1973
27 Jun. 1973 174 p refs Transl. into ENGLISH of Tekhn. i Vooruzhenie (Moscow), no. 1, 1973
(AD-763323; FSTC-HT-23-1864-73) Avail: NTIS CSCL 15/3

Articles written by Russian officer personnel and by Russian civilian scientific personnel are mainly on new scientific and technological advances. GRA

N73-32920# Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.
VULNERABILITY OF DRY BAYS ADJACENT TO FUEL TANKS UNDER HORIZONTAL GUNFIRE Technical Report, Mar. 1966 - Jun. 1971
Robert G. Clodfelter Mar. 1973 102 p refs
(AF Proj. 3048)
(AD-764732; AFAPL-TR-72-83) Avail: NTIS CSCL 19/4

The report deals with the relative vulnerability to incendiary action of dry bays adjacent to fuel tanks as a function of fuel type. Cal .50 API horizontal gunfire was the threat; a high level of simulation was achieved by having air flow external to and in the dry bays. The results of a wide range of test conditions are presented. The overall conclusion of the investigation was that JP-8 fuel is less susceptible to fire and explosion induced by gunfire and should produce less aircraft structural damage than JP-4. Author (GRA)

N73-32922 New York Univ., N.Y.
ANALYSIS OF THE LOW-SPEED FLOW OVER A SLENDER SHARP-EDGED DELTA WING AT ANGLES OF ATTACK Ph.D. Thesis
Paul LeRoy Coe 1973 75 p
Avail: Univ. Microfilms Order No. 73-19383

The phenomena of rolled-up vortex cores above the lee surface of slender bodies, at angle of attack, has been observed since the advent of the highly swept-wing aircraft. Investigations indicate that these vortices exhibit large effects on the longitudinal and lateral stability of these configurations. Because of its geometric simplicity, an untwisted, uncambered, thin, sharp-edged, slender delta wing in subsonic flow is considered. Experimental studies have established the essential features of this type of flow as follows: (1) separation of flow at the leading edges, (2) formation of rolled-up vortex cores above the lee surface, (3) entrainment of mass by the vortex cores, (4) strong axial velocities along the vortex cores and (5) conical flow over the major portion of the wing (with the exception of the apex and trailing edge). Dissert. Abstr.

N73-32923 Maryland Univ., College Park.
AERODYNAMIC FORCES ON OBJECTS IN THE NEARLY FREE MOLECULAR FLOW REGIME Ph.D. Thesis
William Aaron Kuperman 1972 187 p
Avail: Univ. Microfilms Order No. 73-18251

The drag of an object moving in a rarefied gas is discussed. The first (inverse) Knudsen number correction to the drag in the free molecular flow regime is determined by a set of collision integrals associated with the dynamics of two gas molecules in the presence of the object. These collision integrals are analogous to the three-particle collision integrals derived earlier for the transport properties of a moderately dense gas if one of the particles is replaced with the object. Collision integrals for a number of cases assuming a gas of hard sphere molecules which scatter diffusively with the object are calculated. For a sphere moving at low velocity the result is in agreement with Millikan's data for the drag coefficient of oil droplets. For a cylinder and a strip the coefficient of a term logarithmic in the expansion parameter is obtained. Dissert. Abstr.

N73-32924*# Remtech, Inc., Birmingham, Ala.
WING TIP VORTEX MEASUREMENTS WITH LASER DOPPLER SYSTEMS
Charles E. Fuller, III Apr. 1973 79 p refs
(Contract NAS8-25896)
(NASA-CR-124444; RTR-002-3) Avail: NTIS HC $6.00 CSCL 01A

The vortex velocity field produced by a rectangular wing in a subsonic wind tunnel was measured using two laser Doppler velocimeter systems. One system made three dimensional mean velocity measurements and the other made one dimensional turbulence measurements. The systems and test procedures are described and comparisons of the measurements are made. The data defined a strong spiral motion in the vortex formation process. Author

N73-32926*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AN EXPERIMENTAL INVESTIGATION OF THREE OBLIQUE-

WING AND BODY COMBINATIONS AT MACH NUMBERS BETWEEN 0.60 AND 1.40
Lawrence A. Graham, Robert T. Jones, and Frederick W. Boltz Apr. 1973 173 p refs
(NASA-TM-X-62256) Avail: NTIS HC $10.75 CSCL 01A

An experimental investigation was conducted in an 11- by 11-foot transonic wind tunnel to determine the aerodynamic characteristics of three oblique high aspect ratio wings in combination with a high fineness-ratio Sears-Haack body. The three wings had the same elliptical planform and base line curvature but had different airfoil sections. One wing had an airfoil section designed to have a lift coefficient of 1.0 at a Mach number of 0.7, another to have shock-free supersonic flow over the upper surface, and the other to have a lift coefficient of 1.3 at a Mach number of 0.6. Longitudinal and lateral-directional stability data were obtained at wing yaw angles of 0 deg, 45 deg, 50 deg, and 60 deg over a test Mach number range from 0.6 to 1.4 for angles of attack between minus 7 deg and 9 deg. Reynolds numbers for the study were 4 and 6 million per foot. Flow-visualization studies were made to examine the nature of the flow on the wing surfaces. Notable differences were found in the aerodynamic characteristics of the three wing-body combinations, particularly in the lateral-directional characteristics. Author

N73-32927*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AN EXPERIMENTAL INVESTIGATION OF AN OBLIQUE-WING AND BODY COMBINATION AT MACH NUMBERS BETWEEN 0.60 AND 1.40
Lawrence A. Graham, Robert T. Jones, and Frederick W. Boltz Dec. 1972 371 p refs
(NASA-TM-X-62207) Avail: NTIS HC $20.75 CSCL 01A

An experimental investigation was conducted in an 11- by 11-foot wind tunnel to determine the aerodynamic characteristics of an oblique high aspect ratio wing in combination with a high fineness-ratio Sears-Haack body. Longitudinal and lateral-directional stability data were obtained at wing yaw angles from 0 deg to 60 deg over a test Mach number range from 0.6 to 1.4 for angles of attack between minus 6 deg and 9 deg. The effects of changes in Reynolds number, dihedral, and trailing-edge angle were studied along with the effects of a roughness strip on the upper and lower surfaces of the wing. Flow-visualization studies were made to determine the nature of the flow on the wing surfaces. Author

N73-32929# Royal Aircraft Establishment, Farnborough (England). Structures Dept.
RELATIVE FREQUENCY OF OCCURRENCE OF DIFFERENT NORMAL ACCELERATIONS AT THE CENTRE OF GRAVITY OF AIRCRAFT IN TURBULENCE
J. Taylor London Aeron. Res. Council 1973 60 p refs Supersedes RAE-TR-71169; ARC-33503
(ARC-R/M-3714; RAE-TR-71169; ARC-33503) Avail: NTIS HC $5.00; HMSO £2.15; PHI $8.33

An examination is made of the relative frequency of occurrence of different normal accelerations, at points near the aircraft centre of gravity of 5 different aircraft, from about 200 hours of research flying sub-divided into about 12000 time periods mainly of about 1 minute. It is shown that the commonly used assumption of a Rayleigh distribution for vertical gust velocity maxima for each period gives poor estimates of the cumulative totals of all the periods for each aircraft. If, however, it is assumed that (1) the frequency of occurrence of different magnitudes of the maxima of the gust velocity vector is a Rayleigh distribution, and (2) the vector changes direction sufficiently slowly for the maxima of the components to occur at the same time as the maxima of the vector, hold for each period, the estimates of the cumulative totals of all the periods for each aircraft do not differ significantly from the measurements. Author (ESRO)

N73-32930# National Physical Lab., Teddington (England). Aerodynamics Div.
AN EXPERIMENTAL INVESTIGATION OF WIND-TUNNEL WALL CONDITIONS FOR INTERFACE-FREE DYNAMIC MEASUREMENTS
A. W. Moore and K. C. Wight London Aeron. Res. Council 1973 45 p refs Supersedes NPL-AERO-1307; N71-17085; ARC-31704
(ARC-R/M-3715; NPL-AERO-1307; ARC-31704) Avail: NTIS HC $4.25; HMSO £1.70; PHI $6.75

Results are presented of dynamic tests on two model half-wings performing pitching oscillations in a tunnel which has a slotted roof and floor with perforations of variable size behind the slots. A porosity is found which gives small interference for all speeds in the range of Mach numbers from 0.40 to 1.05 and a method is suggested for selecting a wall porosity to give interference-free damping derivatives; interference-free stiffness derivatives are not simultaneously obtained and small corrections to measured values are required. Author (ESRO)

N73-32931# National Physical Lab., Teddington (England). Aerodynamics Div.
ON THE EFFECTS OF VISCOUS INTERACTION FOR A FLAT DELTA WING AT INCIDENCE
L. Davies London Aeron. Res. Council 1973 32 p refs Supersedes ARC-32117
(ARC-CP-1237; ARC-32117) Avail: NTIS HC $3.75; HMSO 55p; PHI $2.35

Equations are derived which enable the effects of viscous interaction on the normal force to be assessed for a flat delta wing at incidence. Author (ESRO)

N73-32932# Bristol Univ. (England). Dept. of Aeronautical Engineering.
DECAY OF TRAILING VORTICES
E. H. Oon London Aeron. Res. Council 1973 65 p refs Supersedes ARC-33215
(ARC-CP-1238; ARC-33215) Avail: NTIS HC $5.25; HMSO £1.05; PHI $4.05

Model wings of various planforms were plunged vertically into a water tank and the vortex patterns on the surface were studied. For each wing the wake drift rate was found to increase with incidence and to decrease with increasing core separation. The wake started off with discrete vortex cores which grew independently, maintained their initial separation, and had peak velocities which decayed as time to the minus one-half power. The edges of the cores ultimately came very close together, and thereafter separation distance between the core centers increased with time, and the peak velocities tended to decay at the reciprocal of time. Author (ESRO)

N73-32933# Brussels Univ. (Belgium). Inst. of Applied Mechanics.
STUDY OF BUFFETING MOTION OF AIR CUSHION VEHICLES [ETUDE DU MOUVEMENT DE PILONNEMENT DES VEHICULES A COUSSAIN D'AIR]
G. VandeSteen 1973 103 p refs In FRENCH
(NT-33-1973) Avail: NTIS HC $7.25

An aerothermodynamical study of buffeting for three types of air cushion vehicle is presented. The main hypotheses are given. A theoretical study for the skirt type vehicle leads to a third order differential equation from which the stability criterion is derived. Experimental tests show the importance of fan characteristics, quasi uniform flow within the skirt, compressibility effects, and non-linear effects. The peripheral jet type may be represented by a second order linear system using a modified Crewe Eddington potential theory with a good approximation.

The two pressure stage vehicle combines both types above. By combining experimental results and theory, a satisfactory approximation was obtained. In all three cases the transient response is damping coefficient lower than the criticial value.
ESRO

N73-32934*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STOL TECHNOLOGY
Washington 1972 516 p refs Conf. held at Moffett Field, Calif., 17-19 Oct. 1972
(NASA-SP-320) Avail: NTIS HC $9.75 CSCL 01C

The proceedings of a conference on STOL technology are presented. The subjects discussed are: (1) short haul transportation systems, (2) aerodynamic characteristics, (3) aerodynamic loads, (4) flight dynamics, (5) operational aspects, (6) quiet STOL propulsion, and (7) jet powered-lift noise technology.

N73-32935* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SHORT-HAUL TRANSPORTATION IN THE 1980'S
Leonard Roberts *In its* STOL Technol. 1972 p 1-8 refs

CSCL 01C

The requirements for short-haul air transportation services in the 1980 time period are analyzed. The identification of short takeoff and landing aircraft to perform this service is reviewed. The adequacy of technical programs for developing short-haul aircraft is examined. The characteristics of several candidate short-haul aircraft are described. A system analysis, to include the economic and environmental factors, is developed. Author

N73-32936* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FUTURE SHORT-FIELD AIRCRAFT
Thomas L. Galloway *In its* STOL Technol. 1972 p 9-22 ref

CSCL 01C

The application of short takeoff and landing aircraft for improving short-haul air transportation is examined. The contracts with industry to study quiet turbofan short-field aircraft in the short-haul air transportation system are identified. Studies of appropriate propulsion systems are conducted in parallel with the aircraft studies. The objectives of the studies are to: (1) determine economic and social viability of short-haul air transportation, (2) identify critical technology and technology-related problems, (3) define representative aircraft configurations and characteristics to include development and operational costs, and (4) to establish desirable technology advances for improving short-haul transportation systems. Author

N73-32937* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ECONOMIC AND ENVIRONMENTAL ASPECTS OF STOL TRANSPORTATION
Elwood C. Stewart *In its* STOL Technol. 1972 p 23-34

CSCL 05C

A system study to analyze the question of the impact of advanced STOL aircraft in meeting the needs of short-haul air transportation systems is discussed. The study is concerned with the following aspects: (1) service to the passenger, (2) economic viability, and (3) economic criteria to include community noise, ground and air decongestion, and air pollution. The STOL aircraft parameters are defined. Preliminary conclusions concerning the feasibility of short-haul air transportation are presented. Author

N73-32938* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
OVERVIEW OF TECHNOLOGY SESSIONS
Bradford H Wick *In its* STOL Technol. 1972 p 35-42

CSCL 01C

Short takeoff aircraft technology development related to the requirements for an expanded and improved short-haul air transportation system is discussed. Systems requirements are summarized, principal aircraft requirements are identified, the status of STOL technology is analyzed, and the scope of the technology efforts covered by the conference are outlined. Charts and diagrams are provided to explain system requirements, lift capability trends, and terminal airspace requirements. Author

N73-32939* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AERODYNAMIC AND PERFORMANCE CHARACTERISTICS OF EXTERNALLY BLOWN FLAP CONFIGURATIONS c01
William G. Johnson, Jr. *In its* STOL Technol. 1972 p 43-54

CSCL 01A

The application of externally blown flaps for improving the performance of short takeoff aircraft is discussed. The characteristics of externally blown flap powered lift are examined. A method for predicting the aerodynamic performance of a particular externally blown flap configuration is presented. The following specific effects are analyzed: (1) induced aerodynamics, (2) static turning, (3) flap span and deflection, and (4) engine size and chord flap. Author

N73-32940* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STABILITY AND CONTROL OF EXTERNALLY BLOWN FLAP CONFIGURATIONS
Lysle P. Parlett *In its* STOL Technol. 1972 p 55-70 refs

CSCL 01A

The results of wind-tunnel investigations on the stability and control characteristics of externally blown jet-flap configurations are presented. Conventional wind-tunnel tests and free-flight model tests have shown that longitudinal trim and stability can be achieved by a properly located horizontal tail of sufficient size, and that lateral trim in the engine-out condition can be produced by combinations of differential flap, spoiler, and rudder deflection. Free-flight model tests have revealed a lightly damped Dutch roll lateral oscillation, and have shown that the oscillation can be stabilized by use of artificial damping. Author

N73-32941* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AERODYNAMIC CHARACTERISTICS OF A SWEPT AUGMENTOR WING
David G. Koenig and Michael D. Falarski (Army Air Mobility R and D Lab.) *In its* STOL Technol. 1972 p 71-86 refs

CSCL 01A

A brief outline of augmentor wing research sponsored by Ames Research Center is presented and is followed by a discussion of large-scale wind-tunnel test results for a swept augmentor wing configuration. The results showed that the augmentor wing could be applied to high-speed swept wing designs with little adverse effect on either the basic performance of the augmentor or the longitudinal characteristics, including maximum lift and stall. Three lateral control devices were shown to be effective and ground effect was measured for several complete aircraft configurations. Author

N73-32942* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ADVANCED AUGMENTOR-WING RESEARCH
Thomas N. Aiken *In its* STOL Technol. 1972 p 87-96 refs

CSCL 01A

Results of research on advanced augmentors are discussed. Research concerned with performance has indicated that: (1) augmentors with lobe-type nozzles give higher thrust augmentation than those with slot-type primary nozzles, (2) the thrust of augmentor wings at forward speed is greater than that of internally blown flaps for the speed range of interest, and (3) the optimum augmentor geometry at forward speed may be different from the optimum static geometry. Analysis of augmentor-wing data has shown that the data may be correlated by accounting for the augmentation and entrainment in defining a net thrust coefficient. Author

N73-32943* Army Air Mobility Research and Development Lab., Hampton, Va.
AERODYNAMICS OF THE UPPER SURFACE BLOW FLAP

Arthur E. Phelps, III *In* NASA. Langley Res. Center STOL Technol. 1972 p 97-110 refs

CSCL 01A

The results of some preliminary wind-tunnel investigations made to provide fundamental aerodynamic information on the upper surface blown jet-flap concept incorporating high-bypass-ratio turbofan engines are summarized. The results of the investigation have shown the concept to have aerodynamic performance generally similar to that of other externally blown high-lift systems. A few of the more critical problems associated with this concept have been identified and preliminary solutions to some of these problems have been found. These results have proven to be sufficiently encouraging to warrant continuation of fundamental research efforts on the concept. Author

N73-32944* Army Air Mobility Research and Development Lab., Hampton, Va.
COMPARISON OF AERODYNAMIC PERFORMANCE OF SEVERAL STOL CONCEPTS
Danny R. Hoad *In* NASA. Langley Res. Center STOL Technol. 1972 p 111-120
CSCL 01C

Wind tunnel tests to determine the aerodynamic characteristics of basically similar short takeoff aircraft were conducted. The investigations were designed to provide data for a systematic direct comparison of five of the concepts considered. The configurations of the five models are illustrated and described. The aerodynamic data are presented in the form of graphs. It was concluded that the most complex systems require the least amount of net thrust. Author

N73-32945* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AERODYNAMIC LOADS MEASUREMENTS ON EXTERNALLY BLOWN FLAP STOL MODELS
George C. Greene and Boyd Perry, III *In its* STOL Technol. 1972 p 121-130
CSCL 01A

Small-scale-model data have shown large static loads on the flap system behind the engines. The large-scale-model tests confirmed the magnitude of these loads and indicated that the relative loading of each flap element depends on the engine-wing-flap geometry. Flap response measurements indicated that the unsteady pressure loading excited the natural vibration modes of the flap system on this model. Since this was a boilerplate model, the only conclusion that can be drawn is that the possibility of large vibration loads must be considered for a flight-weight structure. The similarity of the unsteady pressure and flap response spectra for the wind-off and wind-on cases indicated that it may be possible to realistically test flight-weight flap structures on a static test stand rather than endure the extra costs and scheduling problems associated with large-scale wind-tunnel tests. There is a potential flap-temperature problem which if not resolved might preclude the use of materials such as aluminum and the composites in the flap structure. Author

N73-32946* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EXTERNALLY BLOWN FLAP DYNAMIC LOADS
Donald L. Lansing, John S. Mixson, Thomas J. Brown (Army Air Mobility R and D Lab., Hampton, Va.), and Joseph A. Drischler *In its* STOL Technol. 1973 p 131-142

CSCL 01A

Some of the principal results obtained in three series of measurements of fluctuating surface pressures induced on externally blown flaps by jet impingment are presented. Large- and small-scale models and hot- and cold-flow tests are considered. The discussion sets forth scaling parameters and consistent features of the root-mean-square values and spectra of the loading. Implications of these results with regard to sonic fatigue are indicated. Author

N73-32947* National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
SURVEY OF WING AND FLAP LOWER-SURFACE TEMPERATURES AND PRESSURES DURING FULL-SCALE GROUND TESTS OF AN EXTERNALLY BLOWN FLAP SYSTEM
Donald L. Hughes *In its* STOL Technol. 1972 p 143-156 refs
CSCL 01A

Full-scale ground tests of an externally blown flap system were made using the wing of an F-111B airplane and a CF700 engine. Pressure and temperature distributions were determined on the undersurface of the wing, vane, and flap for two engine exhaust nozzles (conical and daisy) at several engine power and engine/wing positions. The tests were made with no airflow over the wing. The leading-edge wing sweep angle was fixed at 26 deg, the angle of incidence between the engine and the wing was fixed at 3 deg, and the tests were conducted with the flap retracted, extended and deflected 35 deg, and extended and deflected 60 deg. The integrated local pressures on the undersurface of the flap produced loads approximately three times as great at the 60 deg flap position as at the 35 deg flap position. With both nozzle configurations, more than 90 percent of the integrated pressure loads were contained within plus or minus 20 percent of the flap span centered around the engine exhaust centerline. The maximum temperature recorded on the flaps was 218 C (424 F) for the conical nozzle and 180 C (356 F) for the daisy nozzle. Author

N73-32948* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SIMULATOR EVALUATION OF THE FLYING QUALITIES OF EXTERNALLY BLOWN FLAP AND AUGMENTOR WING TRANSPORT CONFIGURATIONS
David A. Kier, Bruce G. Powers, William D. Grantham, and Luat T. Nguyen *In its* STOL Technol. 1972 p 157-800 refs

CSCL 01A

Concurrent simulations of powered-lift STOL transport aircraft having either an externally blown flap configuration or an

augmentor wing configuration were conducted. The following types of simulators of varying sophistication were used: (1) a simple fixed-base simulation with a simple visual display, (2) a more complex fixed-base simulation using a realistic transport cockpit and a high-quality visual display, and (3) a six-degree-of-freedom motion simulator that had a realistic transport cockpit and a sophisticated visual display. The unaugmented flying qualities determined from these simulations were rated as unacceptable for both the externally blown flap and augmentor wing configurations. The longitudinal, lateral-directional, and single-engine-failure characteristics were rated satisfactory with extensive augmentation, including pitch and roll command systems, flight-path (or speed) augmentation, turn coordination, and effective yaw damping. However, the flare and landing characteristics from any approach glide-path angle in excess of 4 deg were rated as unsatisfactory but acceptable. Author

N73-32949* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FLIGHT-PATH AND AIRSPEED CONTROL FOR THE STOL APPROACH AND LANDING
James A. Franklin and Robert C. Innis *In its* STOL Technol. 1972 p 181-198 refs
CSCL 01C

Analytical investigations and piloted moving base simulator evaluations were conducted for manual control of flight path and airspeed for the approach and landing of a powered lift jet STOL aircraft. Flight-path and airspeed response characteristics were described analytically and were evaluated for the simulation experiments which were carried out on a large motion simulator. The response characteristics were selected and evaluated for a specified path and speed control technique. These characteristics were the initial flight-path response, flight-path overshoot, flight-path-airspeed coupling in response to a change in thrust, and the sensitivity of airspeed to pitch-attitude changes. Results are presented in the form of pilot opinion ratings and commentary, substantiated where appropriate by response time histories and aircraft states at the point of touchdown. Author

N73-32950* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STUDY OF GROUND PROXIMITY EFFECTS ON POWERED-LIFT STOL LANDING PERFORMANCE
James L. Hassell, Jr. and Joseph H. Judd *In its* STOL Technol. 1972 p 199-213 refs
CSCL 01C

Data from wind-tunnel measurements are presented to show the magnitude of adverse ground effects on the longitudinal aerodynamic coefficients of a powered-lift STOL airplane. A steady-state analysis shows the changes in thrust and angle of attack required during the landing approach and flare as the airplane flies close to the ground. The piloting problems that these ground effects may create were investigated with an in-flight simulator to find the consequences of lift loss during the landing-flare maneuver for a STOL transport. Flight tests were made using the variable stability Navion setup with STOL transport aerodynamics and control responses and were flown at design approach speeds and descent conditions. Author

N73-32951* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STATUS OF STOL RIDE QUALITY AND CONTROL
D. William Conner and W. Elliott Schoonover, Jr. *In its* STOL Technol. 1972 p 215-226 refs

CSCL 01C

A STOL ride-control development program has been initiated with the objective of generating ride-control technology through development and evaluation of an active control system specifically designed to provide ride smoothing on a STOL vehicle. Although much can be learned through analysis, there are deficiencies in technology for translating analysis results into operating hardware. The general approach being followed is to select an existing STOL vehicle for trial and then carry out a study to establish feasibility of a control system or systems to smooth the ride and generate system trade-off data. Author

N73-32952* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
HEAD-UP DISPLAYS FOR STOL VISUAL APPROACHES

Everett A. Palmer and Fred W. Cronn (San Jose State Univ.) *In its* STOL Technol. 1972 p 227-243 refs

CSCL 01D

A simulation study was conducted to determine the effectiveness of a simple head-up display in improving glide-slope tracking performance during steep visual approaches in a STOL aircraft. The head-up display featured an attitude-stabilized horizon bar and glide-slope reference bar parallel to and 7.5 deg below the horizon bar. On some approaches a flight-path marker symbol showing the projected ground impact point was also displayed. Half of the approaches were flown in a conventional mode in which the pilot changed pitch attitude to correct for height errors. The remaining approaches were flown in a direct-lift mode in which the pilot modulated thrust to change the flight-path angle without pitching the aircraft. Author

N73-32953* National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
A FLIGHT EVALUATION OF CURVED LANDING APPROACHES
S. W. Gee, M. R. Barber, and T. C. McMurtry *In its* STOL Technol. 1972 p 245-258 refs

CSCL 01C

The development of STOL technology for application to operational short-haul aircraft is accompanied by the requirement for solving problems in many areas. One of the most obvious problems is STOL aircraft operations in the terminal area. The increased number of terminal operations needed for an economically viable STOL system as compared with the current CTOL system and the incompatibility of STOL and CTOL aircraft speeds are positive indicators of an imminent problem. The high cost of aircraft operations, noise pollution, and poor short-haul service are areas that need improvement. A potential solution to some of the operational problems lies in the capability of making curved landing approaches under both visual and instrument flight conditions. Author

N73-32954* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PRELIMINARY RESULTS OF FLIGHT TESTS OF THE AUGMENTOR-WING JET STOL RESEARCH AIRCRAFT
Hervey C. Quigley and Richard F. Vomaske *In its* STOL Technol. 1972 p 259-282 refs
CSCL 01C

The Augmentor-Wing Jet STOL Research Aircraft has been developed and has started flight tests. The objectives of the program are to compare aerodynamic characteristics predicted from wind-tunnel data with data obtained in flight, to determine flight dynamic characteristics and limitations of the augmentor-

wing concepts, and to contribute to the development of STOL design and operational criteria. Initial flight test results have shown that the aerodynamic characteristics are close to values predicted from wind-tunnel tests. The lateral-directional stability and control characteristics are satisfactory for research STOL missions with stability augmentation, but the longitudinal control require improvement. STOL take-off distance over 11 m is about 290 m, and landing approach speeds are between 60 and 65 knots. The investigation of the STOL operational and performance characteristics is continuing. Author

N73-32955* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
COMPARISONS OF SIMULATOR AND FLIGHT RESULTS ON AUGMENTOR-WING JET STOL RESEARCH AIRCRAFT
Robert C. Innis and Seth B. Anderson *In its* Stol Technol. 1972 p 283-290
CSCL 01C

The considerations involved in making a piloted simulator an effective research tool in the design and development of new aircraft are discussed. An assessment of the limitations of the simulator in depicting real flight as well as the problem of recognizing erroneous results when the simulator is supplied with incorrect input data is made. Examples of the ways in which the simulator is used to design and develop the augmentor-wing aircraft are presented. Four areas of investigation are: (1) to design the lateral control system for proper feel and response, (2) determine the effect of engine failure during approach, (3) develop the best technique for controlling flight path during approach, and (4) the significance of lift loss in ground effect and how to compensate for such loss. Author

N73-32956* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
INTEGRATION OF STOL AIRPLANES INTO THE ATC SYSTEM
Paul Peterson, Richard H. Sawyer, and Milton D. McLaughlin *In its* STOL Technol. 1972 p 291-306 Prepared in cooperation with FAA, Washington, D. C.

CSCL 17G

The study involving the STOL airplane and air traffic control is a joint NASA/FAA effort designed to examine the effects of introducing large numbers of STOL airplanes into a high-density terminal area. Simply stated, the objectives of the study are to determine the effects of the STOL airplane on the air traffic control (ATC) system and to determine the effects of the ATC system on the STOL airplane. More specifically, the study seeks to determine the airspace requirements and air traffic control equipment and handling techniques required to accommodate the STOL airplane in the ATC system and the design characteristics, avionics equipment, and flight procedures required to operate the STOL airplane in the air traffic control system. Author

N73-32957* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FOUR-D GUIDANCE OF STOL AIRCRAFT IN THE TERMINAL AREA
Thomas Pecsvaradi and Heinz Erzberger *In its* STOL Technol. 1972 p 307-332 refs
CSCL 17G

The primary objective of advanced STOL aircraft is the improvement of the nation's air transportation system by the elimination of delays and congestions associated with today's air travel. A new guidance technique, referred to as 4-D guidance, is being developed to achieve this objective. The 4-D guidance technique synthesizes complex three-dimensional flight paths from a minimum set of input data and flies the aircraft along the paths according to a prespecified time schedule. The two major elements of a 4-D guidance system are the trajectory synthesizer and the control law. Inputs to the trajectory synthesizer are the three-dimensional coordinates of way points, the turning radii, the speed ranges, the acceleration limits, and the arrival times at time control way points. First, the three-dimensional trajectory is computed by using circular arcs and straight lines. Then the airspeed profile, compensated for wind, is calculated to achieve the desired arrival times. The synthesized trajectory is stored as a time sequence of reference states which the aircraft is forced to track by using a linear feedback law. Author

N73-32958* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
TERMINAL-AREA STOL OPERATING SYSTEMS EXPERIMENTS PROGRAM
Donald W. Smith, DeLamar Watson, and Jay V. Christensen *In its* STOL Technol. 1972 p 333-343 ref

CSCL 01E

A system study to determine the application of short takeoff aircraft for a high speed, short haul air transportation service was conducted. The study focused on developing information which will aid in choosing system concepts, design criteria, operating procedures, landing guidance systems, air traffic control systems, and airborne avionics and flight control systems. A terminal area STOL operating system experiments program was developed. The objectives, program approach, program schedule, typical experiments, research facilities to be used, and program status are discussed. Author

N73-32959* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PROGRAM PLAN TO DEVELOP AIRWORTHINESS STANDARDS FOR STOL AIRCRAFT
Jack E. Cayot (FAA), Robert A. Chubboy (FAA), and Charles S. Hynes *In its* STOL Technol. 1972 p 345-351 refs

CSCL 01C

A program plan to develop criteria for airworthiness standards for STOL transport aircraft is presented. Initially, three different STOL concepts are to be examined with a goal to arrive at a generalized set of standards. The Breguet 941 deflected-slipstream STOL has been initially evaluated on a piloted motion simulator and in flight. Confidence in establishing criteria for airworthiness standards for STOL transport aircraft has been obtained from these studies. Author

N73-32961* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
QUIET STOL PROPULSION SESSION INTRODUCTORY REMARKS **c28**
Robert W. Schroeder *In its* STOL Technol. 1972 p 367-370

CSCL 20A

Research activities, preliminary design activities, and system optimization studies in support of the development of advanced, quiet, STOL propulsion systems are discussed. Noise alleviation by means of controlling the source and by means of acoustical treatment receive considerable emphasis. A STOL airplane designed for a given payload has essentially double the installed thrust of a comparable CTOL airplane. Unless compensated for during the design process, this alone will tend to increase the source noise by 3 db. The propulsive lift introduces flap impingement noise or duct and flap scrubbing noise, noise sources not present in CTOL airplanes to any significant degree. These

additional noise sources are illustrated. Depending on the specific configuration, this will tend to increase the noise by several db or more. Although the propulsive lift characteristics of STOL airplanes will tend to increase source noise significantly, the proximity of STOL airfields to populated areas leads to STOL noise objectives considerably lower than those currently applicable to CTOL airplanes. Author

N73-32962* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ENGINE NOISE TECHNOLOGY
Roger W. Luidens, Donald R. Dietrich, James H. Dittmar, Richard G. Goldman, William A. Olsen, Jr., and Brent A. Miller *In its* STOL Technol. 1972 p 371-412 refs

CSCL 21A

The characteristics of aircraft engine noise are discussed. Data are provided to show the noise produced by the following aircraft components: (1) fan noise, (2) noise suppressing structures, (3) sonic inlets, (4) jet mixing noise due to nozzle flow, and (5) thrust reversers. Charts are developed to show the sound pressure level and the frequencies for each type of noise source. The use of laminates and composite materials to dissipate acoustic power is examined. Author

N73-32963* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FLAP NOISE GENERATION AND CONTROL
David Chestnutt, Domenic J. Maglieri, and Richard E. Hayden (Bolt, Beranek and Newman, Inc.) *In its* STOL Technol. 1972 p 413-426 refs
CSCL 01A

The characteristics of aerodynamic noise generated by the interaction of an airstream with a flap surface are discussed. The location and behavior of various noise sources were investigated to determine optimal quieting techniques. A schematic diagram of the jet-flap concepts being considered for integrated-powered-lift systems for short takeoff aircraft is shown. Each of the concepts has in common high velocity turbulent air flowing over relatively rigid surfaces with resultant production of interaction noise. The nature, location, and control of noise sources which involve the interactions of air flows with airfoil surfaces are examined. Author

N73-32964* National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
EXTERNALLY BLOWN FLAP IMPINGEMENT NOISE
Paul L. Lasagna and Terrill W. Putnam *In its* STOL Technol. 1972 p 427-441 refs
CSCL 20A

Tests of the noise produced by the impingement of the jet exhaust on the wing and flap for an externally blown flap system were conducted with a CF700 turbofan engine and an F-111B wing panel. The noise produced with a daisy nozzle installed on the engine was greater than that produced by a conical nozzle at the same thrust. The presence of the wing next to the test nozzles increased the noise, as did increasing the flap deflection angle. Compared with the conical nozzle, the daisy nozzle produced slightly less noise at a flap deflection of 60 deg but produced more noise at the lower flap deflections tested. Tests showed that the single-slotted flap deflected 60 deg, produced less noise than the double-slotted flaps. Also, maintaining the maximum distance between the exit nozzle and flap system resulted in a minor reduction in noise. Author

N73-32965* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ACOUSTIC CHARACTERISTICS OF LARGE-SCALE STOL MODELS AT FORWARD SPEED
Michael D. Falarski (Army Air Mobility Res. and Develop. Lab.), Kiyoshi Aoyagi, and David G. Koenig *In its* STOL Technol. 1972 p 443-454 refs
CSCL 20A

Wind-tunnel investigations of the acoustic characteristics of the externally blown jet flap (EBF) and augmentor wing STOL concepts are discussed. The large-scale EBF model was equipped with a triple-slotted flap blown by four JT15D turbofan engines with circular, coannular exhaust nozzles. The large-scale augmentor wing model was equipped with an unlined augmentor blown by a slot primary nozzle. The effects of airspeed and angle of attack on the acoustics of the EBF were small. Flap deflection had a greater effect on the acoustics of the augmentor wing than did airspeed. The total sound power was also significantly higher for landing indicating that turning in the augmentor generated acoustic energy. Airspeed produced a small aft shift in acoustic directivity with no significant change in the peak perceived noise levels or sound power levels. Small-scale research of the acoustics for the augmentor wing has shown that by blowing an acoustically treated augmentor with a lobed primary nozzle, the 95-PNdb noise level goal can be achieved or surpassed. Author

N73-32966* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EBF NOISE TESTS WITH ENGINE UNDER-THE-WING AND OVER-THE-WING CONFIGURATIONS
Robert G. Dorsch and Meyer Reshotko *In its* STOL Technol. 1972 p 455-473
CSCL 20A

Noise tests of externally blown flaps with the engine under the wing and engine over the wing configurations were conducted. Flap noise data obtained on a TF-34 aircraft are discussed. Noise data obtained during a free-jet forward-speed-effect analysis are presented. Noise sources associated with upper surface flap blowing are described. Results of a small scale configuration screening study and some large scale model test data are analyzed. The noise data for the engine over wing configurations are compared with the engine under the wing configurations. Author

N73-32967* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STOL PROPULSION SYSTEMS
Robert J. Denington, Robert W. Koenig, Michael R. Vanco, and David A. Sagerser *In its* STOL Technol. 1972 p 475-509 ref
CSCL 21A

The selection and the characteristics of quiet, clean propulsion systems for STOL aircraft are discussed. Engines are evaluated for augmentor wing and externally blown flap STOL aircraft with the engines located both under and over the wings. Some supporting test data are presented. Optimum engines are selected based on achieving the performance, economic, acoustic, and pollution goals presently being considered for future STOL aircraft. The data and results presented were obtained from a number of contracted studies and some supporting NASA inhouse programs, most of which began in early 1972. The contracts include: (1) two aircraft and mission studies, (2) two propulsion system studies, (3) the experimental and analytic work on the augmentor wing, and (4) the experimental programs on Q-Fan. Engines are selected and discussed based on aircraft economics using the direct operating cost as the primary criterion. This cost includes the cost of the crew, fuel, aircraft, and engine maintenance and depreciation. Author

N73-32968*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

FORWARD VELOCITY EFFECTS ON JET NOISE WITH DOMINANT INTERNAL NOISE SOURCE

U. VonGlahn and J. Goodykoontz 1973 17 p refs Presented at 86th Meeting of Acoustical Soc. of Am., Los Angeles, 30 Oct. - 2 Nov. 1973

(NASA-TM-X-71438; E-7694) Avail: NTIS HC $3.00 CSCL 20A

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

N73-32969*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

FLAP NOISE PREDICTION METHOD FOR A POWERED LIFT SYSTEM

B. Clark, R. Dorsch, and M. Reshotko 1973 15 p refs Presented at the Aero-Acoustic Specialists Conf., Seattle, 15-17 Oct. 1973; sponsored by AIAA

(NASA-TM-X-71449; E-7717) Avail: NTIS HC $3.00 CSCL 20A

A method is presented for estimating the noise generated by deflection of the engine exhaust for under-the-wing and over-the-wing versions of an externally blown flap configuration for powered lift. Correlation equations and curves are given for the overall sound pressure level and directivity and for spectra scaled to a high bypass 25,000-pound thrust size engine. Data are taken from TF34 engine tests and from large cold flow model tests. The correlations are empirical, and thus application of this prediction procedure is limited to geometrically similar configurations. Application of the method is illustrated by calculated sample footprints. Author

N73-32970*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A FLIGHT STUDY OF THE USE OF DIRECT-LIFT-CONTROL FLAPS TO IMPROVE STATION KEEPING DURING IN-FLIGHT REFUELING

Walter E. McNeill, Ronald M. Gerdes, Robert C. Innis, and Jack D. Ratcliff Washington Oct. 1973 30 p refs

(NASA-TM-X-2936; A-4904) Avail: NTIS HC $3.00 CSCL 01C

To investigate the effectiveness of fast-acting flaps as direct-lift-control (DLC) devices on a fighter airplane, the aileron servo systems of an F-100C variable-stability airplane were modified to provide symmetrical actuation of the surfaces. Initial flight tests using DLC indicated that the task of formation flying and, hence, in-flight refueling could be eased by actuating the DLC flaps through the conventional control stick, with the degree of improvement depending on the basic stability of the receiver aircraft. Results of refueling approaches and connections with U.S. Air Force tankers indicated a moderate overall improvement in vertical station-keeping performance (approximately 19 percent) and a sizeable overall decrease in receiver airplane motions and control activity (approximately 40 percent) with DLC. Author

N73-32971# Boeing Commercial Airplane Co., Seattle, Wash.

THE 727 NOISE RETROFIT FEASIBILITY. VOLUME 3: UPPER GOAL FLIGHT TESTING AND PROGRAM SUMMARY Final Report, Jul. 1971 - Dec. 1972

D. L. Hiatt and M. B. McKaig Jun. 1973 232 p refs (Contract DOT-FA71WA-2637)

(FAA-RD-72-40-Vol-3; D6-60196-Vol-3) Avail: NTIS HC $13.75

Modifications performed on a Boeing 727 aircraft to obtain reduced aerodynamic noise are discussed. Level flyovers covering a wide range of thrusts and altitudes were recorded with a widely spaced microphone grid for the study of long range noise propagation. Acoustic, propulsion, and aerodynamic performance analyses were made, along with the physical effects of integrating the modifications on the aircraft. A direct operating cost analysis was prepared based on realistic retrofit installation cost estimates and aircraft performance analyses. Author

N73-32972# Federal Aviation Administration, Washington, D.C.

INTERRELATIONSHIP OF FAA-DOT-NASA PROGRAMS RELATING TO AIRCRAFT CABIN MATERIALS FIRE

Colin G. Simpson Sep. 1973 21 p refs

(FAA-RD-73-146) Avail: NTIS HC $3.25 CSCL 01C

Aircraft cabin materials fire hazards consisting of flammability, smoke emission, toxic gas emission and flash fire are discussed together with the work ongoing pertinent to these hazards by the FAA and other DOT administrations and the NASA. The relationships among these efforts are considered together with funding estimates for FY 1974. Author

N73-32973*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

WIND TUNNEL INVESTIGATION OF A LARGE-SCALE UPPER SURFACE BLOWN-FLAP TRANSPORT MODEL HAVING TWO ENGINES

Kiyoshi Aoyagi, Michael D. Falarski, and David G. Koenig Aug. 1973 69 p refs Prepared in cooperation with Army Air Mobility R and D Lab., Moffett Field, Calif.

(NASA-TM-X-62296) Avail: NTIS HC $5.50 CSCL 01C

An investigation has been conducted to determine the aerodynamic characteristics of a large-scale subsonic jet transport model with an upper surface blowing flap system that would augment lift. The model had a 25 deg swept wing of aspect ratio 7.89 and two turbofan engines with the engine centerline located at 0.256 of the wing semispan. The lift of the flap system was augmented by turbofan exhaust impingement on the Coanda surface. Results were obtained for several flap deflections and engine nozzle configurations at jet momentum coefficients from 0 to 4.0. Three-component longitudinal data are presented with two engines operating. Limited longitudinal and lateral data are presented with an engine out. In addition, limited exhaust and flap pressure data are presented. Author

N73-32974*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

WIND TUNNEL TESTS OF AN F-8 AIRPLANE MODEL EQUIPPED WITH AN OBLIQUE WING

Lawrence A. Graham, Robert T. Jones, and James L. Summers Jun. 1973 72 p refs

(NASA-TM-X-62273) Avail: NTIS HC $5.75 CSCL 01C

An experimental investigation was conducted in an 11- by 11-foot transonic wind tunnel to study the lift, drag and stability characteristics of a 0.087-scale model of an operational airplane fitted with an oblique wing. The model wing was of elliptical planform with an unswept aspect ratio of 12.7 and a thickness of 10 percent. All other external geometric features of the model were scaled to the basic full size operational airplane with the engine inlet faired closed. Longitudinal and lateral-directional stability data were obtained with the wing at sweep angles of 0 deg, 45 deg and 60 deg Test Mach numbers ranged from

0.6 to 1.4 deg Angles of attack were between minus 4 deg and 8 deg at zero sideslip. Angles of sideslip were between plus and minus 4 degrees for two angles of attack depending upon the wing configuration. Tests were conducted at a Reynolds number of 6 million per foot except for a few runs when balance capacity limited the Reynolds number to 4 million per foot.
Author

N73-32975*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NOISE MEASUREMENTS FROM A LARGE-SCALE LIFT FAN TRANSPORT IN THE 40- BY 80-FOOT WIND TUNNEL
Adolph Atencio, Jr. (Army Air Mobility R and D Lab.) Mar. 1973 77 p refs
(NASA-TM-X-62284) Avail: NTIS HC $6.00 CSCL 01C

Noise data measurements from a large scale lift fan transport model aircraft were made in the 40- by 80-foot wind tunnel. The model had two lift fans in deep inlets in the forward fuselage and two lift-cruise fans in pods on the aft fuselage. The noise data measurements are presented as listings and plots of sounds pressure level versus 1/3-octave center frequency. Author

N73-32976*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THEORETICAL STUDY OF LIFT GENERATED VORTEX SHEETS DESIGNED TO AVOID ROLL UP
Vernon J. Rossow Sep. 1973 39 p refs
(NASA-TM-X-62304) Avail: NTIS HC $4.00 CSCL 01A

The random motions of the vortex elements behind a wing that sheds a disturbed, translating array of vortices are analyzed. The analysis indicates that the wake would diffuse and decay rapidly when viscosity is present and would produce small rolling moments on encountering aircraft. It was found that comparable results could also be achieved with an array consisting of vortices that are equal in magnitude but which alternate in sign. This observation indicates that random motion can probably be achieved with a variety of stepped loadings. Author

N73-32977*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
A STUDY OF RAPID ENGINE RESPONSE SYSTEMS FOR AN ADVANCED HIGH SUBSONIC, LONG RANGE COMMERCIAL AIRCRAFT
J. H. Barber, G. W. Bennett, and T. A. DeRosier Oct. 1973 43 p refs
(Contract NAS3-15544)
(NASA-CR-134496; R73AEG121) Avail: NTIS HC $4.25 CSCL 01C

A dynamic model representing the characteristics of an advanced technology study engine (1985 certification time period) was constructed and programmed on an analogue/digital computer. This model was then exercised to study and evaluate a large number of techniques, singly and in combination, to improve engine response. Several effective methods to reduce engine accelerating time are identified. Author

N73-32978 Deutsche Gesellschaft fuer Luft- und Raumfahrt, Cologne (West Germany).
FLIGHT CONTROL SYSTEMS: REQUIREMENTS AND DESIGN PROBLEMS FROM THE FLIGHT MECHANICS VIEWPOINT [FORDERUNGEN AN FLUGREGELANLAGEN UND AUSLEGUNGSPROBLEME UNTER BESONDERER BERUECKSICHTIGUNG DER FLUGMECHANIK]
Mar. 1972 209 p refs In GERMAN; ENGLISH summary
Proc. of the DGLR Flight Characteristics and Flight Control Panels Meeting, Immenstaad, West Ger., 28-29 Oct. 1971
(DLR-MITT-72-05) Avail: NTIS HC $12.50; ZLDI, Munich 43,90 DM

The application of artificial stabilizing devices to particular cases of instability in flight control is discussed. Based on a unified point of view, basically possible feedback control concepts were derived for aircraft with variable stability. The optimization of a control and damping system for fighter aircraft is described. The specification of a thrust control system for the Airbus A300B is presented. The role of an airborne computer in digital flight control systems is detailed. The DO-31 V/STOL aircraft's control system for vertical velocity regulation is described. The flight control system of the VAK 191 B VTOL fighter aircraft is presented. The design optimization of the flight control systems for light helicopters is exemplified by the BO-105 helicopter. Some effects of artificial stability control are reviewed.

N73-32979 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer Dynamik der Flugsysteme.
NONLINEAR CONTROL CONCEPTS FOR VARIABLE STABILITY AIRCRAFT [NICHTLINEARE REGLERKONZEPTE FUER FLUGZEUGE VARIABLER STABILITAET]
G. Gruebel (Bochum Univ., West Ger.) *In* DGLR Flight Control Systems: Requirements and Design Probl. from the Flight Mech. Viewpoint Mar. 1972 p 7-16 In GERMAN

Based on a unified point of view, the basically possible feedback control concepts for aircraft with variable stability are derived and discussed. Treatment is limited to the general nonlinear case; the treatment of a linearized state for stationary flight results as a special case. It is shown that as the basis of the general nonlinear equations of motion of a reference aircraft and a model, the possible control structures can be simply derived, in which process the related control laws are determined by nonlinear equation systems. ESRO

N73-32980 Bodenseewerk Geraetetechnik G.m.b.H., Ueberlingen (West Germany).
DESIGN OF A MODERN FIGHTER AIRCRAFT CONTROL SYSTEM USING QUADRATIC COST FUNCTIONS [AUSLEGUNG EINES REGELSYSTEMS FUER MODERNE KAMPFFLUGZEUGE MIT HILFE QUADRATISCHER KOSTENFUNKTIONEN]
G. Schaenzer and R. Stadler *In* DGLR Flight Control Systems: Requirements and Design Probl. from the Flight Mech. Viewpoint Mar. 1972 p 17-36 refs In GERMAN

The optimization of a control and damping system for fighter aircraft is discussed. Essential specifications, such as gust and flight control behavior, and stability, can be described exactly by a single quadratic integral quality criterium (cost function). It is shown that the controller, optimized for minimal costs, gives an especially favorable performance related to flight control, disturbance, stability and parameter sensitivity. The investigation of parameter sensitivity produced indications for technical simplification of the control system structure. ESRO

N73-32981 Bodenseewerk Geraetetechnik G.m.b.H., Ueberlingen (West Germany).
DESIGN PROBLEMS OF THE AIRBUS A 300 B FORWARD THRUST REGULATOR [PROBLEME BEI DER AUSLEGUNG DES VORTRIEBSREGLERS FUER DEN AIRBUS A 300 B]
P. Wuest and H. D. Buchholz *In* DGLR Flight Control Systems: Requirements and Design Probl. from the Flight Mech. Viewpoint Mar. 1972 p 37-70 refs In GERMAN

The specification of a thrust control system for the Airbus A 300 B is discussed. This sub-system of the automatic pilot is a

further development of a similar system tested in a Lufthansa Boeing 707. The sub-system is to control the flight speed in relation to indicated air speed by operating the throttle. The following points are discussed: in the absence of disturbances, a specified flight speed should be reached; the system should be stable; when flying through gusts, throttle activity should not exceed a certain limit; in the case of wind shear the flight deviation should not exceed a certain limit; in the case of configuration changes, e.g. in lowering flaps or undercarriage, the flight deviation should not exceed a certain limit. ESRO

N73-32982 Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
PROBLEMS OF AIRBORNE COMPUTER AIDED DIGITAL CONTROL SYSTEMS [BEITRAEGE ZUR PROBLEMATIK VON BORDRECHNERGESTUETZTEN DIGITALEN REGELUNGSSYSTEMEN]
E. Kienzle and G. Schweizer *In* DGLR Flight Control Systems: Requirements and Design Probl. from the Flight Mech. Viewpoint Mar. 1973 p 71-95 In GERMAN

The role of an airborne computer in digital flight control systems is discussed. The following problems in the design of such a system are detailed: (1) models of the processes to obtain adaptive properties in each separate phase, and desired flight characteristics by adaptive behavior in all flight phases; (2) integrated information presentation for observation of control and surveillance problems by the human operator; (3) integration of the operator in the total system; and (4) integration of the onboard computer in the total system. ESRO

N73-32983 Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
PROBLEMS OF AN INTEGRATED FLIGHT CONTROL AND REGULATION SYSTEM FOR LIFT FAN/VSTOL AIRCRAFT TAKING THE DO-31 VERTICAL VELOCITY REGULATOR AS AN EXAMPLE [ERLAEUTERUNG DER PROBLEME EINER INTEGRIERTEN FLUGSTEUERUNGS- UND REGELUNGSANLAGE FUER HUBBLAESER-VSTOL-FLUGZEUGE AM BEISPIEL DES DO 31-VERTIKALGESCHWINDIGKEITSREGLERS]
K. Daser *In* DGLR Flight Control Systems: Requirements and Design Probl. from the Flight Mech. Viewpoint Mar. 1972 p 97-110 In GERMAN

The DO-31 V-STOL aircraft's integrated flight control system for vertical velocity regulation is discussed for the gliding and transition phase, as these phases have the highest requirements with regard to performance and reliability. It was found that in augmenting the demands on the flight control system of a VTOL aircraft, the signal processing effort increases. As long as the maximal hand forces of the pilot determine the force level to be processed, a mechanical signal processing will be the main contribution in weight to the control system. A remedy would be mechanical signal processing at low force level, something similar to servo control, or electrohydraulic control with electric signal processing. ESRO

N73-32984 Vereinigte Flugtechnische Werke-Fokker G.m.b.H., Bremen (West Germany).
THE VAK 191 B FLIGHT CONTROL SYSTEM AND RESULTING NEW DEVELOPMENTS FOR THE NEXT V/STOL FIGHTER AIRCRAFT GENERATION [DAS REGELUNGSSYSTEM DER VAK 191 B UND DARAUS RESULTIERENDE NEUERE ENTWICKLUNGEN FUER DIE NAECHSTE GENERATION VON V/STOL-KAMPFFLUGZEUGEN]
H.-H. VonSalzen and W. Sobotta *In* DGLR Flight Control Systems: Requirements and Design Probl. from the Flight Mech. Viewpoint Mar. 1972 p 111-144 refs In GERMAN

The flight control system of the VAK 191 B VTOL fighter aircraft for gliding and transition flight phases, based on nonlinear feedback, is discussed. The main problems in flight control are unclearly defined requirements of the relation between aircraft and control systems, the mostly nonlinear parameter variations of the control circuit with the application conditions, and the desired high reliability of the system. The VAK 191 B is used as an example to show possible solutions to these problems. A parameter insensitive controller for a supersonic aircraft, as well as a parameter sensitive controller, are described. The problems of redundant systems and the related error disparity are touched upon. For all solutions, applicability to existing specifications is discussed. ESRO

N73-32985 Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).
DESIGN OPTIMIZATION AND TESTING OF FLIGHT CONTROL SYSTEMS FOR LIGHT HELICOPTERS [OPTIMALE AUSLEGUNG UND ERPROBUNG VON FLUGREGELUNGSSYSTEMEN FUER LEICHTE HUBSCHRAUBER]
Herbert Koenig *In* DGLR Flight Control Systems: Requirements and Design Probl. from the Flight Mech. Viewpoint Mar. 1972 p 145-170 refs In GERMAN

Based on the flight dynamic properties of the BO-1-5 helicopter with hingeless rotor, characterized by very good controllability, the influence over several controller concepts was investigated. Flight control systems consisting of a fast controller (with authority limitation of the regulating distance) as attitude stabilizers, and a slow controller as automatic trimmers (with limitation of the regulating speed), were found to be the optimal controller concepts for this type of helicopter. A further optimal concept results from addition of an altitude control, which includes the trimmer system. The investigations and tests have shown that, with relatively little effort, pilot activity can be considerably simplified. ESRO

N73-32986 Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).
EFFECT OF ARTIFICIAL STABILITY ON AIRCRAFT PERFORMANCES [EINFLUSS DER KUENSTLICHEN STABILITAET AUF DIE FLUGLEISTUNGEN]
D. Reich *In* DGLR Flight Control Systems: Requirements and Design Probl. from the Flight Mech. Viewpoint Mar. 1972 p 171-186 In GERMAN

Based on the control configured vehicle (CCV) concept, i.e. taking account of the flight control during the design phase, the effect of an artificial longitudinal stability on the performance of aircraft was investigated. In consequent application of the CCV concept, in the most favorable cases a decrease of about 15% in takeoff weight (for the same radius of action) or an increase of 11% in radius of action (for the same takeoff weight) can be achieved. For a fighter aircraft, it is shown that the advantages of an artificial longitudinal stability are obtained for high lift coefficients and for plane wing-body drag polars. ESRO

N73-32987 Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).
FLIGHT MECHANICAL AND CONTROL TECHNICAL CONSIDERATIONS OF ARTIFICIAL STABILITY AIRCRAFT [FLUGMECHANISCHE UND REGELUNGSTECHNISCHE GESICHTSPUNKTE FUER FLUGZEUGE KUENSTLICHER STABILITAET]
G. K. Kissel *In* DGLR Flight Control Systems: Requirements

and Design Probl. from the Flight Mech. Viewpoint Mar. 1972 p 187-196 In GERMAN

The effects of artificial aircraft stability control on the damping behavior, and the recovery of static stability by means of controllers, are discussed. In designing aircraft the rule that static stability should be available to obtain airworthiness is of major importance. If this rule is not maintained, a reduction of the induced trimming resistance and an increased maneuverability performance can be gained. Airworthiness should then be regained artificially using flight controllers. The improvements obtained in damping behavior are described, and the possibilities of regaining static stability are surveyed. ESRO

N73-32988 Bodenseewerk Geraetetechnik G.m.b.H., Ueberlingen (West Germany).

BASIC TECHNICAL DESIGN OF THE CONTROL SYSTEM FOR AN ARTIFICIAL STABILITY AIRCRAFT [GRUNDSAETZLICHER TECHNISCHER ENTWURF DES STEUERUNGSSYSTEMS FUER EIN FLUGZEUG MIT KUENSTLICHER STABILITAET]

L. Goumas *In* DGLR Flight Control Systems: Requirements and Design Probl. from the Flight Mech. Viewpoint Mar. 1972 p 197-209 In GERMAN

The fundamental design of a pitching axis control system for aircraft with artificial stability is discussed. This control system is based on the measurement of the angular deviation with an air current directional sensor. In order to prevent sensor failures and for consolidation of signals with disparities, the outputs of the air current directional sensor are blocked with supervisory circuits. The produced feedback signal was compared with the control branch signal, and the difference signal passed on to the pitch controller. A hydraulic actuator on the horizontal tail surface closes the feedback circuit. ESRO

N73-32989# Deutsche Gesellschaft fuer Luft- und Raumfahrt, Cologne (West Germany).

[AIRSHIPS: PAST, PRESENT, AND FUTURE] [BERICHT UEBER DAS LUFTSCHIFF-KOLLOQUIUM DER DGLR]

Aug. 1972 172 p refs In GERMAN; ENGLISH summary Proc. of the DGLR Airship Colloq., Stuttgart, 6 Apr. 1972 (DLR-MITT-72-17) Avail: NTIS HC $10.75; ZLDI, Munich 36.15 DM

The technical and economic aspects of using airships for air transportation are discussed. The history of Zeppelin airships is presented. The cost effectiveness of airship passenger and freight transportation is analyzed. Details of the manufacture of flexible airships are presented and ground and loading operations surveyed. The aerodynamic drag and lift of airships is determined; and drag reduction possibilities discussed. The technical conditions for further airship development, based on present technology, are summarized.

N73-32990 Deutsche Gesellschaft fuer Luft- und Raumfahrt, Cologne (West Germany).

THE ZEPPELIN AIRSHIP, INITIATOR OF WORLD AIR TRAFFIC [ZEPPELIN, WEGBEREITER DES WELTLUFTVERKEHRS]

Hans VonSchiller *In its* Airships, Past, Present, and Future Aug. 1972 p 11-25 In GERMAN

The history of Zeppelin airships is presented. The first Zeppelin dirigible flew for 18 minutes on July 1, 1900. The airship was used for civil and military aviation, the latter particularly during World War I. After World War I, the Zeppelin was introduced in the United States, and an Atlantic Ocean crossing was made in 1929. Civil flights to South America were interrupted after the catastrophe of the Hindenburg during the landing of the Graf Zeppelin in Friedrichshafen on 8 May 1937, as a result of which hydrogen gas filling was replaced by nonflammable helium. ESRO

N73-32991 Deutsche Studiengemeinschaft fuer Luftschiffahrt, Frankfurt am Main (West Germany).

POSSIBILITIES OF AND PROSPECTS FOR PASSENGER AND FREIGHT TRANSPORT BY AIRSHIPS [MOEGLICHKEITEN UND AUSSICHTEN EINES PERSONEN- UND GUETERTRAN SPORTS MIT LUFTSCHIFFEN]

Eckart Krueger *In* DGLB Airships: Past, Present, and Future Aug. 1972 p 27-39 In GERMAN

The possibilities and perspectives of using airships for air transportation of passengers and cargo are discussed. Three conditions for successful realization of this concept are: (1) technical realization should be possible, (2) the level of costs involved in construction, manufacturing, and management should allow a selling price leading to a corresponding sales success, and (3) the new product should fit in to the broad spectrum of present offers, and have certain advantages. An important aspect is environment pollution, to which these airships will contribute little. Long-distance flights are seen as the best use because of the airship's hotel-like character. ESRO

N73-32992 Wuellenkemper (Theodor) KG, Mulheim/Ruhr (West Germany).

AIRSHIP MANUFACTURE IN MUELHEIM/RUHR [LUFTSCHIFFBAU IN MUELHEIM/RUHR]

Theodor Wuellenkemper *In* DGLR Airships: Past, Present, and Future Aug. 1972 p 41-48 In GERMAN

Details concerning the manufacture of flexible airships 60 m in length and with a helium gas filling of 6000 cubic m are presented. These airships are to be used for transport of goods, especially in countries with bad roads. The payloads are between 2 and 2.5 tons. ESRO

N73-32993 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Zentralabteilung Luftfahrttechnik.

TECHNICAL ASPECTS OF AIRSHIP MANUFACTURE AND OPERATIONS [EINIGE TECHNISCHE FRAGEN ZUM LUFTSCHIFFBAU UND -BETRIEB]

E. Urbatzka *In* DGLR Airships: Past, Present, and Future Aug. 1972 p 49-66 refs In GERMAN

Some technical aspects of airship manufacture and ground and loading operations are dealt with. Details of possible carrier gases, and altitude control methods are reviewed. Ground handling and freighting operations are discussed. ESRO

N73-32994 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany). Inst. fuer Angewandte Gasdynamik.

PROBLEMS OF AIRSHIP AERODYNAMICS [PROBLEME DER LUFTSCHIFF-AERODYNAMIK]

D. G. Papanikas *In* DGLR Airships: Past, Present, and Future Aug. 1972 p 67-113 refs In GERMAN; ENGLISH summary

The possibilities of determining aerodynamic drag and lift on airships by means of known methods for aircraft aerodynamics were investigated. The effectiveness of boundary layer control by means of suction, and some propulsion problems are considered. On the basis of information gathered from an airship literature survey, speed and propulsion power ranges are discussed and compared with those of transport aircraft. ESRO

N73-32995 Deutsche Gesellschaft fuer Luft- und Raumfahrt, Cologne (West Germany).
TECHNICAL CONDITIONS FOR A RESTART IN AIRSHIP TECHNOLOGY [TECHNISCHE VORAUSSETZUNGEN FUER EINEN NEUEN START IN DER LUFTSCHIFFTECHNIK]
Wolfgang VonKirschbaum *In its* Airships, Past, Present, and Future Aug. 1972 p 115-172 In GERMAN

The technical conditions for the development of airships are summarized. The following main points are taken as a background: low structural weight by using carefully optimized modern light construction methods, lightweight propulsion systems with low consumption based on the state-of-the-art of propulsion system technology, and improved maneuverability from stationary and dynamic points of view. ESRO

N73-32996# Lockheed-California Co., Burbank.
EXPERIMENTAL PROGRAM FOR THE DEVELOPMENT OF IMPROVED HELICOPTER STRUCTURAL CRASHWORTHINESS ANALYTICAL AND DESIGN TECHNIQUES. VOLUME 1: COMPUTERIZED UNSYMMETRICAL MATHEMATICAL SIMULATION AND EXPERIMENTAL VERIFICATION FOR HELICOPTER CRASHWORTHINESS IN WHICH MULTIDIRECTIONAL IMPACT FORCES ARE PRESENT Final Technical Report
Gilbert Wittlin and Max A. Gamon May 1973 224 p refs
(Contract DAAJ02-71-C-0066; DA Proj. 1F1-62203-A-529)
(AD-764985; USAAMRDL-TR-72-72A-Vol-1) Avail: NTIS CSCL 01/2

The results of a four-phase study to develop helicopter structural crashworthiness analytical and design techniques are presented. The study consisted of the development of a computer program (KRASH) and the verification of a mathematical model to predict the dynamic response during a survivable accident in which combined vertical and lateral impact velocities are present. Included in the study were a literature survey and evaluation, a detailed analysis of 32 accident cases, a drop test of a UH-1H helicopter with ground impact conditions of 23 fps vertical velocity and 18.6 fps lateral velocity, and parameter studies. It is concluded that program KRASH is capable of accurately predicting the dynamic responses during a multi-directional accident and that the program is a valuable tool with which to perform design tradeoff studies. (Modified author abstract) GRA

N73-32998# Deutsche Gesellschaft fuer Luft- und Raumfahrt, Cologne (West Germany).
ELECTRONIC DISPLAYS IN AIRCRAFT PILOTING [ELEKTRONISCHE DISPLAYS IN DER FLUGFUEHRUNG]
Jul. 1972 42 p refs In GERMAN; ENGLISH summary Presented at the 12th DGLR Comm. Meeting on Human Factors Engineering, Meckenheim, West Ger., 5 Nov. 1971
(DLR-MITT-72-04) Avail: NTIS HC $4.25; ZLDI, Munich 8.65 DM

Two problems are discribed in the application of electronic display systems to aircraft. The first problem is that of reinforcing the pilot's activity during fully automatic landings; this can be solved by four tasks for advanced displays, whether used for manual control or as a monitor device in automatic landings. The second is the use of predictive displays for manual path and position control of VTOL aircraft. Two displays are discussed and have been tested: an overground display for path control, and an artificial horizon for position control.

N73-32999 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany).
POINTS OF VIEW FOR THE INFORMATION DISPLAY IN AIRCRAFT [GESICHTSPUNKTE FUER DIE INFORMATIONSDARSTELLUNG IN FLUGZEUGEN]
V. Wilckens *In* DGLR Electron. Displays in Aircraft Piloting Jul. 1972 p 7-21 refs In GERMAN; ENGLISH summary

The problem of reinforcing the pilot's activity during fully automatic landings is discussed. The human problem in all-weather landings is analyzed with particular reference to consideration to a larger extent of the real abilities and weaknesses of human beings. Four tasks are discussed which should be fulfilled by advanced displays, whether they are used for manual control or as a monitor device in automatic landings. ESRO

N73-33000 Forschungsinstitut fuer Anthropotechnik, Meckenheim (West Germany).
USE OF PREDICTIVE DISPLAYS IN THE MANUAL PATH AND POSITION CONTROL OF VTOL AIRCRAFT [DER EINSATZ VON VORANZEIGEN BEI DER MANUELLEN KURS- UND LAGEREGELUNG VON VTOL-FLUGZEUGEN]
G. Johannsen *In* DGLR Electron. Displays in Aircraft Piloting Jul. 1972 p 23-33 refs In GERMAN

The role of prediction displays for manual control of VTOL aircraft is discussed. The systems investigated are based on the extrapolative method of prediction, and two-parameter control. Two displays are discussed; an overground display for path control, and an artificial horizon for position control both for a simulated VTOL aircraft. A number of tests were carried out to determine the effectiveness of these prediction displays. Results of the overground display show that because of the control task difficulty, the learning phase should last a few days. In the case of the artificial horizon, a clear reduction of the control errors is found by using the predictive display. ESRO

N73-33157# School of Aerospace Medicine, Brooks AFB, Tex.
A CRITICAL ASSESSMENT OF GROUND-BASED DEVICES FOR SPATIAL ORIENTATION TRAINING Preliminary Report, Sep. 1972 - Apr. 1973
Patrick J. Dowd Aug. 1973 18 p refs
(AF Proj. 7930)
(AD-764740; SAM-TR-73-23) Avail: NTIS CSCL 05/9

Comparisons are made of selected orientation training devices in relation to U.S. Air Force flight training in the T-38 airplane. Assessment categories are: motion parameters, illusions that each device can generate, type of instrumentation available to the pilot-subject in relation to attitude and control, reaction capability provided in each device for the subject to recover or correct his attitude, capability to measure and evaluate the subject's performance in coping with disorienting maneuvers, invulnerability to weather, safety, and initial and operating costs. The USAFSAM spatial orientation trainer (SOT) far excels all other ground-based devices for both hardware- and pilot-oriented assessment criteria. The use and need of a SOT-type trainer are discussed. Author (GRA)

N73-33170 Minnesota Univ., Minneapolis.
THE FLUID MECHANICS OF THE HOLE TONE Ph.D. Thesis
Ram Kumar Matta 1973 171 p
Avail: Univ. Microfilms Order No. 73-18133

The hole tone is a whistle which has been empirically developed as an efficient producer of discrete frequency sound. Two parallel plates with an orifice in each are situated a short distance apart. The jet formed by fluid flow through one orifice impinges centrally on the second orifice and, under certain conditions, gives rise to a pure tone. The sound is aerodynamically generated. The mechanism involves symmetric disturbances of the jet and vortex ring formation in the vortex sheet surrounding the free jet. A model is postulated to show how the energy of a free jet is converted into acoustically radiated energy. According to the model, a periodic disturbance is imposed on

the jet at exit from the upstream orifice, resulting in the formation of a vortex ring street. The rings propagate downstream and interact with the second orifice-plate giving rise to a periodic flow through the orifice. This unsteady flow is the source of sound and also provides the perturbation at the upstream orifice which triggers the instability of the jet. The analytic model is found to correctly predict the qualitative characteristics of the hole tone and quantitative characteristics such as the tone frequency and pressure amplitude. Dissert. Abstr.

N73-33174 Johns Hopkins Univ., Baltimore, Md.
EXPERIMENTS ON THE NEARLY ISOTROPIC TURBULENCE BEHIND A JET GRID Ph.D. Thesis
Mohamed Abo-El-Fath Mohamed Gad-El-Hak 1973 231 p
Avail: Univ. Microfilms Order No. 73-16642

Wind tunnel turbulence behind a parallel rod grid with jets evenly distributed along each rod is nearly isotropic. Homogeneity improvement over prior related experiments was attained by the use of controllable nozzles. Compared with the passive case, the downwind-jet active grid gives smaller static pressure drop across it and smaller turbulence level at a prescribed distance from it, while the upwind-jet grid gives larger static pressure drop and larger turbulence level. Counterflow injection apparently increases the effective solidity, causing instability, larger turbulent energy and larger scales. If the inverse turbulent kinetic energy is approximated as a power law of distance, the exponent decreases with increasing downwind or upwind jet strength, corresponding to slower decay rates. No peculiar decay behavior occurs when the grid is self-propelled (net average force on it = 0), or when the static pressure drop across it is zero. The injection does not change the general behavior of the energy spectra although the absolute spectra changes in as much as the turbulence kinetic energy changes. Dissert Abstr.

N73-33179*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ASSESSMENT OF JETS AS ACOUSTIC SHIELDS BY COMPARISON OF SINGLE- AND MULTITUBE SUPPRESSOR NOZZLE DATA
Vernon H. Gray, Orlando A. Gutierrez, and David Q. Walker 1973 21 p refs Presented at the Aeroacoustic Specialists Conf., Seattle, 15-17 Oct. 1973; sponsored by AIAA
(NASA-TM-X-71450; E-7690) Avail: NTIS HC $3.25 CSCL 20D

Recent 1/4 scale and engine size nozzle acoustic data, for both 37-tube and single nozzles, were used to test the jet-shielding principle. At low jet velocities the multitube nozzle total sound power approaches the equivalent of 37 single tubes (no shielding), while near-sonic and above, the small equivalent number of single tubes compares well with a geometric model of lateral radiation from only about a third of the circumference of the outer jets (nearly complete shielding). At high jet velocities, the geometric shielding hypothesis is in excellent agreement with acoustic data from which the downstream coalesced jet noise is excluded. Present results are compared with an existing correlation for single jets, and with previous publications on multijet shielding. Author

N73-33181*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ON THE RELATIONSHIP BETWEEN ACOUSTIC ENERGY DENSITY FLUX NEAR THE JET AXIS AND FAR FIELD ACOUSTIC INTENSITY
Lucio Maestrello Washington Oct. 1973 64 p refs
(NASA-TN-D-7269; L-8871) Avail: NTIS HC $3.00 CSCL 20D

By measurement and analysis, the relationship between the distribution of the outflow of acoustic energy over the jet boundary and the far-field intensity is considered. The physical quantity used is the gradient of the pressure evaluated on a geometrical plane at the smallest possible radial distance from the jet axis, but outside the vortical region, in the area where the homogeneous wave equation is reasonably well satisfied. The numerical and experimental procedures involved have been checked out by using a known source. Results indicate that the acoustic power output per unit length of the jet, in the region from which the sound emanates, peaks at approximately 9 diameters downstream. The acoustic emission for a jet Strouhal number of about 0.3 exceeds the emission for all other Strouhal numbers nearly everywhere along the measurement plane. However, the far-field peak intensity distribution obtained from the contribution of each station was found to depend on the spatial extent of the region where sound emanates from the jet, which, in turn, depends more on the far-field angle than on the Strouhal number Author

N73-33184*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CALCULATION PROCEDURES FOR POTENTIAL AND VISCOUS FLOW SOLUTIONS FOR ENGINE INLETS
J. A. Albers and N. O. Stockman [1973] 34 p refs Proposed for presentation at 1974 Intern. Gas Turbine Conf., Zurich, 31 Mar. - 4 Apr. 1974; sponsored by ASME
(NASA-TM-X-71457) Avail: NTIS HC $3.75 CSCL 20D

The method and basic elements of computer solutions for both potential flow and viscous flow calculations for engine inlets are described. The procedure is applicable to subsonic conventional (CTOL), short-haul (STOL), and vertical takeoff (VTOL) aircraft engine nacelles operating in a compressible viscous flow. The calculated results compare well with measured surface pressure distributions for a number of model inlets. The paper discusses the uses of the program in both the design and analysis of engine inlets, with several examples given for VTOL lift fans, acoustic splitters, and for STOL engine nacelles. Several test support applications are also given. Author

N73-33185# Royal Aircraft Establishment, Farnborough (England).
THE KUTTA-JOUKOWSKY CONDITION IN THREE DIMENSIONAL FLOW
Robert Legendre Jul. 1973 22 p refs Transl. into ENGLISH from Rech. Aerosp. (France), v. 5, 1972 p 241-248 Presented at 13th Congr. of IUTAM, Moscow, Aug. 1972
(RAE-Lib-Trans-1709; BR36990) Avail: NTIS HC $3.25

The separation line along which a vortex sheet is attached to a wing is not always limited to the conventional trailing edge. It may extend to the wing tips and even to parts of the leading edges. In the light of observations of the flow over models of marine propellers and delta wings, a discussion is initiated, aimed at improving the description of the flow over an arbitrary wing, with a view to formulating a better basis for an accurate calculation of the flow of an ideal fluid, as a point of reference for the consideration of real flows. Author

N73-33187 Vereinigte Flugtechnische Werke G.m.b.H., Bremen (West Germany).
EXPERIMENTAL STUDY OF WING PROFILE WITH FOWLER FLAPS AND SLATS [EXPERIMENTAL-STUDIE AN EINEM PROFIL MIT FOWLERKLAPPE UND VORFLUEGEL]
Juergen Barche *In* DFVLR Papers on Fluid Dyn. with Emphasis on Boundary Layer Theory, Part 1 9 Mar. 1972 p 7-44 refs In GERMAN; ENGLISH summary

Aerodynamic forces, pressure distribution, and wake of a wing profile with leading edge slats and trailing edge flaps were measured in a subsonic wind tunnel (maximum velocity of over 70 m/s). The measurements were performed to establish a theory

on high lift devices for takeoff and landing. To this end, in addition to the classic representation of test results, special plots were drawn to indicate the conditions in separated flow ranges. ESRO

N73-33194 Karlsruhe Univ. (West Germany). Inst. fuer Stroemungslehre und Stroemungsmaschinen.
TURBULENT SHEAR STRESS IN BOUNDARY LAYERS AT PERIODIC STATIONARY FREE FLOW PRESSURE PERTURBATIONS [DIE TURBULENTE SCHUBSPANNUNG IN GRENZSCHICHTEN BEI PERIODISCHEN STATIONAEREN STOERUNGEN DER AUSSENGESCHWINDIGKEIT]
K. O. Felsch and R. Dechow *In* DFVLR Papers on Fluid Dyn. with Emphasis on Boundary Layer Theory, Part 1 9 Mar. 1972 p 125-134 refs In GERMAN; ENGLISH summary

The behavior of a turbulent flat plate boundary layer at small periodic perturbations of the free stream pressure was studied experimentally. In particular, the influence of these perturbations on the shape of the shear stress profiles was investigated. The investigations were carried out in a small boundary layer wind channel over a trajectory of 2m. A wooden sonic wave wall was used to produce the periodic pressure perturbations. ESRO

N73-33229# Council for Scientific and Industrial Research, Pretoria (South Africa). Chemical Engineering Research Group.
PRESSURE DROP IN AIR FLOW ACROSS BANKS OF FIN-TUBES WITH VARYING PITCH
L. Sherman Mar. 1973 28 p refs
(PB-220315/6; CSIR-SR-CENG-003) Avail: NTIS HC $3.00 CSCL 13A

Air was blown isothermally across a bank of helically wound L-type fin tubes containing 6 tube rows. Six banks, each with a different triangular tube pitch, were investigated. The generally accepted Robinson and Briggs correlation underestimated the measured friction factor by about 20%. This is attributed to insufficient recognition of the effect of fin tube dimensions in this correlation, which also underestimates the effect of pitch, at least for the tubes used in these experiments. GRA

N73-33230# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF INLET CONDITIONS ON THE OPTIMAL SHAPE OF A DIFFUSER
D. I. Morozov 6 Aug. 1973 14 p refs Transl. into ENGLISH from Energ. Mashinostr. (USSR), no. 11, 1971 p 61-65
(AD-765577; FTD-HT-23-841-73) Avail: NTIS CSCL 20/4

The research is based on the application to short diffusers of the approximation theory of potential flow of a fluid in channels and the Bur single-parameter theory of a turbulent boundary layer. GRA

N73-33366# Sydney Univ. (Australia). Dept. of Aeronautical Engineering.
AN INSTRUMENT FOR MEASURING STEADY AND OSCILLATORY AERODYNAMIC FORCES
L. Stellema Nov. 1973 53 p refs
(ATN-7101) Avail: NTIS HC $4.75

An instrument to measure the steady and oscillatory aerodynamic forces on a sting-mounted model, using the forced oscillatory technique is described. The sting is oscillated in a sinusoidal motion of known amplitude and frequency. A flexible reference beam, situated outside the wind tunnel is oscillated in phase with the sting. A strain-gauge bridge bonded to the reference beam provides a phase reference signal. With the wind off, the amplified output of the strain-gauge bridge, on the reference beam, is made equal to the amplified output of the two strain-gauges bridges on the sting, by means of two attenuators. Thus the outputs from the sting amplifiers due to inertia are made zero, and when the wind is on the true oscillatory aerodynamic forces can be measured. To measure the steady state forces, the dc output of the sting due to weight is set at zero by means of a potentiometer when the wind is off. Author

N73-33381# Honeywell, Inc., Minneapolis, Minn. Systems and Research Div.
AN INVESTIGATION OF AIRBORNE DISPLAYS AND CONTROLS FOR SEARCH AND RESCUE (SAR). VOLUME 7: NAVY COMBAT SAR AVIONICS CAPABILITY STUDY (1972 - 1974 ERA) Final Report, Jun. 1972 - Jan. 1973
A. L. Jones and James W. Wingert Feb. 1973 53 p refs
(Contract N00014-69-C-0460; NR Proj. 213-072)
(AD-764914; HONEYWELL-12609-FR1-Vol-7; JANAIR-730702-Vol-7) Avail: NTIS CSCL 06/7

The report presents results of a study to assess the avionics capability of the present generation Navy combat search and rescue helicopters (HH-3A's). The study used interviews of experienced combat SAR pilots. Analyses were performed to evaluate the baseline HH-3A avionics and presently available avionic equipments against various search and environmental conditions. The most cost-effective improvement to the present HH-3A avionic capability for search and rescue was found to be Night-Vision Goggles for the pilot and a crew member. Author (GRA)

N73-33502*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL AND THEORETICAL INVESTIGATION OF HT-S/PMR-PI COMPOSITES FOR APPLICATION TO ADVANCED AIRCRAFT ENGINES
M. P. Hanson and C. C. Chamis [1973] 33 p refs Proposed for presentation at 29th Reinforced Plastics Tech. and Management Conf., Washington, D. C., 5-8 Feb. 1974; sponsored by Reinforced Plastics/Composites Inst. of the Soc. of the Plastics Ind., Inc.
(NASA-TM-X-71459; E-7700) Avail: NTIS HC $3.75 CSCL 11D

Investigations were performed in order to: (1) demonstrate that high quality angleplied laminates can be made from HT-S/PMR-PI (PMR in situ polymerization of monomeric reactants), (2) characterize the PMR-PI material and to determine the HT-S unidirectional composite properties required for composite micro and macromechanics and laminate analyses, and (3) select HT-S/PMR laminate configurations to meet the general design requirements for high-tip-speed compressor blades. The results of the investigation show that HT-S/PMR laminate configurations can be fabricated which satisfy the high-tip-speed compressor blade design requirements when operating within the temperature capability of the polyimide matrix. Author

N73-33510# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
APPARATUS FOR THERMOMECHANICAL SURFACE TREATMENT OF ORGANIC GLASS, ITS EFFECT, INSTRUCTIONS AND PRACTICAL TESTING
N. V. Skripnik, B. N. Blinov, and V. I. Prosvnrin 30 Jul. 1973 18 p Transl. into ENGLISH from Eksplutatsionnaya Nadezhnost, Kachestvo i Svoistva Samoletnogo Organicheskogo Stekla (USSR); no. 177, 1971 p 79-93
(AD-764972; FTD-MT-24-438-73) Avail: NTIS CSCL 11/2

In designing equipment which removes the silver (crazing) on aircraft glass one must consider that such operations will be performed under civil aviation repair shop conditions as well as airport conditions. For this reason two items were designed:

one with an electrical drive, which is intended for repair shop conditions; one with a pneumatic drive, intended for both airport conditions and repair shop conditions. GRA

N73-33518# Royal Aircraft Establishment, Farnborough (England). Structures Dept.
THE PREDICTION OF INSTABILITIES OF LINEAR DIFFERENTIAL EQUATIONS WITH PERIODIC COEFFICIENTS
R. J. Davies London Aeron. Res. Council 1973 34 p refs Supersedes RAE-TM-Struct-794; ARC-33260; RAE-TR-67161; ARC-29
(ARC-R/M-3713; RAE-TM-Struct-794; ARC-33260; RAE-TR-67161; ARC-29) Avail: NTIS HC $3.75; HMSO £ 1.32; PHI $5.30

The stability of the solutions of a system of differential equations with periodic coefficients has been examined using Floquet's theorem and a general method of solution has been programmed in ICL 1900 FORTRAN. The application of the method is illustrated by the solution of two dynamical systems, both of which are unsymmetrical rigid rotors in unsymmetrical bearings, and the program has been used to obtain solutions for up to six simultaneous second-order differential equations with periodic coefficients. Author (ESRO)

N73-33522# Joint Publications Research Service, Arlington, Va.
ANALYSIS OF METEOROLOGICAL CONDITIONS FOR AVIATION
K. G. Abramovich, ed. 25 Sep. 1973 69 p refs Transl. into ENGLISH of the publ. "Analiz Meteorologicheskikh Usloviy dlya Aviatsii" Leningrad, Gidrometeoizdat, 1972 63 p
(JPRS-60114) Avail: NTIS HC $5.50

Results are presented of studies conducted on weather phenomena which can limit aircraft landings and flights along air lanes. The effects of the spatial variability of the wind in the stratosphere on the accuracy of maintaining a flight trajectory by a supersonic transport at a given altitude are also discussed.

N73-33523 Joint Publications Research Service, Arlington, Va.
ANALYSIS OF VISIBILITY CONDITIONS WHEN LANDING AN AIRCRAFT IN A RADIATION FOG
Yu. G. Konovalov and M. Ya. Ratsimor *In its* Analysis of Meteorol. Conditions for Aviation (JPRS-60114) 25 Sep. 1973 p 2-8 refs Transl. into ENGLISH from the publ. "Analiz Meteorologicheskikh Usloviy dlya Aviatsii" Leningrad, Gidrometeoizdat, 1972 p 3-9

A procedure is presented for calculating the slant visibility range of ground objects for transparency of the atmosphere which is different with respect to altitude. The calculations were performed for a two-layer atmosphere: the layer of radiation fog and the layer above with relatively high transparency. It was demonstrated that the significant altitude of detection of the ground objects during observation at a high angle to the horizon can confuse the pilot of an aircraft making the approach for a landing with respect to visibility conditions when descending into a layer of fog. Author

N73-33525 Joint Publications Research Service, Arlington, Va.
TURBULENCE NEAR THE TROPOPAUSE IN THE PRESENCE OF HIGH ALTITUDE WAVES
G. S. Buldovskiy *In its* Analysis of Meteorol. Conditions for Aviation (JPRS-60114) 25 Sep. 1973 p 17-27 refs Transl. into ENGLISH from the publ. "Analiz Meteorologicheskikh Usloviy dlya Aviatii" Leningrad, Gidrometeoizdat, 1972 p 17-27

A study was made of the distribution of the recurrence rate of cases of buffeting of different intensity in the troposphere, the layer of the tropopause and the lower stratosphere (to 18km) under the conditions of high altitude waves. It was established that for the occurrence of moderate or severe turbulence near the tropopause, in addition to the high altitude waves it is necessary also to have significant vertical shifts of the wind vector, usually observed near the maximum in the vertical profile of the wind velocity. The probability of turbulence near the tropopause is greater, the deeper the inversion in the tropopause layer. An analysis was made of the data of individual flights under the conditions of high altitude waves. Author

N73-33528 Joint Publications Research Service, Arlington, Va.
CONDITIONS OF ICING OF MODERN TRANSPORT AIRCRAFT FROM ROUTINE FLIGHT DATA
O. K. Trunov and S. P. Khachatryan *In its* Analysis of Meteorol. Conditions for Aviation (JPRS-60114) 25 Sep. 1973 p 45-51 refs Transl. into ENGLISH from the publ. "Analiz Meteorologicheskikh Usloviy dlya Aviatsii" Leningrad, Gidrometeoizdat, 1972 p 45-51

The results of analyzing the statistical data on the icing conditions of modern transport aircraft completing flights from Moscow along the international air lane are presented. A study was made of the data on the recurrence rate of the icing zones as a function of the air temperature, the flight altitude, the form of the clouds, the time of year also the extent of the icing zones and the intensity of icing of the aircraft. Author

N73-33529 Joint Publications Research Service, Arlington, Va.
ADMISSIBLE SCALE OF SPATIAL AVERAGING OF THE VALUES OF THE GEOPOTENTIAL IN THE STRATOSPHERE CONSIDERING THE EFFECT OF THE WIND ON THE FLIGHT OF A SUPERSONIC AIRCRAFT
S. V. Solonin and G. I. Mazurov *In its* Analysis of Meteorol. Conditions for Aviation (JPRS-60114) 25 Sep. 1972 p 52-61 refs Transl. into ENGLISH from the publ. "Analiz Meteorologicheskikh Usloviy dlya Aviatsii" Leningrad, Gidrometeoizdat, 1972 p 52-61

A study was made of the effect of the spatial variability of the wind in the stratosphere on the accuracy of maintaining the flight trajectory of a supersonic transport (SST) at a given altitude. On the basis of simulating the flights with different supersonic velocities on the level of the 100 millibar isobaric surface, admissible scales of spatial averaging of the data on the baric field were established as a function of the significance of the air space. The accuracy of maintaining the given route under different aerosynoptic conditions when using integral corrections is analyzed. The conclusion is drawn regarding the admissible scales of spatial averaging of the values of the geopotential for meteorological servicing of the SST flights. Author

N73-33565 *Ohio State Univ., Columbus.*
CONSTRUCTION AND VALIDATION OF DECISION-THEORETIC MODELS OF LOW-LEVEL PILOTING AND NAVIGATIONAL BEHAVIOR Ph.D. Thesis
Don Carl Hutcherson 1973 500 p
Avail: Univ. Microfilms Order No. 73-18907

An attempt was made to determine whether or not decision and value theory concepts can be used as elements of a model to explain the behavior of a military decision maker in the heat of battle, under severe time constraints, and in the face of the enemy. The decision task selected for analysis is that faced by a helicopter pilot in planning a route to be followed during an attack upon a target. The results indicate that considerable variation exists between subjects so that it may be impossible to develop a single route selection model that is completely acceptable to all individuals. However, the decision behavior of a predominant class of decision makers is apparently described

to an acceptable degree by the route planning model, if the threat perception model known as Model One is used to measure perceived threat. Unfortunately, the model does not describe decision behavior equally well in all route selection situations. Furthermore, the data collected so far are not sufficient to determine whether or not the model can be used to predict the type of attack a decision maker will conduct in a specific situation. Dissert. Abstr.

N73-33568# National Aviation Facilities Experimental Center, Atlantic City, N.J.
EVALUATION OF LARGE SCREEN DISPLAY IN THE AUTOMATED OCEANIC ATC ENVIRONMENT Final Report, Jan. - Jul. 1973
Anthony J. Spingola and Robert L. Giordano Oct. 1973 45 p refs
(FAA Proj. 102-150-020)
(FAA-ND-73-75; FAA-RD-73-136) Avail: NTIS HC $4.25

Tests were conducted utilizing a representative traffic sample within an ocean sector incorporating the northern half of the Oakland Flight Information Region (FIR). The large Screen Display (LSD) was evaluated as a subsystem of the Oceanic Air Traffic Control Experimental Automation System. All test subjects controlled the same traffic sample and performed all of the interactions appropriate to a normal ocean sector operation. The LSD was used to portray all the required oceanic ATC data. A questionnaire was completed by each test subject immediately after completion of each test. There was no intention to evaluate the automated functions as they existed in the experimental system, nor was any consideration given to the cost or technical aspects of this LSD. Analysis of controller questionnaire responses indicates generally that the LSD was an acceptable method of displaying information; however, an individual cathode ray tube was preferred. Author

N73-33569# National Aviation Facilities Experimental Center, Atlantic City, N.J.
OPERATIONAL EVALUATION OF THE ARTS 2 RADAR ALPHANUMERIC DISPLAY SUBSYSTEM (RADS)
James F. Akers and Robert A. Clark Oct. 1973 27 p
(FAA Proj. 142-175-020)
(FAA-NA-73-77; FAA-RD-73-149) Avail: NTIS HC $3.50

A programmable, nontracking beacon Automated Radar Terminal System (ARTS II A) was installed in a TRACON configuration at the National Aviation Facilities Experimental Center. The operational suitability of the Radar Alphanumeric Display Subsystem (RADS) was evaluated. The RADS displays were evaluated over a 2-week period through the collection of subjective data obtained from controller questionnaires. It was concluded that the RADS consoles are suitable for use in air traffic control facilities. Modifications to the FOCUS control, MAP ILLUM control, A/N GAIN control, and Data Block Offset Switch are recommended. Author

N73-33570# Computer Sciences Corp., Falls Church, Va.
STUDY OF OCEANIC AIRSPACE AND GROUND NETWORK CONFIGURATIONS IN SATELLITE SYSTEMS Final Report
S. A. Klein Washington FAA Jul. 1973 203 p refs
(Contract DOT-FA72WA-3102)
(FAA-RD-73-59; Rept-4183-1) Avail: NTIS HC $12.25

The final results of a study of oceanic airspace and ground network configurations in satellite systems are presented. The purpose of the study was to investigate the restructuring of oceanic ATC airspace jurisdictional boundaries in the presence of a satellite system and to identify those future ATC jurisdictional configurations and ground facilities networks which most effectively utilize the satellite capability to obtain ground segment cost savings. The study was exploratory in nature and focused on the 1980 time frame. The analysis was limited to specified North Atlantic and Pacific oceanic regions. The report presents detailed descriptions of the study assumptions, the cost indicator model, and the evaluation techniques, as well as a number of ancilliary results regarding the technical and institutional environment of the oceanic aviation support system and the data base requirements encountered in performing the study. Author

N73-33571# Mitre Corp., McLean, Va.
EXTRAPOLATED METHODOLOGY USED IN THE LOS ANGELES BASIN STANDARD TRAFFIC MODEL Final Report
Frank Maginnis and Saul Cohen Washington FAA Apr. 1973 20 p refs
(Contract DOT-FA70WA-2448)
(AD-765153; MTR-6386; FAA-RD-73-86) Avail: NTIS CSCL 01/2

The Los Angeles Basin Standard Traffic Model is a computer model of the air traffic expected in the basin in 1982. The report explains the methodology used to project into the 1982 time frame a similar model of 1972 traffic. A technique known as time compression was used to make the projection. This report also defines the two types of models produced, the snapshot and scan-by-scan models, and it explains how the former was extracted from the later. (Modified author abstract) GRA

N73-33579 American Airlines, Inc., Tulsa, Okla. Maintenance and Engineering Center.
RADIATION SAFETY IN AIRLINE MAINTENANCE
Warren J. Weldon *In* Bur. of Radiol. Health Radiation Safety and Protect. in Ind. Appl. Oct. 1972 p 137-147

The use of radiation technology and equipment for nondestructive tests of airframes are discussed. The specific application is to the servicing of commercial aircraft during ground maintenance periods. The hazards encountered and the precautions to be observed during radiological inspections are reported. Specific actions followed by the airlines to protect personnel from radiation hazards are explained. P.N.F.

N73-33740# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AN ELECTRICAL FIELD IN THE RESERVOIR OF A FUEL TANK AS IT IS FILLED WITH ELECTRIFIED FUEL
B. K. Maksimov, A. A. Obukh, A. A. Navatskii, and V. A. Mokryshev 27 Jul. 1973 11 p refs Transl. into ENGLISH from the book "Tekh. Vysokikh Napryazh." USSR, 1972 p 138-142
(AD-764941; FTD-HT-23-793-73) Avail: NTIS CSCL 21/4

Aviation fuel (kerosene, gasoline) is highly electrified during passage along pipes and through filters. Charged fluid, filling a reservoir, is a source of an electrical field in a vapor-air space. If the magnitude of the field reaches disruptive strength, a spark discharge will occur. The discharge can be the cause of the ignition of the fuel. The article shows the calculated and graphic dependences, which make it possible to quickly evaluate the components of a three-dimensional electrical field in a vapor-air space an example of which is the TZ-16 fuel tank. The illustrated results may be used for any other reservoir configuration which does not differ significantly from rectangular. GRA

N73-33741*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HIGHLY NOISE SUPPRESSED BYPASS 6 ENGINE FOR STOL APPLICATION
W. L. Jones, L. J. Heidelberg, and R. G. Goldman 1973 21 p

refs Presented at Aeroacoustic Specialists Conf., Seattle, 15-17 Oct. 1973; sponsored by AIAA
(NASA-TM-X-71448) Avail: NTIS HC $3.25 CSCL 21E

A TF-34 engine with an acoustically treated ground test nacelle was built and tested to determine the feasibility of suppressing fan and core engine noise to the stringent levels required for STOL or short-haul commercial aircraft. The design incorporates wall treatment for the fan and core plus three treated splitter rings in the inlet and two treated splitters in the aft fan duct. Maximum suppression of fan tone noise of 40-45 db was obtained from both the inlet and aft fan treatment. At rated fan speed, overall noise was reduced by 21 PNdb to a value of 94 PNdb on a 500-foot sideline. The overall noise reduction value was limited by the jet noise floor. Thrust losses due to the acoustic treatment are also discussed. Author

N73-33742*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NOZZLE GEOMETRY AND FORWARD VELOCITY EFFECTS ON NOISE FOR CTOL ENGINE-OVER-THE-WING CONCEPT
U. VonGlahn, J. Goodykoontz, and J. Wagner 1973 30 p refs Presented at 86th Meeting of the Acoustical Soc. of Am., Los Angeles, 30 Oct. - 2 Nov. 1973
(NASA-TM-X-71453; E-7730) Avail: NTIS HC $3.50 CSCL 21E

Acoustic shielding benefits for jet noise of engine-over-the-wing for conventional aircraft (CTOL) application were studied with and without forward velocity for various small-scale nozzles. These latter included convergent, bypass and mixer, with and without forward ejector, nozzles. A 13-inch free jet was used to provide forward velocity. Farfield noise data were obtained for subsonic jet velocities from 650 to 980 ft/sec and forward velocities from zero to 360 ft/sec. The studies showed that although shielding benefits were obtained with all nozzles, the greatest benefits were obtained with mixer nozzles. The absolute magnitude of the jet noise shielding benefits with forward velocity was similar to the variation in nozzle-only noise with forward velocity. Author

N73-33743*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DISPERSION AND DILUTION OF JET AIRCRAFT EXHAUST AT HIGH-ALTITUDE FLIGHT CONDITIONS
James D. Holdeman [1973] 10 p refs Proposed for presentation at the 12th Aerospace Sci. Meeting, Wash., D. C., 30 Jan. 1 Feb. 1974; sponsored by AIAA
(NASA-TM-X-71451; E-7720) Avail: NTIS HC $3.00 CSCL 21E

A method is presented for estimating the dispersion and dilution of jet aircraft exhaust from aircraft passage through times on the order of weeks thereafter. In the near wake of the aircraft, the solution is that for round turbulent jets in a parallel flow. More rapid dispersion due to atmospheric effects begins when the scale-dependent eddy viscosity becomes larger than the turbulent jet eddy viscosity. In the far wake region, the solution approaches that for scale-dependent dispersion from a point source moving with the aircraft. Calculations are presented for supersonic aircraft at high altitude flight conditions. Author

N73-33744*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NUMERICAL SIMULATION OF NOISE PROPAGATION IN JET ENGINE DUCTS
Kenneth J. Baumeister and Edward C. Bittner Washington Oct. 1973 50 p refs
(NASA-TN-D-7339; E-7217) Avail: NTIS HC $3.00 CSCL 20A

A finite difference formulation is presented which is useful in the study of acoustically treated inlet and exhaust ducts used in turbofan engines. The difference formulation can readily handle acoustic flow field complications, such as axial variations in wall impedance and cross-sectional area, that would occur in a sonic inlet. In formulating the difference solutions, the continuous acoustic field is lumped into a series of grid points spread uniformly throughout the field. At each point, the pressure is separated into its real and imaginary terms. Example solutions are presented for sound propagation in a one-dimensional straight hard-wall duct and in a two-dimensional straight soft-wall duct without steady flow. Author

N73-33748*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
A STUDY OF ENGINE VARIABLE GEOMETRY SYSTEMS FOR AN ADVANCED HIGH SUBSONIC LONG RANGE COMMERCIAL AIRCRAFT
M. A. Compagnon Oct. 1973 112 p refs
(Contract NAS3-15544)
(NASA-CR-134495; R73AER185) Avail: NTIS HC $7.75 CSCL 21E

Several variable geometry high Mach inlet concepts, aimed at meeting a system noise objective of 15 EPNdB below FAR part 36, for a long range, Mach 0.9 advanced commercial transport are assessed and compared to a fixed geometry inlet with multiple splitters. The effects of a variable exhaust nozzle (mixed exhaust engine) on noise, inlet geometry requirements, and economics are also presented. The best variable geometry inlet configuration identified is a variable cowl design which relies on a high throat Mach number for additional inlet noise suppression only at takeoff, and depends entirely on inlet wall treatment for noise suppression at approach power. Relative economic penalties as a function of noise level are also presented. Author

N73-33755# Deutsche Gesellschaft fuer Luft- und Raumfahrt, Cologne (West Germany).
BEHAVIOR OF TURBOJETS
Jan. 1973 114 p refs In GERMAN; ENGLISH summary Proc. of the DGLR Airbreathing Propulsion Committee Meeting, Darmstadt, West Ger., 24 May 1972
(DLR-MITT-73-05) Avail: NTIS HC $7.75; ZLDI, Munich 23,95 DM

The influence of combustion chambers, compressors, and afterburners, and their mechanical configuration, on the static performance of two-cycle turbojet engines, with a high bypass ratio was investigated. Some examples are given to show the influence of the variation of both nozzle surfaces and fuel throughput at given thrust on the parameters of the same engines without primary and secondary flow mixing. The performance of arbitrarily switched gas turbines was calculated by simulation with building block system on a digital computer. The effects of a partly oil-filled converter for a turbine engine used to supply starting power to the main engines were investigated. For individual titles, see N73-33756 through N73-33759. ESRO

N73-33756 Motoren- und Turbinen-Union Muenchen G.m.b.H. (West Germany).
EFFECT OF SINGLE COMPONENTS AND THEIR MECHANICAL LAYOUT ON THE STATIC PERFORMANCE OF TWO-CYCLE TURBOJET ENGINES [EINFLUSS EINZELNER KOMPONENTEN UND IHRER MECHANISCHEN ANORDNUNG AUF DAS STATIONAERE BETRIEBSVERHALTEN VON 2-KREIS-TRIEBWERKEN]
Hubert Grieb *In* DGLR Behavior of Turbojets Jan. 1973 p 7-50 In GERMAN

The influence of combustion chambers, compressors and afterburners, and their mechanical configuration, on the static performance of two-cycle turbojet engines with a high bypass

ratio was investigated. As a basis for comparison of the thermodynamic cycling processes, maximal thrust with and without afterburning at sea altitude and a flight Mach number of 0.9 were chosen. The following conclusions were drawn with regard to the type of engine investigated: (1) within certain limits, a desired performance can be obtained with several thermodynamic designs; (2) the influence of the mechanical configuration of the turbopart in the static performance is small; (3) the technological state-of-the-art of the components is essential for the quality of stationary operating characteristics; (4) the optimal tuning of the compressor characteristics to the expected load lines has considerable influence on the operation; (5) the design of low pressure compressor transition to medium pressure compressor and (6) bypass channel needs special attention besides mechanical conception. ESRO

N73-33757 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Luftsaugende Antriebe.
PERFORMANCE BEHAVIOR OF A TWO-CYCLE TURBOJET ENGINE FOR MULTIPARAMETER CONTROL [DAS LEISTUNGSVERHALTEN EINES ZWEISTROMTRIEBWERKS BEI MEHRGROESSENREGELUNG]
Heinrich Dissen *In* DGLR Behavior of Turbojets Jan. 1973 p 55-72 In GERMAN

Some examples are given to show the influence of the variation of both nozzle surfaces and fuel throughput at given thrust and other boundary conditions on the engine parameters of a two-cycle turbojet engine with large bypass ratio without primary and secondary flow mixing. To this end, a computation method was developed for describing the performance of engines with multiparameter control. The advantages of multiparameter control are summarized. The disadvantages are: the system is more complicated, adjustable nozzles add to the engine weight, and accurate measurements are necessary for determining the engine parameters. ESRO

N73-33761# Pratt and Whitney Aircraft, East Hartford, Conn.
INFLUENCE OF VARIABLE TURBINE GEOMETRY ON ENGINE INSTALLATION LOSSES AND CYCLE SELECTION Final Technical Report, Apr. 1971 - Nov. 1972
Robert J. May, Jr. and William F. Zavatkay Jun. 1973 34 p Presented at 8th JANNAF/AIAA/SAE Propulsion Joint Specialist Conf., New Orleans, La., 27 Nov. - 1 Dec. 1972 Sponsored by AF
(AF Proj. 3066)
(AD-765533; AFAPL-TR-73-18) Avail: NTIS CSCL 21/5

The trend in military aircraft is toward increasing thrust loading for improved maneuverability coupled with a requirement for extended subsonic cruise range at low power settings. Conventional turbine engines designed to meet these requirements must operate over large ranges of airflow between maximum power and cruise. As a result, the inlets and nozzles designed for these engines cannot perform efficiently with the low airflow rates typical of subsonic cruise operation. Variable turbine geometry, however, offers a promising approach for obtaining both high thrust loading and efficient cruise performance by permitting large amounts of thrust modulation at constant airflow rates. As an example, the performance of a turbojet engine, which provides efficient high-thrust maneuvering and supersonic operation, can be improved by variable turbine geometry to the point where it is competitive with a fixed-turbine-geometry turbofan engine in the low-thrust subsonic cruise regime. (Modified author abstract) GRA

N73-33883*# Martin Marietta Corp., Denver, Colo.
HYPERSONIC WING TEST STRUCTURE DESIGN, ANALYSIS, AND FABRICATION Final Report
P. P. Plank and F. A. Penning Aug. 1973 154 p refs
(Contract NAS4-1845)
(NASA-CR-127490) Avail: NTIS HC $9.75 CSCL 01C

An investigation to provide the analyses, data, and hardware required to experimentally validate the beaded panel concept and demonstrate its usefulness as a basis for design of a Hypersonic Research Airplane (HRA) wing is reported. Combinations of the beaded panel structure, heat shields, channel caps and corrugated webs for ribs and spars were analyzed for the wing of a specified HRA to operate at Mach 8 with a lifespan of 150 flights. Detailed analyses were conducted in accordance with established design criteria and included aerodynamic heating and load predictions, transient structural thermal calculations, extensive NASTRAN computer modeling, and structural optimization. Optimum beaded panel tests at 922 K (1200 F) were performed to verify panel performance. Close agreement of predicted and actual critical loads permitted use of design procedures and equations for the beaded panel concept without modification. Author

N73-33887*# Grumman Aerospace Corp., Bethpage, N.Y.
FLUTTER ANALYSIS AND TESTING OF PAIRS OF AERODYNAMICALLY INTERFERING DELTA WINGS Final Report
Richard R. Chipman and Frank J. Rauch Washington NASA Nov. 1973 95 p refs
(Contract NAS1-10635-7)
(NASA-CR-2331) Avail: NTIS HC $3.75 CSCL 01B

To examine the effect on flutter of the aerodynamic interference between pairs of closely spaced delta wings, several structurally uncoupled 1/80th-scale models were studied by experiment and analysis. Flutter test boundaries run in a 26-in transonic blowdown wind tunnel were compared with subsonic analytical results generated using the doublet lattice method. Trends for several combinations of vertical and longitudinal wing separation showed that flutter speeds can be significantly lowered in closely spaced configurations. For some configurations, a new flutter mechanism, characterized by coupling of the flexible modes from both surfaces at a distinctive flutter frequency, was predicted and observed. Author

N73-33919*# Aerospace Corp., El Segundo, Calif.
SYSTEM COST/PERFORMANCE ANALYSIS (STUDY 2.3). VOLUME 1: EXECUTIVE SUMMARY Final Report, 1 Sep. 1972 - 31 Aug. 1973
T. Kazangey 28 Sep. 1973 31 p
(Contract NASw-2472)
(NASA-CR-135903; ATR-74(7333)-1-Vol-1) Avail: NTIS HC $3.75 CSCL 14A

The relationships between performance, safety, cost, and schedule parameters were identified and quantified in support of an overall effort to generate program models and methodology that provide insight into a total space vehicle program. A specific space vehicle system, the attitude control system (ACS), was used, and a modeling methodology was selected that develops a consistent set of quantitative relationships among performance, safety, cost, and schedule, based on the characteristics of the components utilized in candidate mechanisms. These descriptive equations were developed for a three-axis, earth-pointing, mass expulsion ACS. A data base describing typical candidate ACS components was implemented, along with a computer program to perform sample calculations. This approach, implemented on a computer, is capable of determining the effect of a change in functional requirements to the ACS mechanization and the resulting cost and schedule. By a simple extension of this modeling methodology to the other systems in a space vehicle, a complete space vehicle model can be developed. Study results and recommendations are presented. Author

N73-33920*# Aerospace Corp., El Segundo, Calif.
SYSTEM COST/PERFORMANCE ANALYSIS (STUDY 2.3). VOLUME 2: STUDY RESULTS Final Report, 1 Sep. 1972

31 Aug. 1973
T. Kazangey 28 Sep. 1973 376 p ref
(Contract NASw-2472)
(NASA-CR-135902; ATR-74(7333)-1-Vol-2) Avail: NTIS HC $21.00 CSCL 14A

The relationships between performance, safety, cost, and schedule parameters were identified and quantified in support of an overall effort to generate program models and methodology that provide insight into a total space vehicle program. A specific space vehicle system, the attitude control system (ACS), was used, and a modeling methodology was selected that develops a consistent set of quantitative relationships among performance, safety, cost, and schedule, based on the characteristics of the components utilized in candidate mechanisms. These descriptive equations were developed for a three-axis, earth-pointing, mass expulsion ACS. A data base describing typical candidate ACS components was implemented, along with a computer program to perform sample calculations. This approach, implemented on a computer, is capable of determining the effect of a change in functional requirements to the ACS mechanization and the resulting cost and schedule. By a simple extension of this modeling methodology to the other systems in a space vehicle, a complete space vehicle model can be developed. Study results and recommendations are presented. Author

N73-33921# RAND Corp., Santa Monica, Calif.
TRANSPORTATION AND ENERGY
W. E. Mooz Jun. 1973 23 p refs Presented at the 1st Annual Illinois Energy Conf., Chicago, 13-15 Jun. 1973
(Grant NSF GI-44)
(P-5025) Avail: NTIS HC $3.25 CSCL 21D

The use of energy in the transportation sector is discussed. Transportation in the United States presently uses about 25 percent of the total annual energy budget, and the use of energy in the sector is increasing at an average annual rate of about 4 percent per year. Over 95 percent of this energy is supplied by petroleum fuels, and the biggest users are motor vehicles. Differences in modal efficiencies are shown, with motor vehicles and aircraft the least efficient energy users. The growth in energy use by transportation is shown to be due to increasing modal energy intensiveness, shifts in traffic from low intensiveness modes to high intensiveness modes, and increasing per capita use of transportation. One may expect to see more small cars, shifts from air and highway modes to buses, trains, and pipelines, and changes in personal transportation habits. Author

N73-33928# Committee on Science and Astronautics (U. S. House).
SHORT TERM ENERGY SHORTAGES
Washington GPO 1973 928 p refs Hearings before Comm. on Sci. and Astron., 93d Cong., 1st Sess., No. 7, 3, 8 and 17 May 1973
Avail: Subcomm. on Energy

Congressional hearings are given on the causes and implications of impending shortages of gasoline, heating oil, diesel fuel, jet engine fuel, and electricity. The immediate energy shortages and policy options are discussed in three parts: (1) the character of the present energy crisis, (2) the relationship of energy growth and economic growth, and (3) the relationship of short-run measures and long-term objectives. Short term fuel shortages are given along with their effects on the electric utilities. The hearings take into account the regulated energy industries and the effect of the present situation on energy research and development. A gas field identification list is included. T.M.R.

N73-33929# Sandia Labs., Albuquerque, N.Mex.
AIRVAL: DOD PROGRAM TO EVALUATE AIR-TO-AIR MISSILE EFFECTIVENESS
T. E. Latta Mar. 1973 30 p Presented at 11th Symp. on Infrared Countermeasures, White Oak, Md., 10 Apr. 1973 Sponsored By AEC
(SLA-73-5271; Conf-730428-1) Avail: NTIS HC $3.50

The AIRVAL program has conducted a survey to determine the extent of past infrared (IR) signature measurements on high-performance jet aircraft. The results of this survey have been used to categorize broadly aircraft signatures and to indicate areas requiring further signature measurement. Measurements on the F-102 are now underway at Naval Weapons Center. The results of these measurements will be compared to signature predictions of the F-102 as calculated by Grumman Aircraft Corp. Additional IR signature measurements will be made this calendar year on the A-3, A-4, A-7, F-4, F-5, and F-14 by the measurement groups at the Naval Missile Center and Eglin AFB using advanced instrumentation and techniques. The results of these measurements will be combined with target vulnerability models and missile guidance, fuze, and warhead characteristics in a computer model to determine the predicted outcome of missile/target encounters. The results of a drone firing program will be compared to the computer model predictions.
Author (NSA)

N73-33930# Eurosat S.A., Geneva (Switzerland).
AIMS, PROSPECTS, ORGANISATION, AND FINANCING
Aug. 1972 30 p
Avail: NTIS HC $3.50

The aims, prospects, organization, and financing of EUROSAT S.A. are presented. EUROSAT S.A. was founded in January 1972 to cooperate with public authorites to ensure economical use of the possibilities offered by space techniques. Emphasis was placed on satisfying European requirements in ATC, navigation, and meteorological and communication satellites. ESRO

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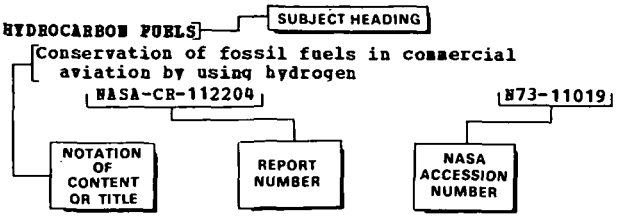

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A

B

C

D

E

F

G

H

J

M

N

O

P

R

S

T

X

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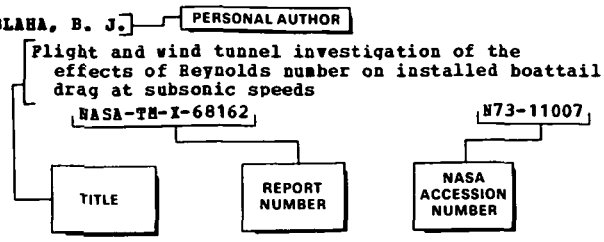

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A

B

C

D

E

F

G

H

I

J

K

L

M

N

O

P

Q

R

S

U

V

W

Y

Z

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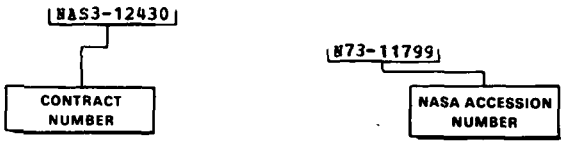

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