AERONAUTICAL ENGINEERING

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AERONAUTICAL ENGINEERING

A Special Bibliography

Supplement 42

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 February 1974 in

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

Scientific and Technical Information Office
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MARCH 1974
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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 338 reports, journal articles, and other documents originally announced in February 1974 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*.

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

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

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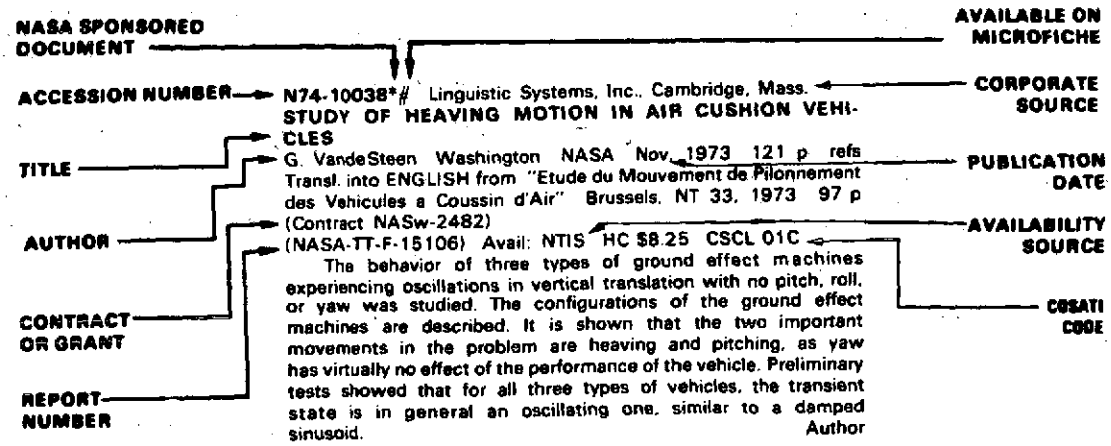

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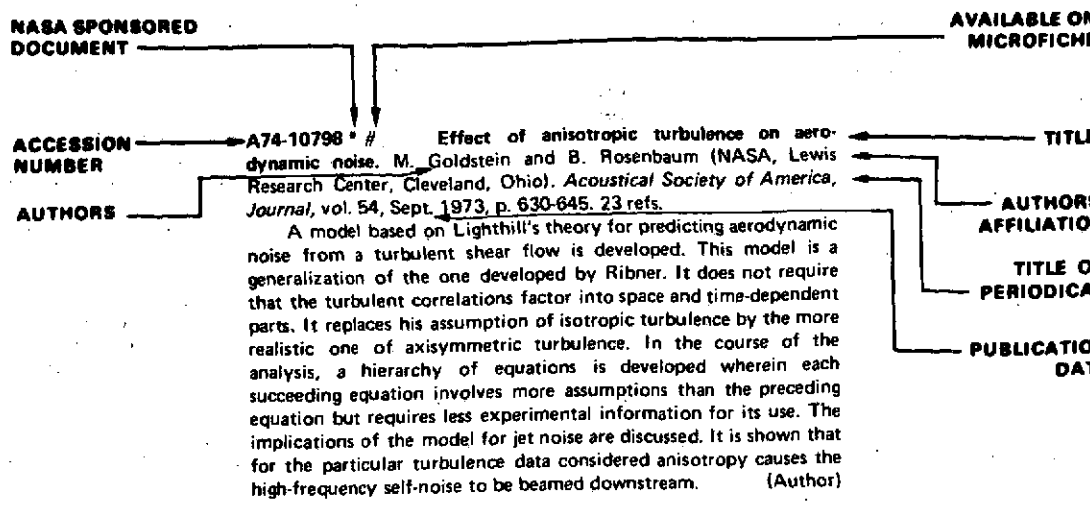

AERONAUTICAL ENGINEERING

A Special Bibliography (Suppl. 42) MARCH 1974

IAA ENTRIES

A74-12971 # Experimental study on the characteristics of an isolated swept-back aerofoil with two parallel side-walls. Y. Tanida and Y. Saito. *Tokyo, University, Institute of Space and Aeronautical Science, Bulletin*, vol. 9, July 1973, p. 763-793. 8 refs. In Japanese, with abstract in English.

Results of a study of an isolated swept-back airfoil spanning the space between two parallel side walls, in which the static pressure distribution over the airfoil was measured and the flow pattern on its surface was visualized. The study was carried out for airfoils with aspect ratios of 1, 2, and 3 and sweep-back angles of 0, 30, and 45 deg, respectively. It is found that in the range of small angles of attack the spanwise variation of the pressure distribution on the airfoil is large for small aspect ratios and large sweep-back angles, but the local lift is almost constant over the whole span. As the angle of attack increases, the stalled portion due to leading-edge separation spreads from the downstream to the upstream side of the swept airfoil. When the aspect ratio and the sweep-back angle are both large, a so-called part-span vortex is observed crossing diagonally over the airfoil. The total lift changes gradually as a function of the angle of attack, although the local lift tends to increase abruptly just before falling into stall. A.B.K.

A74-12974 # An earth resources aircraft facility. J. Plevin (ESRO, Space Applications Div., Neuilly-sur-Seine, Hauts-de-Seine, France). *(British Interplanetary Society, Symposium on Earth Observation Satellites, University College, London, England, Apr. 10-12, 1973.) British Interplanetary Society, Journal*, vol. 26, Dec. 1973, p. 728-741. 8 refs.

Description of an earth resources aircraft facility (ERAF) fitted with a wide range of advanced remote sensing instruments, which could provide the central component for a preparatory program centered around airborne remote sensing platforms. ERAF, as a European project, would complement existing national aircraft facilities available commercially or through government agencies, which are, at present, usually relatively small aircraft fitted with simple payloads such as multiband cameras and thermal IR line scanners. (Author)

A74-13001 Finite element analysis of supersonic panel flutter. G. Sander, C. Bon, and M. Geradin (Liège, Université, Liège, Belgium). *International Journal for Numerical Methods in Engineering*, vol. 7, no. 3, 1973, p. 379-394. 28 refs.

Development of a new approach to the application of the finite element method to the analysis of the supersonic flutter of a flat thin plate subjected to in-plane stresses during bending. The proposed approach consists in representing the unsteady aerodynamic forces by finite elements - i.e., directly in terms of the generalized displacements used as unknowns. The resulting advantage is an increased flexibility and generality in the structural configurations that can be treated. The aerodynamic forces are evaluated, using the linearized piston theory, following the line first presented by Olson (1967). The proposed method is based on the use of a purely compatible, conforming quadrilateral plate bending finite element. The algorithm of the bi-iteration used to compute the complex eigenfrequencies arising in this problem is described, giving due attention to the problem of correctly taking the aerodynamic damping into account. A.B.K.

A74-13017 World-wide Navy program controls aircraft contamination. M. H. Margolis (RCA Service Co., Springfield, Va.). *Hydraulics and Pneumatics*, vol. 26, Nov. 1973, p. 105-108.

An investigation shows that hydraulic pump and seal life is directly related to the level of hydraulic fluid contamination, involving particulate matter smaller than 15 microns. Excessive contamination is found to effect servovalve performance and service life. Five-micron absolute filtration significantly increases pump and seal life, and overall system reliability. It is pointed out that personnel indoctrination and special maintenance training is essential to effective contamination control. G.R.

A74-13028 # Location of aircraft by an acoustic method. H. Kobatake, Y. Ishii, and J. Igarashi. *Tokyo, University, Institute of Space and Aeronautical Science, Bulletin*, vol. 9, Oct. 1973, p. 854-869. In Japanese, with abstract in English.

Description of studies carried out on the measurement of aircraft positions at close range by applying correlation analysis of aircraft noise measured by spaced microphones. The acoustic path difference between two microphones is determined from the peak of the cross-correlation function of the noise signals picked up by the microphones, yielding the elevation angle of the aircraft. Elevation angles measured at two points of observation determine the crossing point of the aircraft flight path on the vertical plane encompassing the two points of observation. Effects of meteorological factors which influence sound propagation are also examined. T.M.

A74-13041 Distribution of turbulent kinetic energy in the wake of an airfoil in detached flow (Répartition de l'énergie cinétique turbulente dans le sillage d'un profil en écoulement décollé). P.-E. Lemonnier and L. F. Tsen (Centre d'Etudes Aérodynamiques et Thermiques, Poitiers, France). *Académie des Sciences (Paris), Comptes Rendus, Série A - Sciences Mathématiques*, vol. 277, no. 16, Oct. 22, 1973, p. 813-815. In French.

The tests were carried out in a subsonic Eiffel type wind tunnel the converging section of which was immediately followed by a plane diffuser with a half angle at the peak of about 3 deg, and one meter in length. The airfoil section, consisting of a flat plate with a rounded leading edge and swept back trailing edge, was mounted on the wall, the leading edge being in the immediate vicinity of the beginning of the diffuser. The maximum velocity of the clear flow was of the order of 60 m/sec. Exploration of the wake was carried out systematically by a Pitot tube and a crossed wire anemometer. The evolution of characteristic speeds and thicknesses, and distributions of the mean speed and of the turbulent kinetic energy are shown graphically. F.R.L.

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A74-13048 **Theoretical analysis of the noise characteristics of an ejector jet.** D. Tirumalesa (Rohr Industries, Inc., Chula Vista, Calif.). *Journal of Sound and Vibration*, vol. 30, Oct. 22, 1973, p. 465-481. 22 refs.

Review of a theoretical analysis of the noise radiation from an ejector performed with the aid of techniques based on Green's function. It is shown that convection effects of sound sources and of uniform axial flow in the ejector introduce considerable modifications into the analysis. M.V.E.

A74-13094 **Vibrations of asymmetric rotors supported by asymmetric bearings.** T. Iwatsubo, (München, Technische Universität, Munich, West Germany), A. Tomita (Hitachi, Ltd., Hitachi, Japan), and R. Kawai (Kobe University, Kobe, Japan). *Ingenieur-Archiv*, vol. 42, no. 6, 1973, p. 416-432. 12 refs.

In this paper the vibrations of an asymmetric flexible rotor supported by asymmetric bearings is theoretically analyzed by using Galerkin's method and the perturbation method, and numerically calculated. The effects of the asymmetries of the rotor and the bearings and the changes of the main instability regions and the ultraharmonic resonance due to the external and internal dampings are investigated. The experimental tests are performed on a smaller laboratory model in order to verify the validity of the theoretical results. The following results are obtained; the instability regions divide into two ones by the lack of the symmetries in the rotor and the bearings. The ultraharmonic resonances appear at fractional values of the main critical speed. The character of the internal damping is changed by the magnitude of the asymmetries of the rotor and the bearings. (Author)

A74-13131 * # **Classical study of rotational excitation of a rigid rotor - Li/+/ + H2. II - Correspondence with quantal results.** R. A. LaBudde and R. B. Bernstein (Wisconsin, University, Madison, Wis.). *Journal of Chemical Physics*, vol. 59, Oct. 1, 1973, p. 3687-3691. 33 refs. NSF Grant No. GP-35848X; Grant No. NGL-50-002-001.

Further classical trajectory calculations of the rotational excitation of H2 in collision with Li(+) have been carried out in order to assess several alternative classical-quantal correspondence relationships. The results are compared with exact quantal cross sections computed for the same model system by Lester and Schaefer (1973). (Author)

A74-13152 # **Supersonic flow about slab delta wings and wing-body configurations.** C.-W. Chu ((Northrop Corp., Hawthorne, Calif.). *Journal of Spacecraft and Rockets*, vol. 10, Nov. 1973, p. 741, 742. 7 refs.

The three-dimensional characteristics algorithm previously described by Chu (1972) is applied to calculate supersonic flow fields over a 70-deg slab delta wing and Space Shuttle wing body configuration. The presented results show that the algorithm and the associated computer program offer a valuable numerical tool that provides inviscid solutions for boundary-layer analyses and can determine complete super/hypersonic flow-fields as input to design of global gliders, Shuttle Orbiters or similar vehicles. M.V.E.

A74-13164 **A direct method for linear dynamical problems in continuum mechanics with random loads.** F. Y. M. Wan (MIT, Cambridge, Mass.). *(International Congress of Theoretical and Applied Mechanics, 13th, Moscow, USSR, Aug. 1972.) Studies in Applied Mathematics*, vol. 52, Sept. 1973, p. 259-276. 10 refs. Army-supported research.

Linear dynamic problems formulated as initial boundary value problems in linear partial differential equations are examined. The application of a method proposed by Lin (1967) for linear time-invariant discrete dynamic systems to the solution of such linear dynamic problems is described, and its effectiveness for the first- and second-order statistics is demonstrated, using a nonself-adjoint nonseparable equation with variable coefficients (describing the dimensionless blade displacements of a lifting rotor in forward flight) as an example. V.P.

A74-13176 # **Influence of the atmosphere in the fall of bodies into water (Vliianie atmosfery pri padenii tel na vodu).** Iu. L. Iakimov. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza*, Sept.-Oct. 1973, p. 3-6. In Russian.

The mechanism by which the atmosphere affects the pattern of the entry of a body into water is examined. The self-similar nature of the jets of spray is revealed, and estimates of the aerodynamic forces acting on the jets are obtained. The estimates explain qualitatively the behavior of liquid as a function of atmospheric density. V.P.

A74-13179 # **Nonuniqueness of the solution to the problem of viscous interaction on an axisymmetric body (Needinstvennost' resheniia zadachi o viazkom vzaimodeistvii na osesimmetrichnom tele).** V. P. Provotorov. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza*, Sept.-Oct. 1973, p. 41-47. 7 refs. In Russian.

The solutions of the equations of a hypersonic boundary layer on an exponential slender axisymmetric body (exponent = 3/4) are analyzed with allowance for the interaction with inviscid flow. It is shown that in this case, the boundary layer equations have solutions that differ from the self-similar solution for the flow past a semiinfinite body. The solutions obtained are analogous to the strong-interaction solutions for a plate or a delta wing. An asymptotic solution is obtained for the case where the interaction parameter tends to zero. V.P.

A74-13183 # **Investigation of the characteristics of flows past plates at large angles of attack (Issledovanie osobennostei obtekaniia plastinki pri bol'shikh uglakh ataki).** S. M. Belotserkovskii and M. I. Nisht. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza*, Sept.-Oct. 1973, p. 110-116. 10 refs. In Russian.

The method of discrete vortices proposed by Belotserkovskii and Nisht (1972) is applied to a detailed analysis of the separated flow past a plate of infinite span at angles of attack ranging from 0 to 90 degrees. The flow pattern, obtained on the basis of an ideal fluid model, reveals the characteristic features of separated flow. It can be seen how the initially continuous vortex sheet disintegrates with time into vortex configurations of the type of Karman streets. The suction force is absent, while the lifting force and drag can be determined as the corresponding projections of the normal force. As flow separation develops, the flow varies periodically with time. The period and amplitude of the normal-force fluctuations increase with increasing angle of attack. V.P.

A74-13188 # **Investigation of heat transfer at the surface of a two-step wedge in supersonic flow (Issledovanie teploobmena na poverkhnosti dvukhstupenchatogo klina v sverkhzvukovom potoke).** V. A. Bashkin, N. P. Kolina, and A. Ia. Iushin. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza*, Sept.-Oct. 1973, p. 158-163. 6 refs. In Russian.

The boundary layer at local high-curvature portions of an aircraft surface in a low-density flow was studied using a wedge whose taper formed a break toward the tip. The distribution of static pressure and local heat flows was measured at the symmetry plane of the wedge. The shear stress distribution and the distribution of local heat flows was studied as a function of the taper within the framework of classical laminar boundary layer theory. The experimental data and the results of the numerical integration of the boundary layer equations are diagrammed and discussed. V.P.

A74-13243 # **The reduction of gas turbine idle emissions by fuel zoning for compressor bleed.** T. R. Clements (United Aircraft Florida Research and Development Center, West Palm Beach, Fla.). *American Society of Mechanical Engineers, Winter Annual Meeting,*

Detroit, Mich., Nov. 11-15, 1973, Paper 73-WA/Aero-1. 4 p. Members, $1.00; nonmembers, $3.00.

Two methods of reducing the idle emissions of gas turbine engines have been investigated. The methods were (1) fuel zoning, whereby a portion of the fuel nozzles were shut down and all of the fuel passed through the remaining nozzles and (2) larger than normal compressor overboard bleed. Both methods operate on the fact that a combustor's efficiency increases as the fuel/air ratio is increased from idle to full power conditions. Fuel zoning increases the local fuel/air ratio making those portions of the combustor which are operating more efficient. This method has been shown to reduce the idle emission of total hydrocarbon by 5 to 1 in a double annular combustor sized for a large augmented turbofan engine. Operating with a larger than normal compressor overboard bleed allows increasing fuel/air ratio without increasing idle thrust. By using this method in a JT3C-7 engine a reduction of 2 to 1 in the emission of total hydrocarbon was demonstrated. (Author)

A74-13244 * # Advanced technology for reducing aircraft engine pollution. R. E. Jones (NASA, Lewis Research Center, Cleveland, Ohio). *American Society of Mechanical Engineers, Winter Annual Meeting, Detroit, Mich., Nov. 11-15, 1973, Paper 73-WA/Aero-2.* 6 p. 16 refs. Members, $1.00; nonmembers, $3.00. NASA-sponsored research.

The proposed EPA regulations covering emissions of gas turbine engines will require extensive combustor development. The NASA is working to develop technology to meet these goals through a wide variety of combustor research programs conducted in-house, by contract, and by university grant. In-house efforts using the swirl-can modular combustor have demonstrated sizable reduction in NO emission levels. Testing to reduce idle pollutants has included the modification of duplex fuel nozzles to air-assisted nozzles and an exploration of the potential improvements possible with combustors using fuel staging and variable geometry. The Experimental Clean Combustor Program, a large contracted effort, is devoted to the testing and development of combustor concepts designed to achieve a large reduction in the levels of all emissions. This effort is planned to be conducted in three phases with the final phase to be an engine demonstration of the best reduced emission concepts. (Author)

A74-13245 # A similarity parameter for scaling dynamic inlet distortion. M. T. Moore and J. E. Lueke (General Electric Co., Cincinnati, Ohio). *American Society of Mechanical Engineers, Winter Annual Meeting, Detroit, Mich., Nov. 11-15, 1973, Paper 73-WA/Aero-3.* 6 p. Members, $1.00; nonmembers, $3.00. Contract No. F33615-72-C-1763. AF Project 3066; AF Task 11.

A similarity parameter suitable for use in both analog and digital analyses of time-dependent inlet pressure distortion data is proposed. The similarity parameter facilitates prediction of full-scale time-variant pressure distortion levels from scale-model inlet dynamic data when used in conjunction with the Method D distortion parameters. Consistent selection of frequency bandwidths in filtering the fluctuating pressure signals for an instantaneous distortion analysis and the production of similarity ratios for dynamic-to-steady distortion levels in inlets of different types and sizes can be achieved by using the parameter. V.Z.

A74-13246 * # Some stability and control aspects of airframe/propulsion system interactions on the YF-12 airplane. D. T. Berry and G. B. Gilyard (NASA, Flight Research Center, Handling Qualities Branch, Edwards, Calif.). *American Society of Mechanical Engineers, Winter Annual Meeting, Detroit, Mich., Nov. 11-15, 1973, Paper 73-WA/Aero-4.* 7 p. Members, $1.00; nonmembers, $3.00.

Airframe/propulsion system interactions can strongly affect the stability and control of supersonic cruise aircraft. These interactions generate forces and moments similar in magnitude to those produced by the aerodynamic controls, and can cause significant changes in vehicle damping and static stability. This in turn can lead to large aircraft excursions or high pilot workload, or both. For optimum integration of an airframe and its jet propulsion system, these phenomena may have to be taken into account. (Author)

A74-13292 # The effects of water, pressure, and equivalence ratio on nitric oxide production in gas turbines. H. Shaw (Esso Research and Engineering Co., Linden, N.J.). *American Society of Mechanical Engineers, Winter Annual Meeting, Detroit, Mich., Nov. 11-15, 1973, Paper 73-WA/GT-1.* 7 p. 21 refs. Members, $1.00; nonmembers, $3.00.

A semiempirical technique, based on chemical kinetics and disregarding fluid-dynamic effects, was developed for predicting the NOx emission index during the combustion of distillate-type fuels with air in an attempt to evaluate combustion modification procedures for lowering NOx emissions. The basis of the technique was a modified Zeldovich chain mechanism (1946) for NO production from hot air, and Fenimore's (1970) data for 'prompt NOx.' The resulting expression lends itself to hand calculation when the nitric oxide equilibrium value is known for the temperature and pressure of interest. Excellent agreement was obtained between experimental results for gas turbines and calculations by this technique. A large volume of data from aircraft gas turbines was correlated by assuming an apparent residence time of 0.5 millisec for NOx production. The effectiveness of water addition in minimizing NOx emissions was predicted for a model of an industrial gas turbine using a 2 millisec residence time. V.Z.

A74-13293 # Conversion of fuel nitrogen to NOx in a compact combustor. H. R. Hazard (Battelle Columbus Laboratories, Columbus, Ohio). *American Society of Mechanical Engineers, Winter Annual Meeting, Detroit, Mich., Nov. 11-15, 1973, Paper 73-WA/GT-2.* 4 p. Members, $1.00; nonmembers, $3.00.

A low-nitrogen fuel, ASTM Jet A aviation kerosene, was doped with increasing amounts of pyridine as a means of increasing the content of chemically bound nitrogen; it was then burned at a rate of 50 lb/hr in a compact combustor incorporating staged air admission with a rich primary zone and water cooling of the walls. Each increase in fuel nitrogen content resulted in a significant increase in NOx in the combustion products, and it is estimated that as much as 90% of the fuel nitrogen was converted to NOx at very low nitrogen levels, decreasing to 55% conversion at higher levels. These results are consistent with data reported for large steam boilers and for small residential boilers. It appears that emission standards requiring very low levels of NOx emission will require use of fuels with very low nitrogen content. (Author)

A74-13296 # Acoustic characteristics of a gas turbine exhaust model. J. R. Cummins (General Electric Co., Gas Turbine Products Div., Schenectady, N.Y.). *American Society of Mechanical Engineers, Winter Annual Meeting, Detroit, Mich., Nov. 11-15, 1973, Paper 73-WA/GT-5.* 4 p. Members, $1.00; nonmembers, $3.00.

To investigate the sources of acoustic radiation from a gas turbine exhaust, a one-seventh scale model has been constructed. The model geometrically scales the flow path downstream of the rotating parts including support struts and turning vanes. A discussion and comparison of different kinds of aerodynamic and acoustic scaling techniques are given. The effect of the temperature ratio between model and prototype is found to be an important parameter in comparing acoustical data. (Author)

A74-13298 * # Turbine noise generation and suppression. M. J. Benzakein and E. B. Smith (General Electric Co., Cincinnati, Ohio). *American Society of Mechanical Engineers, Winter Annual Meeting, Detroit, Mich., Nov. 11-15, 1973, Paper 73-WA/GT-7.* 14 p. 8 refs. Members, $1.00; nonmembers, $3.00. U.S. Department of Transportation Contracts No. FA-SS71-13; No. FA72WA-3023; Contract No. NAS3-12430.

An analytical method for the prediction of turbine generated noise is discussed. The method links the duct acoustic modes with

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the turbomachinery aerodynamics. The results of the analysis are compared with turbine component and engine results. Component data on the effects of the variation of axial spacing between blade rows on turbine aerodynamics and acoustics are presented. The results of an experimental evaluation of the relative importance of turbine noise on highly suppressed bypass turbofans are discussed. The development of high temperature acoustic treatment and its application to high bypass turbofans are presented. (Author)

A74-13299 # **Status of state air emission regulations affecting gas turbines.** N. R. Dibelius and R. J. Ketterer (General Electric Co., Gas Turbine Div., Schenectady, N.Y.). *American Society of Mechanical Engineers, Winter Annual Meeting, Detroit, Mich., Nov. 11-15, 1973, Paper 73-WA/GT-8.* 13 p. Members, $1.00; nonmembers, $3.00.

A summary of the state regulations as of May 30, 1973, covering air pollution emissions from stationary gas turbines. The summary includes a tabulation of allawable emission for the 50 states, 2 territories, and the District of Columbia for particulates, sulfur dioxide, nitrogen oxides, and visible emission. The tabulation presents a useful quick reference to the overall situation as of June, 1973, even though extensive changes to these regulations may be forthcoming. V.Z.

A74-13300 # **Sampling a turbine engine exhaust for average emissions.** B. W. Doyle (Avco Corp., Avco Lycomine Div., Stratford, Conn.). *American Society of Mechanical Engineers, Winter Annual Meeting, Detroit, Mich., Nov. 11-15, 1973, Paper 73-WA/GT-9.* 9 p. 8 refs. Members, $1.00; nonmembers, $3.00. Grant No. DAAJ02-72-C-0102.

The method of obtaining an average value for the exhaust emissions from a turbine engine at a fixed power setting is explored. The general characteristics of a gas turbine exhaust are discussed in the light of recent experimental data and concepts are presented for designing a multiport probe which will collect a sample representative of the average engine emissions. A comparison is made of the average and traverse data gathered from an engine and a laboratory rig using the same combustor as used in the engine. In general it appears that the variation of engine emissions with time may be more difficult to deal with than the spatial emission profiles in the exhaust plane. (Author)

A74-13301 * # **Application of finite difference techniques to noise propagation in jet engine ducts.** K. J. Baumeister (NASA, Lewis Research Center, Cleveland, Ohio). *American Society of Mechanical Engineers, Winter Annual Meeting, Detroit, Mich., Nov. 11-15, 1973, Paper 73-WA/GT-10.* 8 p. 9 refs. Members, $1.00; nonmembers, $3.00.

A finite difference formulation is presented for wave propagation in a rectangular two-dimensional duct without steady flow. The difference technique, which should be used in the study of acoustically treated inlet and exhausts ducts used in turbofan engines, can readily handle acoustical flow field complications such as axial variations in wall impedance and cross-section area. In the numerical analysis, the continuous acoustic field is lumped into a series of grid points in which the pressure and velocity at each grid point are separated into real and imaginary terms. An example calculation is also presented for the sound attenuation in a two-dimensional straight soft-walled suppressor. (Author)

A74-13303 # **Manufacture of hollow airfoils for elastic fluid turbines - Rokor.** R. O. Kaufman, Sr. (Universal-Cyclops Steel Corp., Specialty Steel Div., Tutusville, Pa.). *American Society of Mechanical Engineers, Winter Annual Meeting, Detroit, Mich., Nov. 11-15, 1973, Paper 73-WA/GT-12.* 7 p. Members, $1.00; nonmembers, $3.00.

Description of a manufacturing technique for the production of a hollow airfoil by joining specially-shaped suction and pressure surfaces to form the top and bottom halves of the airfoil. Two experimental shapes of such surfaces were joined by conventional metal fastening techniques to demonstrate the feasibility of this technology in the production of constant and tapered vanes with a hollow subsonic airfoil section. Constant bucket sections, and constant and tapered circular arc airfoils have been produced from experimental pressure surface components. Vanes with and without integral stiffening ribs are also produced. Wrought metals except titanium can be used as the materials. V.Z.

A74-13321 The influence of a high velocity fluid environment on the static and dynamic stability of thin cylindrical shell structures. W. Horn, R. Stearman (Texas, University, Austin, Tex.), and G. Barr (Sandia Laboratories, Albuquerque, N. Mex.). In: Hydromechanically loaded shells. Honolulu, University Press of Hawaii, 1973, p. 24-47. 17 refs.

The investigation discussed includes the basic evaluation of the past and currently employed analytical modeling of the problem. The general problem becomes one of practical consideration in the design of skin panels on space shuttle vehicles, reusable launch boosters, and high performance supersonic aircraft. As a result of theoretical studies several observations were made concerning the degree of sophistications required in the analytical modeling of the problem. Both experimental and analytical results from this investigation demonstrate that the still-air buckling characteristics of thin cylindrical shells were not significantly influenced by the supersonic air stream. G.R.

A74-13362 Dynamic stability of straight airplane wings regarded as thin-walled bars. N. D. Popescu-Castellin (Petrosani, Institutul de Mine, Petrosani, Rumania). *L'Aerotecnica - Missili e Spazio,* vol. 52, Aug. 1973, p. 261-270. 6 refs.

The differential equations describing the vibratory motion of a wing under a periodic aerodynamic pressure are derived for wing approximated by a thin-walled bar of closed cross section. A solution of the equations is obtained for the case where the variable force has a continuous sinusoidal form. The stability (instability) conditions of the wind are deduced from the stability conditions of the solution as a function of the elastic characteristics of the wing, the amplitude of the load, and the wing velocity. V.P.

A74-13364 The state of application of composite materials in aeronautics (Sullo stato applicativo dei materiali compositi in aeronautica). P. Jauch (Aeritalia S.p.A., Naples, Italy) and I. C. Visconti (Napoli, Università, Naples, Italy). *L'Aerotecnica - Missili e Spazio,* vol. 52, Aug. 1973, p. 279-292. 16 refs. In Italian.

Review of the wide range of composite materials provided by industry or synthesized in laboratories. The various types of matrices and fiber reinforcements are examined in successive groups to shed light on the characteristics peculiar to each family of products. This applies to both plastic and metallic fibers and matrices. The advantages and disadvantages of each material in comparison with conventional materials are indicated, as well as methods of fabricating the new materials, and an analysis is made of the suitability of introducing these materials. Finally, both technical and economic aspects of the use of these composites in various structural components of aircraft in which selective reinforcement has been introduced on an experimental basis are elucidated. A.B.K.

A74-13365 Recent research activities at the Aeronautics Institute of the University of Pisa in the field of aircraft structure fatigue (Recenti attività di ricerca dell'Istituto di Aeronautica dell'Università di Pisa nel campo della fatica delle strutture aeronautiche). A. Salvetti and C. Casarosa (Pisa, Università, Pisa, Italy). *L'Aerotecnica - Missile e Spazio,* vol. 52, Aug. 1973, p. 293-302. 15 refs. In Italian.

A74-13548 Investigations concerning yawed caret wings in the hypersonic domain (Untersuchungen an schiebenden Wellenreiterflügeln im Hyperschallbereich). K. Kipke (Braunschweig, Technische Universität, Braunschweig, West Germany). *Zeitschrift für*

Flugwissenschaften, vol. 21, Nov. 1973, p. 381-400. 40 refs. In German.

The results of investigations on yawed caret wings, which were carried out in a gun tunnel, are presented. The measurements comprised lateral force, yaw moment, roll moment, static pressure distribution on the contour, and Pitot pressure in the flow field for the determination of the shock system. Measurements of velocity profiles in the boundary layer on the lower side of unyawed wings showed only weak influence of the pressure side bending. The derivatives of lateral motion determined from the measurements were compared with the tangential wedge theory and the two-dimensional theory by Bagley, showing poor agreement between theory and measurement. However, good agreement between theory and measurement even in the case of large angles of incidence was obtained by assuming a modified pressure distribution in span the direction. (Author)

A74-13549 Unsteady pressure distribution measurements involving a harmonically vibrating wing model in three-dimensional compressible flow (Instationäre Druckverteilungsmessungen an einem harmonisch schwingenden Flügelmodell in dreidimensionaler, kompressibler Strömung). H. Triebstein (Aerodynamische Versuchsanstalt, Göttingen, West Germany). *Zeitschrift für Flugwissenschaften*, vol. 21, Nov. 1973, p. 400-412. 27 refs. In German.

Unsteady pressure distributions were measured on a harmonically oscillating rectangular semi-wing model with a rudder in three-dimensional, compressible flow with numerous parameter variations. The measurements were made at wing oscillations about the 1/4-axis and the center axis of the profile and at rudder oscillations about the rudder leading edge in the Mach number range from 0.5 to 1.2. Reynolds numbers were between 1.3 and 4.8 million. The results of the measurements were critically compared with corresponding theoretical results of the unsteady aerofoil theory. Particularly, the influences of the oscillation amplitude, of the angle of attack, and of the Reynolds number on the unsteady pressure distributions for wing oscillations about the 1/4-axis were more closely investigated. (Author)

A74-13730 Jet engine emissions. S. O'Quigley (Air Lingus Irish, Dublin, Ireland). *(Académie Internationale de Médecine Aéronautique et Spatiale and Société Française de Physiologie et de Médecine Aéronautiques et Cosmonautiques, Congrès International de Médecine Aéronautique et Spatiale, 20th, Nice, France, Sept. 18-21, 1972.) Revue de Médecine Aéronautique et Spatiale*, vol. 12, 2nd Quarter, 1973, p. 260-263.

In the immediate vicinity of airports, aircraft become major contributors to air pollution. The relative magnitude of the contribution by aircraft would rise in the next decade because of increased aircraft activity. A comparison of the emission rates in tons per day between motor vehicles and jet aircraft in Los Angeles County in 1969 indicate that the jet engine contributed approximately 1 per cent of the total. Attention is given to particulates, carbon monoxide, hydrocarbons, and oxides of nitrogen in exhausts. F.R.L.

A74-13770 Aircraft noise induced vibration in fifteen residences near Seattle-Tacoma International Airport. S. M. Cant and P. A. Breysse (Washington, University, Seattle, Wash.). *American Industrial Hygiene Association Journal*, vol. 34, Oct. 1973, p. 463-468. 9 refs.

Wall acceleration (g rms) levels were investigated in 15 single-family dwellings. Levels measured during 24-hour continuous sampling ranged from 0.0025 to 0.22 g rms. Background levels were under 0.0018 g rms. Although acute adverse health effects and major structural damage were not shown to be likely, aircraft noise induced vibration is shown to create a nuisance problem for residents near a major airport. (Author)

A74-13789 INTER-NOISE 73; Proceedings of the International Conference on Noise Control Engineering, Copenhagen, Denmark, August 22-24, 1973. Conference sponsored by the Danmarks Tekniske Hojskole. Edited by O. J. Pedersen (Danmarks Tekniske Hojskole, Lyngby, Denmark). Lyngby, INTER-NOISE 73, Danmarks Tekniske Hojskole, 1973. 645 p. $34.

Ground vibrations generated by factory machines and vehicles, the assessment of the overall effect of intermittent noise sources by noise exposure indices, and aspects of temporary hearing loss resulting from occasional or brief noise exposures are among the topics covered in papers concerned with noise control in industry. Other areas covered include noise control in buildings, aircraft noise, and methods and instrumentation for noise measurements. M.V.E.

A74-13791 Tip load modulation as a source of discrete tone fan noise. T. E. Siddon and L. J. Leggat (British Columbia, University, Vancouver, Canada). In: INTER-NOISE 73; Proceedings of the International Conference on Noise Control Engineering, Copenhagen, Denmark, August 22-24, 1973. (A74-13789 03-02) Lyngby, INTER-NOISE 73, Danmarks Tekniske Hojskole, 1973, p. 176-185. 8 refs. Defence Research Board of Canada Grant No. 66-9603.

Experimental data are presented that show blade load modulations, concentrated mainly in the vicinity of blade tips, as the source of discrete frequency noise from axial flow fans. The pressure modulation pattern is cyclic and appears to be fixed to the geometry of the fan. The several possible mechanisms investigated include tip clearance modulation, inflow separation on the bell mouth, and ingestion of concentrated inlet distortions. M.V.E.

A74-13792 Effect of unsteady loading on rotor noise. A. Fathy (Cairo University, Cairo, Egypt) and E. Lumsdaine (Tennessee, University, Knoxville, Tenn.). In: INTER-NOISE 73; Proceedings of the International Conference on Noise Control Engineering, Copenhagen, Denmark, August 22-24, 1973. Lyngby, INTER-NOISE 73, Danmarks Tekniske Hojskole, 1973, p. 186-190. 12 refs.

A method is presented that is adaptable to the study of fan rotor noise resulting from any type of unsteady conditions. It is used for predicting the noise resulting from rotor and inlet guide vane interaction and for comparison with some pertinent experimental findings. M.V.E.

A74-13793 Aerodynamic noise from porous propeller fans. R. C. Chanaud, N. Kong, and R. B. Sitterding (IBM Corp., Boulder, Colo.). In: INTER-NOISE 73; Proceedings of the International Conference on Noise Control Engineering, Copenhagen, Denmark, August 22-24, 1973. Lyngby, INTER-NOISE 73, Danmarks Tekniske Hojskole, 1973, p. 191-195.

An experimental assessment of aerodynamic noise from porous propeller fans indicates that under realistic conditions sound power can be reduced by about 5 dB(A) and that this small noise reduction is accompanied by small decreases in static flow efficiency. It is suggested that, in using porous blades for fan noise reduction, the material be solid to within 10% of the blade tips, and that the pitch angle of the blades be increased. M.V.E.

A74-13795 Can helicopters be good neighbors. H. Sternfeld, Jr. (Boeing Vertol Co., Philadelphia, Pa.). In: INTER-NOISE 73; Proceedings of the International Conference on Noise Control Engineering, Copenhagen, Denmark August 22-24, 1973. Lyngby, INTER-NOISE 73, Danmarks Tekniske Hojskole, 1973, p. 438-444. 6 refs.

Problems associated with the generation and effects of helicopter noise are reviewed. Cost of noise reduction as a function of noise level, relative effect of changing the duration of a sound on its subjectively rated annoyance, the principal sources of helicopter noise, effects of tip airfoil on rotor noise, comparison of measured and predicted rotational noise, and operating costs as a function of

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noise reduction are among the various aspects of the problems discussed. M.V.E.

A74-13796 Non-engine aerodynamic noise - The limit to aircraft noise reduction. J. S. Gibson (Lockheed-Georgia Co., Marietta, Ga.). In: INTER-NOISE 73; Proceedings of the International Conference on Noise Control Engineering, Copenhagen, Denmark, August 22-24, 1973. Lyngby, INTER-NOISE 73, Danmarks Tekniske Hojskole, 1973, p. 445-454. 30 refs.

Review of some of the techniques, results, and result implications of nonengine, aerodynamic noise measurements performed upon a large transport aircraft, the C-5 Galaxy. The noise contributions of aerodynamic-configuration and flap-extension effects, landing gear, wheel well, and trailing vortex wake are discussed, and nonengine noise reduction possibilities are examined. M.V.E.

A74-13797 The role of certification in freeing the environment from aircraft noise nuisance. F. B. Greatrex (U.K. Civil Aviation Authority, London, England). In: INTER-NOISE 73; Proceedings of the International Conference on Noise Control Engineering, Copenhagen, Denmark, August 22-24, 1973. Lyngby, INTER-NOISE 73, Danmarks Tekniske Hojskole, 1973, p. 455-463.

The use of noise certification is proposed as a practical means for freeing the environment from the aircraft noise nuisance. Specific goals in terms of noise level limits are suggested for all new types of aircraft that are to enter service in 1990 and thereafter. Advance planning for the implementation of these goals is recommended. M.V.E.

A74-13798 Performance and noise aspects of supersonic transport. J. Calmon and R. Hoch (SNECMA, Paris, France). In: INTER-NOISE 73; Proceedings of the International Conference on Noise Control Engineering, Copenhagen, Denmark, August 22-24, 1973. Lyngby, INTER-NOISE 73, Danmarks Tekniske Hojskole, 1973, p. 464-473. 5 refs.

The operating economics of a supersonic commercial aircraft are shown to be very sensitive to changes in power plant weight and propulsion efficiency and, therefore, necessarily compelled to be noisier than subsonic aircraft at the same technology level. It is expected that the noise level of supersonic commercial aircraft will be governed by the capability of varying optimal aerodynamic and propulsive configurations between takeoff and cruise. M.V.E.

A74-13799 Electroacoustical performance requirements for aircraft noise certification measurements. V. Bruel (Bruel and Kjaer A/S, Naerum, Denmark). In: INTER-NOISE 73; Proceedings of the International Conference on Noise Control Engineering, Copenhagen, Denmark, August 22-24, 1973. Lyngby, INTER-NOISE 73, Danmarks Tekniske Hojskole, 1973, p. 474-481.

Discussion of some of the problems associated with the determination and implementation of electroacoustical requirements of noise measurement accuracy for aircraft noise certification. Some recommendations about the design and calibration of aircraft noise measuring systems are also presented. M.V.E.

A74-13800 Airport noise monitoring systems. W. Vase (Bruel and Kjaer A/S, Naerum, Denmark). In: INTER-NOISE 73; Proceedings of the International Conference on Noise Control Engineering, Copenhagen, Denmark, August 22-24, 1973. Lyngby, INTER-NOISE 73, Danmarks Tekniske Hojskole, 1973, p. 482-486.

Description of a permanently installed airport noise monitoring system that requires a minimum of human attention and is capable to detect noise infringements as and when they occur. The system consists essentially of: (1) an outdoor installation made up of five noise monitoring terminals; (2) a computer-based indoor central station; and (3) the communication system between (1) and (2). Provisions are included also for the storage of noise data to be subsequently processed. M.V.E.

A74-13802 Automatic support systems for advanced maintainability; International Symposium, Arlington, Tex., November 5-7, 1973, Record. Symposium sponsored by the Institute of Electrical and Electronics Engineers. New York, Institute of Electrical and Electronics Engineers, Inc., 1973. 160 p. $15.

Recent advances in automatic test equipment and procedures are described in papers dealing with sensor systems, data transmission, and computer software developed for commercial and military applications. Topics considered include the use of infrared signatures for analysis of digital circuits, a compiler-compiler system for avionic test languages, a system test set of military telephone switchboards, built-in testing of advanced aircraft electrical systems, a surface vehicle mobility measuring and recording system, test documentation guidelines, development of diagnostic test procedures for digital logic systems, a programming language for automatic testing, and determination of waveform parameters by an automatic test system. T.M.

A74-13804 A compiler-compiler system for avionic test languages. M. N. Matelan (General Dynamics Corp., Convair Aerospace Div., San Diego, Calif.). In: Automatic support systems for advanced maintainability; International Symposium, Arlington, Tex., November 5-7, 1973, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1973, p. 17-24. 6 refs.

An overview of a developmental translation system intended to produce compilers for computer languages specifically designed for use in avionic testing is presented. The base of the system is a compiler-compiler that will produce parsing subroutines corresponding to the syntactic requirements of the high order statement types found in the target test language. Partial semantic interpretation is included in the subroutines, while the final interpretation is directed from tables at target compiler run-time. The subroutines produced are integrated into a generalized skeleton program used to interface the final compiler with a particular operating system. Low order language elements are processed from tables at test problem compile-time. Simplified examples of the major elements of the meta-language used to define a test language to the compiler-compiler are included. (Author)

A74-13807 AIRTRANS operational readiness test. R. A. Nicholson (LTV Aerospace Corp., Dallas, Tex.). In: Automatic support systems for advanced maintainability; International Symposium, Arlington, Tex., November 5-7, 1973, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1973, p. 45-52.

AIRTRANS provides interterminal transportation at the Dallas-Fort Worth Regional Airport. Operational readiness of the vehicles is assured by an automated Departure Test. The test plan was formulated in the conceptual stages of AIRTRANS design. Main objectives of the plan were to make the vehicles testable using existing operational hardware and with no special test connector. Test design features had the same priority as other vehicle operating requirements. Merging test constraints with prime system operating requirements achieved an efficient and very thorough test. In addition, vehicle checkout features aided verification, production and maintenance testing. The results demonstrate that sufficient priority applied to test objectives, early, provides important contributions to overall system design. (Author)

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A74-13808 **Cost effective built-in test for advanced aircraft electrical systems.** H. Brown (U.S. Naval Material Command, Naval Air Development Center, Warminster, Pa.) and H. W. Heinzman (LTV Aerospace Corp., Vought Systems Div., Dallas, Tex.). In: Automatic support systems for advanced maintainability; International Symposium, Arlington, Tex., November 5-7, 1973, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1973, p. 53-60. 7 refs.

This paper presents a method for utilizing the data handling portion of the SOSTEL multiplex system to provide a cost effective built-in test (BIT) capability to isolate faults to the line replaceable unit (LRU). The evolved techniques provide a means for determining the health of each of the 2048 input and 2048 output controls which are multiplexed by the system. In addition four techniques to automatically test the data handling circuits are also discussed. The BIT system as defined is efficient, small in size and weight, and cost effective because most of the data circuits are time shared to accommodate BIT data. The BIT data is used inflight in the solution of power management equations to permit programming of redundancy and safety interlocks. Two types of maintenance displays are discussed; a maintenance panel and an onboard strip printer. The BIT system is compatible with air-to-ground data link to maintenance data. (Author)

A74-13813 **User report on automatic test equipment.** D. A. Degerman (Forsvarets Materielverk, Stockholm, Sweden). In: Automatic support systems for advanced maintainability; International Symposium, Arlington, Tex., November 5-7, 1973, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1973, p. 105-112.

Description of a family of automatic test equipment units that provide a completely integrated system for the avionics maintenance testing of the AJ37 'Viggen' aircraft. The development of this equipment and its actual service performance are discussed. M.V.E.

A74-13815 **CTL - A programming language for automatic testing.** D. B. Loveman (Massachusetts Computer Associates, Inc., Wakefield, Mass.). In: Automatic support systems for advanced maintainability; International Symposium, Arlington, Tex., November 5-7, 1973, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1973, p.131-140. 6 refs. Grant No. DAAA25-72-C-0492.

CTL is a new language for the programming of test procedures to be run on automatic test equipment. In CTL one can describe test procedures for a wide class of units to be tested. The CTL approach uses a model of the abstract or virtual test equipment on which a program is to run, a structured programming approach to the design and implementation of test programs, and the idea of a programming system in which test programs are constructed. This paper discusses the approach and introduces some of the language features of CTL. (Author)

A74-13842 # **Reynolds number effects at low speeds on the maximum lift of two-dimensional aerofoil sections equipped with mechanical high lift devices.** J. A. Thain (National Aeronautical Establishment, High Speed Aerodynamics Laboratory, Ottawa, Canada). *Canada, National Research Council, Division of Mechanical Engineering and National Aeronautical Establishment, Quarterly Bulletin*, no. 3, 1973, p. 1-24. 24 refs.

A review of the published data on the maximum lift coefficient, at low speeds, of aerofoils equipped with mechanical high lift devices as affected by variations in the Reynolds number has been conducted. The results of two-dimensional wind tunnel tests on high lift systems indicate that Reynolds number has a marked and varied effect on maximum lift coefficient and the optimum geometry of the high lift system is Reynolds number dependent. The investigation has also revealed an important interaction of Mach number with Reynolds number effects, which must be taken into account when extrapolating model tests to full scale. (Author)

A74-13886 * **Numerical analysis of stiffened shear webs in the postbuckling range.** M. Stein and J. H. Starnes, Jr. (NASA, Langley Research Center, Hampton, Va.). In: Numerical solution of nonlinear structural problems; Proceedings of the Symposium, Detroit, Mich., November 11-15, 1973. New York, American Society of Mechanical Engineers, 1973, p. 211-223. 9 refs.

The postbuckling behavior of shear webs divided into rectangular panels by stiffeners (uprights) was studied numerically, using the STAGS program in which two-dimensional finite differences are used to solve buckling and nonlinear problems. Universal nondimensional parameters, suggested by linear buckling data, are found to hold for the postbuckling range. Results indicate that the postbuckling stiffness of shear webs with isotropic panels is roughly two thirds of the prebuckling stiffness. The postbuckling behavior of shear webs with isotropic and orthotropic material properties is compared. Some practical aspects of solving nonlinear problems of this type by the numerical method employed are examined. V.P.

A74-13953 **Fabrication of advanced fibrous composite structures.** A. T. Tucci (McDonnell Douglas Corp., St. Louis, Mo.). *Society of Manufacturing Engineers, Paper EM73-716*, 1973. 20 p. 11 refs. Members, $1.50; nonmembers, $2.00.

An improved method is described for densifying and staging graphite/epoxy preimpregnated materials for A-4 Skyhawk flap ribs, reducing the rib fabrication time by 75%. Tool design and cure cycles modifications reduced to a minimum the problem of springback initially encountered in the curing of composite attach angles on the A-4 horizontal stabilizer. Graphite/epoxy attach angles were formed, debulked, co-cured, and bonded to composite parts simultaneously. Trimming B-stages composite laminates on the tool, curing, and holding part tolerances to within 0.03 in., were successfully carried out. A solid diamond stem router was successfully used to edge rout the substructure honeycomb panels to the contour, without shattering or delaminating the thin skins. Form-fitting silicone rubber vacuum bags were developed and successfully used to fabricate large contour-shaped components. V.Z.

A74-13958 * # **Jet engine exhaust noise due to rough combustion and nonsteady aerodynamic sources.** E. G. Plett and M. Summerfield (Princeton University, Princeton, N.J.). *Acoustical Society of America, Meeting, 84th, Miami Beach, Fla., Nov. 28-Dec. 1, 1972, Paper.* 27 p. 11 refs. Contract No. N00014-67-A-0151-0029; Grant No. NGR-31-001-241.

Internal sources are accounted for in terms of fluctuations of mass and momentum at the nozzle exit plane. At low Mach numbers, mass flow fluctuations generated at the exit plane by acoustic resonant type fluctuations inside the engine are found to be dominant. In the subsonic Mach number range between 0.3 and 0.5, exit plane mass flow fluctuations at frequencies characteristic of turbulence become most dominant. Above Mach 0.5, the turbulent momentum fluctuations at the exit plane become dominant, and the jet contribution is not found significant at subsonic speeds. (Author)

A74-13973 # **What's wrong with airline earnings.** D. J. Lloyd-Jones (American Airlines, Inc., New York, N.Y.). *Air Transport Association of America, Engineering and Maintenance Conference, Miami, Fla., Oct. 10-12, 1973, Paper.* 17 p.

It is pointed out that the airline industry's profits continue to lag well behind the levels necessary for reasonable financial stability. The general economic conditions are discussed together with questions of airline traffic growth, unit costs, total costs, and requirement. The problems which the industry is experiencing make it mandatory that everything is done to minimize the airline's operating costs and maximizing its schedule reliability. The opportunity for reduced costs and increased reliability are especially evident in the wide-body aircraft. G.R.

A74-13974 # **What keeps wide body jets down on the ground.** R. F. Moore (Eastern Air Lines, Inc., New York, N.Y.). *Air*

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Transport Association of America, Engineering and Maintenance Conference, Miami, Fla., Oct. 10-12, 1973, Paper. 10 p.

Factors involving a mechanical or operational breakdown of an aircraft are discussed, giving attention to engine problems, hydraulic system problems, auxiliary power unit problems, thrust reverser system problems, air-conditioning system problems, avionics systems, water/waste problems, the lavatory systems, flight controls, panels, and doors. The nature of the technical problems is considered, together with the impact of these problems on the airlines and approaches to assure that the wide body jets will achieve economic operating expense levels. G.R.

A74-13975 # The cost of a quality product. C. F. Turcott (American Airlines, Inc., Maintenance and Engineering Center, Tulsa, Okla.). *Air Transport Association of America, Engineering and Maintenance Conference, Miami, Fla., Oct. 10-12, 1973, Paper.* 13 p.

The subject of cost quality in today's jet aircraft is explored, with emphasis on hardware and systems quality rather than aircraft performance. Brief considerations and comments are directed at the areas of material selection, out of service time, training demands, spares support, design complexity, and warranty activity. An airline is dependent upon quality and cost effective designs from its vendors. In turn, these same vendors are dependent not only on the airline's initial business, but also the repeat business. By building and buying quality a guaranteed cost can be achieved. F.R.L.

A74-13976 # Improving aircraft productivity - We all have a part of the action. C. S. Glasgow (Douglas Aircraft Co., Long Beach, Calif.). *Air Transport Association of America, Engineering and Maintenance Conference, Miami, Fla., Oct. 10-12, 1973, Paper.* 15 p.

Aircraft productivity is a function of utilization, speed, passenger capacity, load factor, and service life. In order to expedite the solution to delays and high maintenance problems Douglas appointed 'problem managers,' each responsible for elimination of a specific problem. In carrying out their responsibilities the problem managers made observations that clearly illustrate that increasing aircraft productivity involves manufacturers, equipment vendors, and the airlines. Some additional means of improving productivity are outlined, e.g., use of optimum flap setting on takeoff, and operating at the aft center of gravity limit. F.R.L.

A74-13977 # Make no mistake about it - Air transport productivity demands a total and dedicated 'team effort.' J. F. Sutter (Boeing Commercial Airplane Co., Renton, Wash.). *Air Transport Association of America, Engineering and Maintenance Conference, Miami, Fla., Oct. 10-12, 1973, Paper.* 8 p.

It is pointed out that the modern fleet of wide body jet transports can be even more productive by a team effort on the part of the airlines, the FAA, and the manufacturers. Since mid-1971, 36 features have been incorporated in new production aircraft to make the Boeing 747 more productive. An agressive program has been adopted to recognize and develop improvements for in-service problems. A number of details are provided concerning the program to reduce maintenance costs on the 747. G.R.

A74-13978 # Modular construction - Fully optimised. C. S. Webster (Rolls-Royce /1971/, Ltd., Derby, England). *Air Transport Association of America, Engineering and Maintenance Conference, Miami, Fla., Oct. 10-12, 1973, Paper.* 16 p.

Modular construction and the ability to monitor the 'in-service' health of parts is a direct result of the constant drive toward easy and economic maintenance. Like any new concept, it is not only necessary to accept it as a principle, but also to accept its effect on many techniques and practices which are by nature 'traditional' but if not suitably amended can seriously degrade the advantages. Some areas are suggested where new thinking is necessary to take full advantage of the features of modular construction. The modular construction of the RB.211 and Adour engines is illustrated. It is considered that the next generation of engines will be modular, and easier replacement must be a target together with even better monitoring techniques. F.R.L.

A74-14018 # Problems of stress corrosion in the case of aluminum alloys employed in aerospace technology (Problemas de corrosión bajo tensiones en las aleaciones de aluminio empleadas en la tecnología aeroespacial). J. M. de la Torre Cursach and F. Ramírez Gomez (Instituto Nacional de Técnica Aeroespacial, Madrid, Spain). *(CENIN, Asamblea General, 3rd, Madrid, Spain, June 1973.) Ingeniería Aeronáutica y Astronáutica,* vol. 25, July-Aug. 1973, p. 30-41. 6 refs. In Spanish.

Directions of stress corrosion cracks in structural aircraft components are examined. A humid atmosphere provides a suitable medium for the process of corrosion, particularly in the case of a presence of chloride traces. The susceptibility of aircraft components depends to a large degree on the direction of stress relative to the structure of the material. Approaches for preventing an introduction of residual stresses into the components of the aircraft structure are discussed together with the various types of nondestructive testing methods. Questions of crack or fracture identification are also considered, taking into account macroscopic methods, microscopic methods, and aspects of correlation between microstructure and microfracture. G.P.

A74-14093 * Two-color dual-beam backscatter laser Doppler velocimeter. G. R. Grant and K. L. Orloff (NASA, Ames Research Center, Moffett Field, Calif.). *Applied Optics,* vol. 12, Dec. 1973, p. 2913-2916. 16 refs.

A laser Doppler velocimeter has been developed that uses two of the colors emitted from an argon-ion laser for the simultaneous measurement of orthogonal velocities. Designed for use in a 2.13- by 3.05-m wind tunnel, it is capable of traversing its focal volume across spatially unstable flows at scan speeds of up to 1.5 m/sec. Its optical layout and principles of operation are discussed, and the data from a typical traversal of a trailing wing-tip vortex are presented. (Author)

A74-14126 Western Electronic Show and Convention, San Francisco, Calif., September 11-14, 1973, Proceedings. Conference sponsored by WESCON. North Hollywood, Calif., Western Periodicals Co. (WESCON Technical Papers. Volume 17), 1973. 511 p. $70.

Recent advances in the fabrication, marketing, and application of new electronic devices are described in papers dealing with air traffic control, microwave systems, data processing, semiconductors, and power distribution. Some specific topics examined include point-of-sale computer terminals, computer-aided test design for automatic testing of electronic equipment, new designs and applications of microprocessors and minicomputers, applications in medical electronics, modeling of bipolar semiconductor devices, solid-state microwave sources, new semiconductor memories, Gunn effect devices, programmable test instrumentation, airport electric power sources, data distribution networks, ferroelectric ceramic electro-optic devices, LED displays, and liquid crystals. T.M.

A74-14127 Computer aided test design today. H. D. Kimp (Continental Consultants, Inc., Devon, Pa.). In: Western Electronic Show and Convention, San Francisco, Calif., September 11-14, 1973, Proceedings. North Hollywood, Calif., Western Periodicals Co., 1973, p. 10/1-1 to 10/1-8.

A study of avionics testing requirements for modern military aircraft was conducted to determine the optimum solution to the problem of maintaining avionic shop replaceable assemblies on board aircraft carriers. Typical testing problems encountered are explained, and the need for computer aided test design is demonstrated. Emphasis is placed on the operational principles and typical application of currently available computer-aided test design systems that would meet the requirements posed by testing of digital, analog, and hybrid circuit assemblies performing a wide variety of functions in various types of aircraft. T.M.

A74-14132 MLS program - Phase II. J. W. Edwards (FAA, Microwave Landing System Branch, Washington, D.C.). In: Western Electronic Show and Convention, San Francisco, Calif., September

11-14, 1973, Proceedings. North Hollywood, Calif., Western Periodicals Co., 1973, p. 24/1-1 to 24/1-9.

Phase II of the national plan for development of a microwave landing system (MLS) is intended for the acquisition of appropriate data and information to support the selection of the best equipment and technique (scanning beam or Doppler scanning). Four contractor teams are presently developing and fabricating hardware that will be tested to evaluate compliance with a specified range of operational requirements. The main features of equipment to be developed by each of the four contractors are delineated, and the anticipated test program is described in terms of the envisioned factory, static-field, and flight tests. T.M.

A74-14133 Power conditioning system for FAA Air Route Traffic Control Centers. A. J. Froehlich, Jr. (FAA, Washington, D.C.) and A. Kusko (Alexander Kusko, Inc., Needham Heights, Mass.). In: Western Electronic Show and Convention, San Francisco, Calif., September 11-14, 1973, Proceedings. North Hollywood, Calif., Western Periodicals Co., 1973, p. 25/2-1 to 25/2-4.

The FAA is currently installing solid-state uninterruptible power source (UPS) equipment to supply electrical power at a high level of reliability in 20 U.S. air route traffic control centers. Each UPS consists of several parallel-connected 200-kVA rectifier-inverter modules which operate either from the commercial power line or from batteries and engine-generator sets upon failure of the commercial power. Performance and reliability requirements dictated by application in the air route traffic control centers are outlined together with plans developed for testing and maintenance of these power units. T.M.

A74-14142 Reliability in avionics. P. H. Mead (Ferranti, Ltd., Edinburgh, Scotland). *Flight International*, vol. 104, Nov. 29, 1973, p. 900, 901.

In avionics, advanced technology has brought greater complexity with wider use being made and increased reliance being imposed on more and more components. Complexity, however, may increase unreliability to wholly unacceptable levels threatening safety, confidence, and economy. Built-in test equipment can make a significant economic contribution by allowing correct diagnosis on the flight line and making it unnecessary to remove serviceable units. The benefits and challenges of new technology and cost-effective reliability are considered. As would be expected, problems in reliability are in proportion to the degree of sophistication or technological advance in avionics equipment. F.R.L.

A74-14158 # Multi-axial low cycle fatigue test rig. S. J. Leshenski (Avco Corp., Lycoming Div., Stratoford, Conn.). *Society for Experimental Stress Analysis, Fall Meeting, Indianapolis, Ind., Oct. 16-19, 1973, Paper.* 26 p. 5 refs.

A multiaxial test rig for testing aircraft gas turbine compressor and turbine disks is described. The rig is based on the closed-loop electro-servo hydraulic control principle. This principle combines the use of hydraulic and electronic components to not only control the loads but to hold the true disk position. Nonrotating disks can be loaded to produce stresses which closely simulate loading experienced by disks in service. Disks with up to 100 loading points and with diameters between 2.5 and 18 in. are acceptable within this framework, with loads up to 25,000 lb per loading point, at frequencies up to 7 Hz, and at temperatures in excess of 1500 F. The rig has demonstrated its effectiveness as a useful laboratory tool for compressor and turbine disk low cycle fatigue and cyclic stress rupture life evaluation. (Author)

A74-14262 Man-powered flight - The oscillating wing machine. H. Upenieks. *Aeronautical Journal*, vol. 77, Oct. 1973, p. 502-505. 8 refs.

Oscillating-wing machine designs are considered, giving attention to the unbalanced and the balanced power system. The opportunity to rest during the exercise is important for the reason that man's physical endurance can be greatly extended if periods of high activity are alternated with short periods of rest. It is pointed out that the basic requirements of man made, man-powered oscillating wings are different from the requirements imposed by nature on the natural wings. G.R.

A74-14263 An oscillatory method for the flight calibration of sideslip and incidence sensors. B. R. A. Burns (British Aircraft Corp., Ltd., Military Aircraft Div., Preston, Lancs., England). *Aeronautical Journal*, vol. 77, Oct. 1973, p. 506-511.

The local flow angles measured by incidence and sideslip probes mounted on aircraft differ in general from the free stream or 'true' values due to the flow field of the aircraft and of the sensors themselves. A method is described for determining the correction factors by means of measurements made in oscillatory motion. The longitudinal short period mode is used for incidence calibration, the dutch roll for sideslip. G.R.

A74-14361 QTOL-Europlane. H. Redemann. *Flug Revue/Flugwelt International*, Dec. 1973, p. 18-21. In German.

The aerospace company Europlane Ltd. was founded in Weybridge, England, in April 1972. The new firm was to develop an aircraft for short-distance flights. It is estimated that about 2500 aircraft of the new design will be needed, taking into account the expected global demand. The noise produced by the new aircraft is to be below the noise level of presently operating aircraft. Regular commercial flight operations with the new aircraft are to begin in 1979. The payload range of the new aircraft is discussed together with the noise levels, the effects of improved climb performance, and details of interior layout. G.R.

A74-14362 Remotely piloted vehicles - Necessity, wishful thinking, or plaything (Unbemannte Flugkörper - Notwendigkeit, Wunschdenken oder Spielerei). R. Olsen. *Flug Revue/Flugwelt International*, Dec. 1973, p. 27-30, 35-38. In German.

Various types of remotely piloted vehicles (RPV) are considered, taking into account the military objectives for which the vehicles are to be used. RPV developed in Germany during the time from 1939 to 1945 are compared with RPV designed in the U.S. after 1945. Attention is given to the Matador TM-61C, the Mace TM-76, the Goose SM-73, the Regulus II, and the SNARK SM-62. Other RPV considered include the Jindivik MK.3, the Beechcraft PD-121, the Beechcraft KDB-1, the Radioplane RP-76, the Ryan Firebee, and the Radioplane XQ-4. Ground-to-air missiles are discussed together with the German space program in the years from 1935 to 1945 and unmanned VTOL platforms for military applications. G.R.

A74-14363 Wear determination in Boeing 747 engines (Abriebauffindung in Boeing 747-Triebwerken). E. Jantzen (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Flugtreib- und Schmierstoffe, Munich, West Germany). *Flug Revue/Flugwelt International*, Dec. 1973, p. 47, 48, 50. 5 refs. In German.

Regular checks of the aircraft engines are being conducted for a number of years in order to increase flight safety. Studies have been carried out to use the amount of metal rubbed off from engine components and suspended in the lubricant as an indication for the degree of wear. The Spectrometric Oil Analysis Program of the U.S. Air Force was conducted to develop suitable equipment and approaches for wear control methods based on the amount of metal found in the oil. In the case of the Boeing 747 engines it was found that the amounts of metal in the oil was very small. The possible causes for this phenomenon are discussed, taking into account studies of the residue in centrifugal oil filters. G.R.

A74-14461 # **Fracture mechanics aircraft structural design application and related research.** H. A. Wood (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio) and N. Tupper (USAF, Materials Laboratory, Wright-Patterson AFB, Ohio). In: International Congress on Fracture, 3rd, Munich, West Germany, April 8-13, 1973, Reports. Part 9. Düsseldorf, Verein Deutscher Eisenhüttenleute, 1973, p. VIII-523.1 to VIII-523.6.

Description of fracture control procedures employed by the U.S. Air Force in the design of current and future aircraft to ensure safety by reducing the probability of catastrophic failure due to undetected damage. Attention is given to fracture-safety related aspects of material and process selection, material procurement and control, nondestructive inspection, and damage tolerance analyses and testing. Applications of fracture mechanics criteria to aircraft design have helped to clarify the importance of research in identifying the basic metallurgical mechanisms of fracture. Knowledge gained from such research is judged necessary for improving resistance to crack growth and for developing alloys which are relatively insensitive to chemical environments in which aircraft operate. T.M.

A74-14480 Evaluation of the helicopter as a camera platform. S. A. Veress (Washington, University, Seattle, Wash.). In: American Society of Photogrammetry, Annual Meeting, 39th, Washington, D.C., March 11-16, 1973, Proceedings. Falls Church, Va., American Society of Photogrammetry, 1973, p. 252-278. 12 refs.

The helicopter belongs to the family of low vibrating camera platforms. The predominant frequency range involved is 8.5 to 24 cycles per second. Such a frequency theoretically permits a photographic exposure time of 1/50 of one second. Thus an 'all weather' photography is made possible. Aspects of the evaluation problem are discussed together with the vibration effect, questions of camera suspension, and the testing of the photographic parameters. G.R.

A74-14498 # **Wake turbulence - The invisible killer.** R. M. Kidd (Canadian Air Line Pilots Association, Montreal, Canada). *CATCA Journal*, vol. 5, Fall 1973, p. 4-7, 26. 7 refs.

A number of hazardous takeoff situations and some accidents caused by wake vortices (wing tip vortices) from a preceding aircraft on a congested runway are described. Details are given on a wake vortices accident of June 8, 1966, resulting in a collision of an XB-70 and an F-104 over the Mojave Desert in California, and on the crash of a DC-9 behind a DC-10 at Fort Worth on May 30, 1972. Recommendations made by the ALPA air safety team after the crash are listed. V.Z.

A74-14499 # **The future of secondary surveillance radar in air traffic control.** R. Shipley (Cossor Electronics, Ltd., Harlow, Essex, England). *CATCA Journal*, vol. 5, Fall 1973, p. 18, 19.

The recent evolution of the SSR system is reviewed, noting the removal of reflected signals, the vastly improved azimuth accuracy, a lower interference and steadier displayed signals within sight, and the possibility of a high-capacity information link. It is anticipated that the SSR system will further improve the Air Traffic System and thereby contribute to greater safety and regularity of aviation. V.Z.

A74-14501 Airports for the 80s; Proceedings of the Fourth World Airports Conference, London, England, April 3-5, 1973. Conference sponsored by ICE, RIBA, RAeS, Chartered Institute of Transport, BAA, Royal Town Planning Institute, AOA, and ASCE. Edited by J. S. Davis. London, Institution of Civil Engineers, 1973. 210 p. $28.05.

Anticipated development and growth of air transport in the near future is examined in relation to the planning and design of airports for the 1980's. Papers examine differences between present and future commercial aircraft, the effects of technological development on international air transport, changes in the European air transport pattern, terminal planning for improved passenger and baggage movement, special development problems envisioned for Maplin Airport, social and economic consequences of airport operation, and the contrasts in national airport planning as occasioned by participation of central governments in different countries. T.M.

A74-14502 Demands for air transport - 1980-1990. K. Hammarskjold (International Air Transport Association, Montreal, Canada). In: Airports for the 80s; Proceedings of the Fourth World Airports Conference, London, England, April 3-5, 1973. London, Institution of Civil Engineers, 1973, p. 13-20.

Air transport in the 80s will be characterized by traffic volumes many times greater than those of today. In meeting this demand, the resolution of the economic and political aspects of the general problem will present greater difficulties than resolving the technical aspects. World airline passenger traffic should double by 1980 and increase six-fold by 1990. Scheduled air freight by 1980 will be 3.5 times, and by 1990 ten times, present volumes. Industrial countries will continue to predominate air passenger and freight traffic. Today's turbojet fleet of 4000 will expand to about 6000 by the early 80s and some aircraft may have over 1000 seats. Cargo capacity will increase proportionately. Congestion of airport runways, passenger and cargo terminals, inspection and ground transport facilities is expected to increase, as will demand for additional and improved airport systems. (Author)

A74-14503 Conventional take-off and landing. G. Sim (Lockheed-California Co., Burbank, Calif.). In: Airports for the 80s; Proceedings of the Fourth World Airports Conference, London, England, April 3-5, 1973. London, Institution of Civil Engineers, 1973, p. 25-34. 12 refs.

This paper discusses the characteristics of the new generation, wide-body jet transports, and in particular the Lockheed TriStar, with particular reference to airport operational interfaces. Considerations of physical dimensions and passenger access together with taxiway and runway requirements are included. Traffic control and noise factors are briefly reviewed. Traffic trends to the end of 1980 are indicated with some more speculative projections given for the balance of this century. Some immediate trends in aeroplane design are postulated with particular comment on airport community noise. A review of future CTOL size, cruise speed and field length requirements provides an indication of possible future airport needs. (Author)

A74-14504 Concorde in the airport environment. P. Besson (Compagnie Nationale Air France, Paris, France). In: Airports for the 80s; Proceedings of the Fourth World Airports Conference, London, England, April 3-5, 1973. London, Institution of Civil Engineers, 1973, p. 35-41.

The problem of injecting Concorde into the airport environment raises three different aspects: first, the handling of Concorde during approach and departure from an airport involving navigation aids, aerodynamic qualities of Concorde in subsonic flight and also long-range guidance; second, problems of noise and environment in general, either during take-off, approach or landing; third, problems related to the specific layout of the airport and which implicate the ground handling possibilities of Concorde, runway loads, temperatures and engine exhaust velocities, facilities for boarding and disembarkation of passengers and luggage. (Author)

A74-14505 Short take-off and landing. H. Davies (British Aircraft Corp., Ltd., London, England). In: Airports for the 80s; Proceedings of the Fourth World Airports Conference, London, England, April 3-5, 1973. London, Institution of Civil Engineers, 1973, p. 43-46.

It has been recognized for a long time that the development of STOL aircraft could make an important contribution to the solution of the problems of congestion and noise, while at the same time

easing the problem of opening up new routes, particularly between population centers which do not already possess large airports. Unfortunately, the attainment of STOL capability inevitably implies some increase in operating costs and, although a reduction in delay times and other operational factors favourable to STOL, do something to lessen the increase in operating costs, these effects have proved insufficient to give confidence in the prospects of true STOL aircraft, i.e., of aircraft capable of taking off and landing within about 2000 ft. The prospects for aircraft aiming at the less ambitious target of landing and take-off within 3000-5000 ft, however, seem much brighter, and the paper discusses the implications of such aircraft on the future of short-haul and medium-haul transportation. (Author)

A74-14506 **Vertical/short take-off and landing.** J. T. Stamper (Hawker Siddeley Aviation, Ltd., Kingston-on-Thames, Surrey, England). In: Airports for the 80s; Proceedings of the Fourth World Airports Conference, London, England, April 3-5, 1973. London, Institution of Civil Engineers, 1973, p. 47-55.

The growth of air transport as it exists today is briefly reviewed. The factors governing this growth are defined and the different choices of system are mentioned. The unique characteristics of the VSTOL system are discussed in some detail. It is suggested that, when all factors are taken into consideration, the VSTOL system will prove the most satisfactory for the future. Possible ways in which this VSTOL system will evolve are given. (Author)

A74-14507 **Changes in the European air transport pattern.** C. Stuart (British European Airways Corp., Ruislip, Middx., England). In: Airports for the 80s; Proceedings of the Fourth World Airports Conference, London, England, April 3-5, 1973. London, Institution of Civil Engineers, 1973, p. 65-72.

The history of European air transport is considered, giving attention to conditions at the beginning of air traffic, questions of aircraft development, predictions concerning future developments, and the liberalization of European air transport. Airline objectives are related to the customer, national aspects, and questions of profitability. Problems of airline creative marketing are discussed together with the significance of airport location, taking into account aircraft movement trends at Heathrow airport. G.R.

A74-14508 **Airport terminal planning.** T. M. Sullivan (Dallas/Fort Worth Airport, Fort Worth, Tex.). In: Airports for the 80s; Proceedings of the Fourth World Airports Conference, London, England, April 3-5, 1973. London, Institution of Civil Engineers, 1973, p. 79-84.

Using the Dallas/Fort Worth Airport as an example, it is necessary to point out that airport terminal planning must be done with a broad view of the future and an understanding of the problems of the past. A general criterion concerning expansibility and automation with passenger convenience as a goal is presented. An airport transit system is also described, pointing out the fact that distances between terminals must be traversable in a minimum of time. Moving passengers from their deplaning gate to another terminal or to a remote parking area is a prime consideration. This same transit system is used to move employees, baggage, mail and rubbish throughout its entire circulatory system, thus completely automating the airport. A future convenience for travellers of all kinds could be an inter-city transit system tied in with the airport transit system. (Author)

A74-14509 **Access to airports.** L. B. Mullett and P. J. Corcoran (Department of the Environment, England). In: Airports for the 80s; Proceedings of the Fourth World Airports Conference, London, England, April 3-5, 1973. London, Institution of Civil Engineers, 1973, p. 93-98.

Surface access to airports is discussed in the context of a methodology for assessing the demand for a link and selecting a suitable system. A five-stage evaluation procedure is proposed: airport classification, demand estimation, interchange studies, selection of modes and socio-economic analysis. Emphasis is placed on the necessity of considering the link in relation to the urban and airport distribution networks and the operational characteristics of the airport. The evaluation of the surface access requirements of the third London airport at Maplin are discussed in the framework of the methodology. (Author)

A74-14510 **Maplin - Planning aspects and their influence on airport design.** K. B. Walter (British Airports Authority, London, England). In: Airports for the 80s; Proceedings of the Fourth World Airports Conference, London, England, April 3-5, 1973. London, Institution of Civil Engineers, 1973, p. 115-118.

The paper deals first with the specific problems that are a direct outcome of the site choice, in particular the problems of access to the airport. Land-use planning for the reclaimed site is discussed, including the way in which the airport will develop in stages to its ultimate four runway configuration. The strategic planning of the terminal zone is dealt with in some detail, in particular the influence that rail access will have on the development of passenger facilities and vice versa. Inter-terminal movements and other communication requirements are discussed, showing how an integrated public transport system serving the airport link to principal areas of new urbanization and the seaport create both an opportunity and a challenge for the future. (Author)

A74-14511 **Maplin - The operational factors and their influence on the design of the airport.** G. A. Champniss (British Airports Authority, London, England). In: Airports for the 80s; Proceedings of the Fourth World Airports Conference, London, England, April 3-5, 1973. London, Institution of Civil Engineers, 1973, p. 119-123.

The paper reviews the possible future development of the air vehicle and the effect that the increase in size of the vehicle will have on the design parameters relating to the runways and taxiways. The design criteria which are related to operations in the lower visibility ranges are also examined so that comprehensive design parameters for the runway and taxiway system related to future technological changes are used for planning. Various runway layouts suitable for a high capacity airport are examined with particular reference to the layout chosen for Maplin. Probable movement rates are given together with an indication of possible future increases resulting from operational and technological development. The importance of a phased development plan so that individual areas of development contribute to the future whole while at the same time maintaining an efficient operation is considered. (Author)

A74-14512 **Maplin - Management aspects.** P. Whitford (British Airports Authority, London, England). In: Airports for the 80s; Proceedings of the Fourth World Airports Conference, London, England, April 3-5, 1973. London, Institution of Civil Engineers, 1973, p. 125-129.

Managing in the 80s a new airport like Maplin will present a different challenge from that which faced the first managers of existing airports. Both the size and the technological content will be different. Objectives and management styles must be carefully chosen and defined, and the airport manager must ensure that the whole airport system gives a high level of passenger service. To do this he must know what the passenger really wants, not what he thinks the passenger wants. It will be difficult to permit large numbers of individual, autonomous organizations to operate in parallel without adversely affecting the level of passenger service. A large degree of automation throughout the whole airport system will be necessary if the maximum planned capacity, approximately 125 million passengers per annum, is to be achieved. (Author)

A74-14513 **Noise - The technical aspects.** J. B. Large (Southampton, University, Southampton, England) and R. C. Lam

(Department of Civil Aviation, Melbourne, Australia). In: Airports for the 80s; Proceedings of the Fourth World Airports Conference, London, England, April 3-5, 1973. London, Institution of Civil Engineers, 1973, p. 141-146.

Although there are many sources of noise around an airport, the dominant source is due to aircraft operations, including taking off, landing, and taxi manoeuvres. Monitoring is one of the few methods open to authorities involved in airport operation in order to control this noise. Several automatic monitoring systems now in use at world airports are discussed, together with the standards adopted for aircraft noise control. The most comprehensive system of monitoring is that proposed for the State of California. This system not only regulates individual noise levels, but also noise exposure boundaries around the airports. It is difficult to see how this system could be applied to an airport such as Heathrow, with its complex routeing system. The paper suggests how a compromise system could apply at this London airport, so that closer control of take-off and landing noise could be achieved. (Author)

A74-14514 **Noise - The social impact.** W. Allen. In: Airports for the 80s; Proceedings of the Fourth World Airports Conference, London, England, April 3-5, 1973.
London, Institution of Civil Engineers, 1973, p. 147-154. 6 refs.

The nature of airports as noise sources is described, and the propagation of ground to ground noise is discussed, including the influence of wind, temperature gradients, and topography. The analysis of air to ground noise by equal energy contour systems is criticized for its lack of realism, and a comparison study is described between noise and number index (NNI) and PNdB contours for a specific airport and their relation to the geographical location of reported complaints. The PNdB contours fit well and the NNI poorly. It is then argued that single index measures of annoyance as developed for the interpretation of equal energy contour systems have little value for the planner, and that a more satisfactory way of expressing criteria to limit the adverse social consequences of noise will generally be by separate statements about acceptable noise levels and numbers of incidents in respect of each major category of community need. (Author)

A74-14516 **Criteria for the siting of major airports.** A. Goldstein. In: Airports for the 80s; Proceedings of the Fourth World Airports Conference, London, England, April 3-5, 1973.
London, Institution of Civil Engineers, 1973, p. 169-174. 9 refs.

After commenting on the basic problem of airport location, the role of criteria is considered. There are comparatively few mandatory standards involved, leaving a substantial area where all factors need to be weighed and compared against each other. This involves trade-offs between factors, some of which may be measured and valued and some of which remain more intangible. The techniques involved in such comparisons must incorporate both the physical and the social sciences. The paper then considers four important criteria of airport location, i.e. noise, surface access, urbanization, and planning. (Author)

A74-14517 **The role of local planning authorities in relation to the siting and development of airports.** E. G. Silbert (Surrey County Council, Kingston-on-Thames, Surrey, England). In: Airports for the 80s; Proceedings of the Fourth World Airports Conference, London, England, April 3-5, 1973.
London, Institution of Civil Engineers, 1973, p. 175-179.

Planning considerations are given for the siting of new airports and the development of control of existing airports. It is proposed that the decision making in siting new airports should be made at national and regional levels and that a national policy be adopted in this matter. Noise, urban development and growth, air route patterns, public participation in making local decisions, land safeguarding for future airport growth, and the relations of airports and nearby countrysides are covered as airport siting factors. The main point of the discussion is the close interrelation between operational concern and environmental response which must be given prime consideration. V.Z.

A74-14521 # **Recent advances in aerodynamics for transport aircraft.** I. L. T. Goodmanson and L. B. Gratzer (Boeing Co., Seattle, Wash.). *Astronautics and Aeronautics*, vol. 11, Dec. 1973, p. 30-45. 20 refs.

Noise, pollution, and congestion have become the major problems of the air-transport industry. The desire to extend regular air transportation to areas and markets not well served now has fostered technology for short takeoff and landing (STOL) aircraft and design concepts for really quiet and economical STOL systems. During the past decade or so, considerable effort has also gone into the development of high-lift systems important to the more conventional transports as well as STOLs. An aircraft with boundary-layer control (BLC) is discussed together with a near-sonic-transport concept and transonic transport configuration concepts. G.R.

A74-14523 # **Bird control at the airport.** G. E. Meyer and M. J. Boulter (USAF, Weapons Laboratory, Kirtland AFB, N. Mex.). *Astronautics and Aeronautics*, vol. 11, Dec. 1973, p. 55-57. 15 refs.

In 1971 bird-aircraft collisions damaged or destroyed 383 Air Force aircraft and inflicted serious injuries on several pilots. More bird-strikes occur during takeoff and landing than any other phase of flight. This fact underscores the need for bird control in the immediate vicinity of the airfield. Birds may be dispersed locally by any of a great number of means designed to elicit an escape response. Radar detection of birds may enable pilots to evade approaching flocks. G.R.

A74-14548 **Functional tests of a cryo-cooled mass spectrometer ion source in a supersonic wind tunnel.** D. Offermann and T. G. Scholz (Bonn, Universität, Bonn, West Germany). *Review of Scientific Instruments*, vol. 44, Nov. 1973, p. 1573-1577. 10 refs. Bundesministerium für Bildung und Wissenschaft Grant No. WRK-197.

A modified helium cooled ion source was operated in supersonic gas flows simulating some conditions of a rocket flight through the upper mesosphere and lower thermosphere. It is shown that the shock in front of this ion source is removed due to the low temperature of the ion source front part and that the mass spectrometer measures the composition of the undisturbed gas flow. Stability and angular dependence of the ion source signal are analyzed. The light emission from the cold ion source in an arc heated supersonic flow is discussed. (Author)

A74-14563 **Deposition and corrosion in gas turbines; Proceedings of the Conference, London, England, December 6, 7, 1972.** Conference sponsored by the Central Electricity Generating Board. Edited by A. B. Hart and A. J. B. Cutler (Central Electricity Generating Board, Research Laboratories, Leatherhead, Surrey, England). New York, Halsted Press, 1973. 424 p. $47.50.

The papers examine the limitations which deposition and corrosion problems impose on gas turbine operations. Special emphasis is given to laboratory and experimental rig studies of corrosion under operating conditions and the assessment of commercial alloys for gas turbine applications. Some aspects of the development of new corrosion-resistant alloys are also described. The chemical reactions of the fuel and air impurities during combustion and the aerodynamic factors which influence the depositions of the combustion residues are considered. Industrial experience with land-based and marine gas turbines and the procedures which have been established for successful operation are described. F.R.L.

A74-14564 **Problems of future high-temperature corrosion research and testing.** W. Möller (Brown, Boveri et Cie AG, Mannheim, West Germany). In: Deposition and corrosion in gas turbines; Proceedings of the Conference, London, England, December 6, 7,

1972. New York, Halsted Press, 1973, p. 1-16. 21 refs.

Hot flue gases attack engine parts. This metal wastage which is called high temperature corrosion is influenced by fuel impurities such as V, alkali metals, Cl and S. The scaling resistance given by protective layers and models of the corrosion mechanism are described. Checking the models by metallurgical investigation of corrosion layers yields the following results. Heavy corrosion corresponds to thick scale layers. Bad adhesion of this scale causes frequent spalling and formation of new scale. The flow conditions around an airfoil affect the scaling considerably. There are several overlapping processes which contribute to the phenomenon of high temperature corrosion: isothermal oxidation; scale spalling by thermal cycling, impact and mechanical stresses; and high gas stream velocities, pressures, and mechanical stresses accelerating scale growth. Traces of fuel impurities also accelerate scale growth. (Author)

A74-14565 **Air and fuel monitoring for gas turbines.** I. Davies and P. W. Polfreman (Central Electricity Generating Board, SE Region Scientific Services Dept., Barnet, Herts., England). In: Deposition and corrosion in gas turbines; Proceedings of the Conference, London, England, December 6, 7, 1972. New York, Halsted Press, 1973, p. 17-21.

The investigation of gas turbine corrosion in the SE Region led to a study of the routes of entry of alkali metals into the turbines. Part of this investigation concerned the procedures for measuring the sodium contents in air and fuel. The methods can give misleading results and many of the errors have been studied and eliminated. The results of air and fuel monitoring are briefly reviewed. Although no association between airborne sodium and corrosion can be demonstrated a clear association has emerged between fuel-borne sodium and corrosion. This may of itself be insufficient to account for the intense corrosion observed at one station and a concentration process in the filters may be taking part. (Author)

A74-14567 **Aerodynamic aspects of gas turbine blade corrosion.** J. M. Moore and R. I. Crane (Central Electricity Generating Board, Research Laboratories, Leatherhead, Surrey, England). In: Deposition and corrosion in gas turbines; Proceedings of the Conference, London, England, December 6, 7, 1972. New York, Halsted Press, 1973, p. 34-57. 40 refs.

To provide a background to research on the chemistry of blade corrosion, a description is given of the aerodynamic processes which may be involved. Current gas turbine design methods are summarized and the vectors controlling the geometry of the blades and their surface boundary layer development are discussed. A detailed account is given of the mechanisms by which potentially corrosive material can be deposited on the blades. Although few firm conclusions can be drawn until more is known of the corrosion process, this survey may assist in the design of corrosion experiments and the interpretation of results. (Author)

A74-14580 **The assessment of hot corrosion resistance by rig testing - Philosophy and experience.** J. F. G. Condé and G. C. Booth (Ministry of Defence, Admiralty Materials Laboratory, Poole, Dorset, England). In: Deposition and corrosion in gas turbines; Proceedings of the Conference, London, England, December 6, 7, 1972. New York, Halsted Press, 1973, p. 278-293. 9 refs.

In a low pressure test rig, corrosion closely similar to that seen in engines in service has been reproduced in 200 hr on simulated aerofoil specimens in cascade arrangement, the only accelerating factor being a salt in air level of 0.1 ppm compared with 0.01 ppm in service. Simulated aerofoil specimens were adopted in the rig as an appropriate vehicle for assessment of coatings, but it is also possible to test cylindrical rod specimens to enable precise measurement of corrosion of substrate materials. Even with the comparatively low heating and cooling rates attainable in the rig, it has been shown that thermal cycling has an accelerating effect and hence better simulation is desirable. To enable the correct heat-transfer rates to be achieved and to permit the effect of blade cooling to be assessed, a high pressure facility has been designed. (Author)

A74-14583 **Turbine corrosion - Rig evaluation and engine experience.** K. Page and R. J. Taylor (Rolls Royce /1971/, Ltd., Coventry, England). In: Deposition and corrosion in gas turbines; Proceedings of the Conference, London, England, December 6, 7, 1972. New York, Halsted Press, 1973, p. 350-375.

Rolls Royce gas turbine operating experience in environments promoting turbine corrosion is reviewed, and an attempt is made to identify where further environmental data on engines in the field are required, and to define the current rig problems on alternative materials and coatings, and the philosophy considered necessary for final engine evaluation. The improved corrosion resistance of IN 738 relative to the existing N105 and N115 blade materials has been established from rig testing. In order to properly assess the relative merits of alternate materials and coatings it is preferable to test engines with rainbow turbines in the actual operational environment. More extensive field monitoring of engine operating environments and running schedules is necessary in order to obtain a better understanding of the relative importance of various factors influencing corrosion. F.R.L.

A74-14595 **Simulator tests of pilotage error in area navigation with vertical guidance - Effects of descent angle and display scale factor.** R. J. VanderKolk and S. N. Roscoe (Illinois, University, Urbana, Ill.). In: Human Factors Society, Annual Meeting, 17th, Washington, D.C., October 16-18, 1973, Proceedings. Santa Monica, Calif., Human Factors Society, Inc., 1973, p. 229-239. 6 refs.

Pilotage error in area navigation with vertical guidance was measured in a flight simulation facility for all combinations of four descent angles and four scale factors for the vertical guidance display for each of two pilot groups representing different experience levels. Pilot performance was measured in terms of altitude error, crosstrack error, airspeed error, procedural error, and information processing rate on an independent side task. The results show that altitude tracking errors increase with descent angle and decrease as display scale factor becomes more sensitive. Altitude errors for airline transport pilots were reliably smaller than for commercial instrument pilots for most of the experimental conditions tested. (Author)

A74-14596 **Control authority with a flight performance controller.** C. A. Bergman, K. R. Sivier, and S. N. Roscoe (Illinois, University, Urbana, Ill.). In: Human Factors Society, Annual Meeting, 17th, Washington, D.C., October 16-18, 1973, Proceedings. Santa Monica, Calif., Human Factors Society, Inc., 1973, p. 240-245. 10 refs. USAF-sponsored research.

Description of a performance control system that provides direct pilot control of vertical speed and bank angle and has been flight tested in a twin-engine, general aviation aircraft. Automatic coordination and lift compensation in turns are provided. The system is FAA-certified for normal category operations under visual flight rules, above 400 feet AGL. M.V.E.

A74-14597 **Motion relationships in aircraft attitude and guidance displays - A flight experiment.** S. N. Roscoe and R. C. Williges (Illinois, University, Urbana, Ill.). In: Human Factors Society, Annual Meeting, 17th, Washington, D.C., October 16-18, 1973, Proceedings. Santa Monica, Calif., Human Factors Society, Inc., 1973, p. 246-255. 24 refs. Navy-sponsored research.

Review of the results of tests administered to nonpilot students on tasks involving conflicting visual and vestibular cues while flying with each of four basic aircraft attitude presentations (moving horizon, moving airplane, frequency separated, and kinalog) in a

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Beechcraft airplane. The results indicate that the principle of display frequency separation provides at least equivalent pilot steering performance to that obtained with the conventional moving horizon format, while the anticipatory cues it affords tend to reduce the incidence of control reversals under circumstances of subliminal angular acceleration by providing initial direction-of-motion compatibility. M.V.E.

A74-14598 **Aircraft simulator motion and the order of merit of flight attitude and steering guidance displays.** F. Ince, R. C. Williges, and S. N. Roscoe (Illinois, University, Urbana, Ill.). In: Human Factors Society, Annual Meeting, 17th, Washington, D.C., October 16-18, 1973, Proceedings. Santa Monica, Calif., Human Factors Society, Inc., 1973, p. 256-264. 21 refs. Navy-USAF-sponsored research.

Investigation of the effects of variations in flight simulator motion dynamics upon the order of merit of a family of flight displays. The results indicate that the outcome of human engineering experiments in simulators can depend upon the motion system employed. In the experiments performed, only two degrees of motion freedom were available for experimental manipulation. Nevertheless, results obtained for various flight tasks were sufficiently clear to allow the conclusion that motion systems that introduce gravitational cues not present in flight can be as damaging to the validity of an experiment as the absence of acceleration cues. M.V.E.

A74-14599 **Uses of a visual landing system in primary flight training.** L. L. Young, R. S. Jensen, and C. W. Treichel (Illinois, University, Urbana, Ill.). In: Human Factors Society, Annual Meeting, 17th, Washington, D.C., October 16-18, 1973, Proceedings. Santa Monica, Calif., Human Factors Society, Inc., 1973, p. 265-271. 10 refs. Contract No. F44620-70-E-0105.

Exploratory study of the potential usefulness of a visual landing system (VLS) in a primary flight training program, aimed at determining the design and instructional changes that may be necessary for optimizing a landing trainer. The opinion of instructors and students was generally favorable about the effectiveness of VLS, and they praised it highly as a means for teaching traffic pattern procedures including airspeed, altitude, radio communications, turn-to-final, angle of descent, and runway alignment. However, its lack of altitude cues and groundspeed indication near the ground was felt to limit somewhat its value as a trainer. M.V.E.

A74-14620 # **Elastic, plastic behavior of a rotor. I - Analysis of an axisymmetric rotor whose radius varies in axial direction.** A. Nagamatsu, T. Murota, and T. Jimma (Tokyo Institute of Technology, Tokyo, Japan). *JSME, Bulletin*, vol. 16, Oct. 1973, p. 1532-1538; Discussion, p. 1538; Authors' Closure, p. 1539. 5 refs.

Elastic stress and strain are analyzed in an axisymmetric rotor whose radius allows arbitrary variation in the axial direction. A theoretical approach using the finite element method is taken to follow the changes of shape, stress, and strain, as well as the appearance and growth of plastic zones due to successive increase of rotational speed. Yamada's matrix is adopted as stress-strain relations after yielding of material, and not only material nonlinearity but also geometric nonlinearity due to finite deformation is taken into account in this analysis. As an example, nonuniform deformation of solid and hollow cylinders of various heights is analyzed through elastic, partially plastic, and totally plastic ranges. (Author)

A74-14621 # **The effect of gyroscopic moment and distributed mass on the vibration of a rotating shaft with a rotor.** S. Aiba (Yamanashi University, Kofu, Japan). *JSME, Bulletin*, vol. 16, Oct. 1973, p. 1550-1559; Discussion, p. 1559, 1560; Author's closure, p. 1560, 1561. 9 refs.

This paper deals with the vibration and critical speeds of a rotating shaft fitted with a symmetrical or an asymmetrical rotor, taking into account the gyroscopic effect of the rotor and distributed mass of the shaft. Eigenfrequencies at any shaft speed, mode of eigen-vibration, and the amplitude due to unbalances are obtained theoretically, and numerical examples are shown. Critical speeds in the case of a symmetrical shaft system and two kinds of critical speed bands in the case of a shaft having an asymmetrical rotor are obtained theoretically, and numerical calculations are performed. (Author)

A74-14622 # **Balancing of a flexible rotor. III - Universal state of balance of a flexible rotor irrespective of its bearing stiffness.** S. Miwa (Aoyama-Gakuin University, Tokyo, Japan). *JSME, Bulletin*, vol. 16, Oct. 1973, p. 1562-1570; Discussion, p. 1570, 1571; Author's Closure, p. 1571, 1572. 10 refs.

In balancing a flexible rotor, two alternative procedures have been proposed; one of them is n-plane-balancing and the other (n + 2)-plane-balancing, named after the required numbers of correction planes. In this paper, both procedures are discussed theoretically, and the latter is found to be superior for the purpose. Next, analysing how the form of the characteristic function of rotor shaft deflection is influenced by its bearing stiffness, the conditional equation and practical method of balancing are presented here for the universal state of balance of a flexible rotor which will no more be affected by its bearing stiffness. The (n + 2)-plane-balancing guarantees this state of balance of the rotor. (Author)

A74-14623 # **The stability of flexibly supported, externally pressurized gas journal bearings - Case of a rigid rotor.** A. Tatara, H. Koike, and A. Iwasaki. *JSME, Bulletin*, vol. 16, Oct. 1973, p. 1573-1579. 5 refs.

The stability of a self-excited whirl is an important problem of externally pressurized gas bearings used in high speed turbomachines. Bearings are often flexibly supported in order to suppress this whirl. In this study, the stability characteristics are shown for a system connected with a symmetrical rigid rotor. Also, analytical results are presented and compared with an experiment on bearings flexibly supported by 'O' rings. The whirl onset speed can be made very high by adequately selecting stiffness, damping, and other parameters in relation to rotor and bearings. Comparison shows theory and experimental results in near coincidence, and the effectiveness of flexible support is exhibited remarkably in contrast with cases of rigidly supported bearings. (Author)

A74-14732 **Narmco 5208/T300 - A graphite-epoxy system engineered for high-performance aircraft structures.** B. E. Kaminski (General Dynamics Corp., Convair Aerospace Div., Fort Worth, Tex.). In: Materials and processes for the 70's - Cost effectiveness and reliability; Proceedings of the Fifth National Technical Conference, Kiamesha Lake, N.Y., October 9-11, 1973. (A74-14730 03-15) Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1973, p. 11-17. 5 refs.

An improved Type II graphite-epoxy tape system was developed using a commercial fiber and resin system. The material, Narmco 5208/T300, was predicted, created, and confirmed through a systematic process of data evaluation within a three-month period. Narmco 5208/T300 has demonstrated a longitudinal modulus approximately equal to that of Type II graphite and a 1 percent strain capability surpassing that of the current Type II material. In addition, through improved cosmetic appearance and fiber performance, the material has exhibited lower scatter than other commercial graphite-epoxy material systems. (Author)

A74-14738 **Polyimides for advanced radomes.** S. A. Moorefield and J. B. Styron (Brunswick Corp., Marion, Va.). In: Materials and processes for the 70's - Cost effectiveness and reliability; Proceedings of the Fifth National Technical Conference, Kiamesha Lake, N.Y., October 9-11, 1973.
Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1973, p. 71-79.

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Reinforced polyimide composite materials provide good structural and electrical properties, and retention of these properties at high temperatures. This combination of properties makes polyimide composites particularly attractive for use in advanced aircraft and missile radomes. Manufacturing processes and material properties are described for polyimide radomes using solid laminate, foam sandwich, and honeycomb core sandwich constructions. An improved high temperature rain erosion coating and a new lightning diverter strip is described for use on aircraft radomes. (Author)

A74-14739 **Improved manufacturing of the F-14A composite horizontal stabilizer.** A. London, G. Lubin, and S. Dastin (Grumman Aerospace Corp., Bethpage, N.Y.). In: Materials and processes for the 70's - Cost effectiveness and reliability; Proceedings of the Fifth National Technical Conference, Kiamesha Lake, N.Y., October 9-11, 1973. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1973, p. 80-90. 5 refs.

Production of the F-14A horizontal stabilizer, which is manufactured by bonding precured boron/epoxy skins to full-depth aluminum honeycomb core and titanium intercostals and ribs, was upgraded by several process improvements. Reusable, silicone rubber vacuum bags are used for curing and bonding. An upgraded bleeder system eliminated the need for felt and fiberglass bleeders. An automatic, boron tape laying machine is being used that significantly reduces layup time. Aluminum honeycomb core is being sculptured by a numerically controlled core cutting machine at a considerable reduction in cutting time. (Author)

A74-14741 **RohrBond.** M. M. Schwartz (Rohr Industries, Inc., Chula Vista, Calif.). In: Materials and processes for the 70's - Cost effectiveness and reliability; Proceedings of the Fifth National Technical Conference, Kiamesha Lake, N.Y., October 9-11, 1973. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1973, p. 103-114.

Advanced aerospace programs such as the Space Shuttle, other space vehicles, supersonic aircraft, advanced engines, and tactical systems need new, extremely strong, lightweight, high-temperature products to perform with maximum effectiveness in demanding environments. RohrBond assemblies are formed from titanium honeycomb core sandwiched between titanium sheets, and bonded by a Rohr process LID (liquid interface diffusion). Unlike prior processes which involved difficult forming of flat sandwich planks, RohrBond is contoured, and then vacuum bonded in a single operation to the finished configuration. This paper describes sophisticated RohrBond components for America's most advanced military aircraft which are currently in production. New configurations of assemblies and hardware applications are described which show the versatility of the bonding process, equipment and tooling. (Author)

A74-14748 **Development of a graphite-epoxy tailboom for a high-performance armed helicopter.** H. Zinberg (Bell Helicopter Co., Fort Worth, Tex.). In: Materials and processes for the 70's - Cost effectiveness and reliability; Proceedings of the Fifth National Technical Conference, Kiamesha Lake, N.Y., October 9-11, 1973. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1973, p. 207-216.

This paper describes a research and development program performed by Bell Helicopter Company to design, fabricate, and test an advanced composite tailboom for the AH-1G Cobra helicopter. Several materials were evaluated for the structure. The structure chosen was a sandwich of Nomex core between Modmor III graphite faces. Two structures were built; one for structural test and one to be available for flight test. The first one has been tested, with failure occurring at 127% of design ultimate load in a predictable manner. (Author)

A74-14749 **Design and fabrication of a mixed composite wing box.** R. N. Hadcock, S. J. Dastin, and H. A. Erbacher (Grumman Aerospace Corp., Bethpage, N.Y.). In: Materials and processes for the 70's - Cost effectiveness and reliability; Proceedings of the Fifth National Technical Conference, Kiamesha Lake, N.Y., October 9-11, 1973. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1973, p. 217-227. USAF-supported research.

The application of mixed composite materials to aircraft structures can result in components which are significantly lighter and less expensive than their single composite or metal counterparts. Studies of the wing box structure of an advanced fighter aircraft have shown that maximum structural efficiency is obtained using boron/aluminum for the upper cover, a mixture of boron/epoxy and graphite/epoxy for the lower cover, and graphite/epoxy for the beam and rib substructure. Design and fabrication techniques for mixed composite wing box structures were developed under an Air Force funded program. The program objective was to extend composite technology and demonstrate with a representative component, structural weight savings of 30 percent over a comparable all-titanium baseline wing. (Author)

A74-14752 **Sliding-seal electron-beam welding of titanium.** R. H. Witt, J. G. Maciora, and H. P. Ellison (Grumman Aerospace Corp., Materials, and Processes Development Dept., Bethpage, N.Y.). In: Materials and processes for the 70's - Cost effectiveness and reliability; Proceedings of the Fifth National Technical Conference, Kiamesha Lake, N.Y., October 9-11, 1973.
Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1973, p. 270-297. Contract No. F33615-70-C-1806. AF Project 828-9.

The sliding-seal electron beam (SSEB) welding process demonstrated capability for achieving aerospace quality weldments in titanium alloys equivalent to hard vacuum EB welding in chambers using production, nondestructive inspection techniques for inspection. For Ti-6Al-4V titanium alloy SSEB weldments, joint efficiencies of 100% of the base metal were obtained for both tensile and fatigue properties. Fracture toughness of one-inch thick, SSEB welded Ti-6Al-4V titanium alloy was determined. Values obtained were for weldments made in the flat and vertical up welding positions. A selected simulated aerospace structure - an integrally stiffened wing skin - was successfully welded to demonstrate capability to fabricate production-type parts. (Author)

A74-14754 **Laminated metallic structure - An approach to fracture control.** J. R. Ellis (LTV Aerospace Corp., Vought Systems Div., Dallas, Tex.). In: Materials and processes for the 70's - Cost effectiveness and reliability; Proceedings of the Fifth National Technical Conference, Kiamesha Lake, N.Y., October 9-11, 1973. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1973, p. 329-335.

Fatigue crack growth and residual strength tests were performed on a conventional machined aluminum wing spar section and a laminated adhesive bonded counterpart. Test results are presented and discussed with respect to fracture control. Manufacturing methods used in the fabrication of the laminated spar are discussed and weight and cost comparisons are presented. (Author)

A74-14756 * **Long range view of materials research for civil transport aircraft.** M. D. Ardema and M. H. Waters (NASA, Ames Research Center, Systems Studies Div., Moffett Field, Calif.). In: Materials and processes for the 70's - Cost effectiveness and reliability; Proceedings of the Fifth National Technical Conference, Kiamesha Lake, N.Y., October 9-11, 1973.
Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1973, p. 356-370. 26 refs.

The impact of various material technology advancements on the economics of civil transport aircraft is investigated. Benefits of advances in both airframe and engine materials are considered. Benefits are measured primarily by improvements in return on investment for an operator. Materials research and development programs which lead to the greatest benefits are assessed with regards to cost, risk, and commonality with other programs. Emphasis of the

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paper is on advanced technology subsonic/transonic transports (ATT type aircraft) since these are likely to be the next generation of commercial transports. (Author)

A74-14763 **Advanced composite F-5 fuselage component.** P. D. Schockey (General Dynamics Corp., Convair Aerospace Div., Fort Worth, Tex.). In: Materials and processes for the 70's - Cost effectiveness and reliability; Proceedings of the Fifth National Technical Conference, Kiamesha Lake, N.Y., October 9-11, 1973. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1973, p. 423-431.

An F-5 mid-fuselage section has been designed and fabricated with extensive use of advanced composite materials. The manufacturing approach was very different from that commonly used for aircraft fuselage structure and represents the design and manufacturing flexibilities permitted by advanced composite materials. Tooling, fabrication, and assembly procedures are presented, and the resulting man-hour costs are described. The major problems are identified, and the pertinent conclusions and recommendations are discussed. (Author)

A74-14765 **Application of powder metallurgy in gas turbine aircraft engines.** D. J. Evans, J. E. Flynn, and D. N. Duhl (United Aircraft Materials Engineering and Research Laboratory, Middletown, Conn.). In: Materials and processes for the 70's - Cost effectiveness and reliability; Proceedings of the Fifth National Technical Conference, Kiamesha Lake, N.Y., October 9-11, 1973. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1973, p. 438-447.

The application of powder metallurgical processing to aircraft gas turbine engines is discussed. Fully dense powder structures, using nickel and titanium alloys are employed in initial rotating components. Less than fully dense applications, involving nickel, titanium and ferrous alloys, are selected where P/M can effect substantial cost reductions over previous components machined from conventionally processed wrought alloys. (Author)

A74-14768 **Fabrication and repair of titanium engine components by welding.** D. S. Duvall and W. A. Owczarski (United Aircraft Materials Engineering and Research Laboratory, Middletown, Conn.). In: Materials and processes for the 70's - Cost effectiveness and reliability; Proceedings of the Fifth National Technical Conference, Kiamesha Lake, N.Y., October 9-11, 1973. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1973, p. 472-485. Contracts No. F33615-70-C-1212; No. F33615-72-C-1178.

Cost and performance benefits can be gained through use of metal joining in the fabrication and repair of rotating titanium gas-turbine components. Because these rotating parts have a critical role in engine operation, joining methods used in their fabrication must consistently produce high-strength, defect-free weldments. Also, the joint quality must be accurately measurable on a production basis. Techniques have been derived for meeting these goals in the diffusion bonding of Ti-6Al-4V lightweight fan disks. Procedures are currently being established to produce plasma-arc weld repair methods for service-damaged Ti-6Al-4V and Ti-8Al-IV-IMo fan blades which will also meet the high-quality requirements of rotating engine hardware. (Author)

A74-14771 **Feasibility study of use of polysulfide sealants for corrosion protection of spot welded aluminum alloys.** J. J. Bethke and S. J. Ketcham (U.S. Navy, Naval Air Development Center, Warminster, Pa.). In: Materials and processes for the 70's - Cost effectiveness and reliability; Proceedings of the Fifth National Technical Conference, Kiamesha Lake, N.Y., October 9-11, 1973. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1973, p. 505-517.

Severe corrosion problems occur in the faying surfaces of thin-gauge, spot-welded aluminum sheets unprotected by a surface treatment. This problem is very severe in naval aircraft because of their operation in a hostile sea and carrier environment. Early detection of deterioration is difficult, resulting in extensive, costly repairs and replacements. The feasibility of utilizing polysulfide sealants in the faying surfaces was studied. MIL-W-6858C Class A certification welds were successfully made through MIL-S-8802 and MIL-S-81733(AS) sealants. Accelerated corrosion tests of the welds demonstrated the beneficial effects of sealants in protecting the faying surfaces and welds against corrosion. (Author)

A74-14774 * **Service evaluation of aircraft composite structural components.** W. A. Brooks, Jr. and M. B. Dow (NASA, Langley Research Center, Hampton, Va.). In: Materials and processes for the 70's - Cost effectiveness and reliability; Proceedings of the Fifth National Technical Conference, Kiamesha Lake, N.Y., October 9-11, 1973. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1973, p. 538-558. 7 refs.

The advantages of the use of composite materials in structural applications have been identified in numerous engineering studies. Technology development programs are underway to correct known deficiencies and to provide needed improvements. However, in the final analysis, flight service programs are necessary to develop broader acceptance of, and confidence in, any new class of materials such as composites. Such flight programs, initiated by NASA Langley Research Center, will be reviewed in the proposed paper. These programs, which include the selectively reinforced metal and the all-composite concepts applied to both secondary and primary aircraft structural components, will be described and current status will be indicated. (Author)

A74-14778 **Cost effective composite structures.** R. L. Pinckney (Boeing Vertol Co., Philadelphia, Pa.). In: Materials and processes for the 70's - Cost effectiveness and reliability; Proceedings of the Fifth National Technical Conference, Kiamesha Lake, N.Y., October 9-11, 1973. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1973, p. 607-612.

Analysis of a series of fiber-reinforced composite helicopter rotor blades for determining the design features, components, and fabrication operations which control blade costs. A number of design and fabrication suggestions are set forth for improvement of aerodynamic performance and a high structural reliability of such rotor blades to make them competitive with more conventional metal structures. Close coordination of work of all engineering and manufacturing groups is indicated as indispensable for the production of economically sound structures by the composite fiber technology. V.Z.

A74-14780 **Effective methods for fabrication of large polyimide-matrix aircraft components.** H. Sanders, J. A. Munyak, and L. M. Poveromo (Grumman Aerospace Corp., Materials and Processes Development Dept., Bethpage, N.Y.). In: Materials and processes for the 70's - Cost effectiveness and reliability; Proceedings of the Fifth National Technical Conference, Kiamesha Lake, N.Y., October 9-11, 1973. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1973, p. 627-642.

A suitable cure cycle was developed for molding structural quality glass-fabric reinforced polyimide resin matrix laminated plastics. A selective rate of rise of curing temperature and the precise control of pressure application resulted in laminated plastics having (1) reduced variations in flexural strength; (2) reduced variations in resin content; and (3) substantially no entrapment of n-methyl-2-pyrrolidone, which is a cause of resin precipitation. The crucial relationship of vacuum/pressure/temperature with time was monitoring during resin polymerization using a dielectrometer analyzer. Major effort was centered on a condensation type polyimide polymer using E-glass and quartz reinforcements. An optimized materials and processing system was generated for use in fabrication of structural quality aircraft parts. (Author)

A74-14786 Composite to metal bonding using structural thermosetting adhesives. T. J. Reinhart, Jr. and W. M. Scardino (USAF, Materials Laboratory, Wright-Patterson AFB, Ohio). In: Materials and processes for the 70's - Cost effectiveness and reliability; Proceedings of the Fifth National Technical Conference, Kiamesha Lake, N.Y., October 9-11, 1973. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1973, p. 713-731.

Two research programs designed to demonstrate the feasibility and practicability of the use of bonded composite and metallic doublers on aircraft metallic substructures have been completed. These programs involved the selection of materials, the design and analysis, and fabrication and testing of prototype and full-scale structural test specimens. Boron epoxy and graphite epoxy laminate doublers as well as beryllium, Lockalloy, and stainless-steel doublers have been evaluated under both static and dynamic load. Problems involving thermal stresses, instrumentation, and nondestructive inspection were encountered in the application of adhesive bonded doublers to metal substrates. The programs demonstrated the engineering feasibility and practicability of the use of structural adhesive bonded doublers applied to metal substrates. (Author)

A74-14873 A performance and cost analysis of aircraft and satellites for operational earth resources systems. C. E. Cheeseman, Jr. (GE Valley Forge Space Center, Philadelphia, Pa.). In: Management and utilization of remote sensing data; Proceedings of the Symposium, Sioux Falls, S. Dak., October 29-November 1, 1973. Falls Church, Va., American Society of Photogrammetry, 1973, p. 1-16.

A model for system analysis is considered, giving attention to the target variable set, target/carrier spatial relationships, aircraft time-cost relationships, the number of aircraft required, the number of aircraft bases needed, satellite time/cost relationships, the number of low altitude satellites, the number of geostationary satellites, and satellite operation costs. Some test case results are discussed, taking into account the imaging of the U.S. every eighteen days at resolutions varying between 2 and 50 meters. Another case considered involves the imaging of varying numbers of small targets evenly distributed over the U.S. G.R.

A74-14928 Waves in an elastic medium generated by a point source moving in an overlying fluid medium. A. Ungar and Z. Alterman (Tel Aviv University, Tel Aviv, Israel). *Pure and Applied Geophysics*, vol. 110, no. 9, 1973, p. 1932-1938.

Consideration of the interaction between elastic waves, coupled with atmospheric compression waves, and two adjacent semiinfinite spaces filled with fluids. Expressions are derived to describe the motion of the two half-spaces when a conical shock wave generated by a supersonic point source impinges against the plane interface between the fluid half-space and the elastic half-space. V.Z.

A74-14972 # Buckling of orthotropic circular plates. A. S. J. Swamidas and V. X. Kunukkasseril (Indian Institute of Technology, Madras, India). *AIAA Journal*, vol. 11, Dec. 1973, p. 1633-1636. 7 refs.

Exact closed form solutions in terms of Bessel and Lommel functions are obtained for the symmetric buckling of cylindrically aeolotropic circular plates. Closed form solutions are also obtained for the first asymmetric mode of buckling. Further, a series solution is proposed for higher asymmetric modes of buckling. On the basis of the closed form solutions, simple characteristic expressions to determine buckling loads are developed for fixed and supported edge conditions. The numerical results are compared with those previously obtained from series solutions. (Author)

A74-14989 # Transonic flow past lifting airfoils. N. R. Subramanian and M. Balakrishnan (Indian Institute of Technology, Madras, India). *AIAA Journal*, vol. 11, Dec. 1973, p. 1766-1768. 5 refs.

The method of local linearization proposed by Spreiter et al. (1958) for the approximate solution of the nonlinear transonic flow equation (to obtain the pressure distribution about airfoils) is extended to cover lifting airfoils. A comparison with Knechtel's (1959) experimental data shows good agreement for a freestream Mach number of 0.706 at small angles of attack. At larger angles of attack (of the order of 4 degrees), the distribution at the upper surface is less satisfactory. This may be due to the large expansion occurring near the leading edge, and to viscous effects. It is suggested that improvement may be achieved by applying a quadratic iteration process along the lines of Spreiter for the thickness case. V.P.

A74-15003 * Dynamic analysis of a system of hinge-connected rigid bodies with nonrigid appendages. P. W. Likins (California, University, Los Angeles, Calif.). *International Journal of Solids and Structures*, vol. 9, Dec. 1973, p. 1473-1487. 10 refs. Contract No. NAS7-100.

Equations of motion are derived for use in simulating a spacecraft or other complex electromechanical system amenable to idealization as a set of hinge-connected rigid bodies of tree topology, with rigid axisymmetric rotors and nonrigid appendages attached to each rigid body in the set. In conjunction with a previously published companion paper on finite-element appendage vibration equations, this paper provides a complete minimum-dimension formulation suitable for generic programming for digital computer numerical integration. (Author)

A74-15033 Fracture toughness and ndt requirements for aircraft design. P. F. Packman (Vanderbilt University, Nashville, Tenn.). *Non-Destructive Testing*, vol. 6, Dec. 1973, p. 314-324. 23 refs.

This paper reviews current design concepts of fracture toughness and ndt in fracture-control programmes for advanced aircraft. The author discusses the dual role of fracture toughness for materials selection and for design where fatigue-crack growth is analysed under constant-amplitude and spectrum loading. It is essential that the lower limit of detection be known with confidence. The materials are then chosen so that the critical flaw size is above this limit. From this knowledge the life of a particular design may be forecast for different conditions of service. The lifetime is influenced by both detection capabilities and changes in service conditions. (Author)

A74-15045 # Transport aerospace industry contributions to modern problem solutions /W. Rupert Turnbull Lecture for 1973/. J. E. Steiner (Boeing Commercial Airplane Co., Renton, Wash.). *(Canadian Aeronautics and Space Institute, Annual General Meeting, Edmonton, Alberta, Canada, May 14, 1973.) Canadian Aeronautics and Space Journal*, vol. 19, Oct. 1973, p. 388-403.

The significance of air transportation in Canada is briefly examined. Economic trends for the period from 1965 to 1985 are discussed, giving attention to a number of countries of different levels of economic development. Questions concerning the stimulation of the economy provided by tourism are considered together with aspects of the world commercial jet transport market, details regarding the pressures and constraints of transportation, program management tools, the cost management cycle, trends of aircraft production cost, airspace control problems, runway acceptance rate, and the growth in U.S. gross national product. G.R.

A74-15046 # Analysis of passenger acceptance of commercial flights having characteristics similar to STOL. A. R. Kuhthau and I. D. Jacobson. *Canadian Aeronautics and Space Journal*, vol. 19, Oct. 1973, p. 405-409.

The analysis reported is based on the answers obtained from passengers who were asked for an overall subjective rating of the ride comfort on a five-point scale. Overall ratings were also obtained from the flight crew. The study involved the rank order of the passenger's evaluation of the importance of each of a list of 10 parameters. With

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the aid of an example it is shown how the model representation developed can be used in conjunction with response data to design an optimal ride smoothing system. G.R

A74-15047 # **Comparison of surface-vorticity method with surface-source method and with an exact solution for two-dimensional potential flow around two adjacent lifting airfoils.** F. Mavriplis (Canadair, Ltd., Montreal, Canada). *Canadian Aeronautics and Space Journal*, vol. 19, Oct. 1973, p. 411-413. 6 refs.

A74-15082 **Problems and organization in the case of aerial-survey flights at intermediate and high altitudes (Zur Problematik und Organisation von Vermessungsflügen in mittleren und grossen Höhen).** F. Carnec (Creil-Flughafen, Creil, France). *Bildmessung und Luftbildwesen*, vol. 41, Dec. 1, 1973, p. 218-222. In German.

Aircraft with pressure cabins are best suited for aerial surveys conducted at intermediate and great altitudes. Unfortunately many aerial-survey aircraft are not equipped with pressure cabins. In this case oxygen masks must be worn by the crew of the aircraft. There are also difficulties in connection with the sensitivity of the human body to variations in pressure. Problems of navigation are discussed together with details regarding the operational procedures for aerial surveys and questions concerning desirable improvements in aerial-survey equipment. G.R.

A74-15150 # **Prepared for overhauling the RB211.** H. J. Pope (British Airways Engine Overhaul, Ltd., England). *Aircraft Engineering*, vol. 45, Nov. 1973, p. 6-10, 13-15.

The work of British Airways Engine Overhaul Ltd. (BEOL) is reviewed. This division of British Airways overhauls and repairs Rolls Royce bypass and Avon turbojets, Pratt and Whitney turbofans, and Garrett auxiliary power units. Four engine test beds provide ample capacity and capability for full performance testing. Particulars of control and documentation, engine dismantling, and cleaning and crack detection are discussed. Three basic types of cleaning processes are employed, i.e., chemical, mechanical, and electrolytic. Attention is given to first inspection, replenishment, and component and repair facilities. Parts handling, rotor balancing, engine test facilities, and fuel systems and accessory overhaul are considered. F.R.L.

A74-15151 # **MRCA progress report.** K. T. Foulton. *Aircraft Engineering*, vol. 45, Nov. 1973, p. 17-19.

The RB199 is an advanced three-shaft augmented turbofan under development by Turbo-Union Ltd. to power the twin-engined Panavia 200 multirole combat aircraft (MRCA) for the air forces of Britain, Germany, and Italy. Maximum aircraft speed is in excess of Mach 2. The critical propulsion requirements are outlined. The turbofan has a 3-shaft layout which, in terms of component and bearing arrangements, embodies the benefits of Rolls Royce's experience with its RB211 and Trent 3-shaft civil turbofans. The RB199 is described in detail, with attention to systems and associated components and the development program. F.R.L.

A74-15152 # **F28 - Development of the Mk 5000/6000. II - Development of the family.** *Aircraft Engineering*, vol. 45, Nov. 1973, p. 22-31.

The basic F28 aircraft has been developed with the aim of providing fast economic air transportation in areas with low traffic density. Better performance than originally predicted, coupled with an increase in maximum takeoff weight resulted in greater flexibility in operating range, payload capacity, and improved hot and high field performance. The growth in capability has formed the basis on which a family similar in concept to the F27 can be developed. Growth in traffic could mean that operators of the Mk 1000 will require an aircraft with bigger capacity, yet with similar short field performance. This demands improvements in low speed aerodynamic characteristics, and modifications to the powerplant to provide uprating and reduced noise levels. Mk 5000 and Mk 6000 correspond in fuselage length to the short and long body versions of the basic aircraft, respectively. Significant changes are a span increase of 1.50 m, single position leading edge slats, and an uprated version of the current Rolls Royce Spey Mk 555-15 engine. F.R.L.

A74-15445 # **Computerized design of transport airplane.** K. Takao (Defense Academy, Yokosuka, Japan). *Japan, Defense Academy, Memoirs*, vol. 13, Sept. 1973, p. 327-335. 5 refs.

This paper is concerned with the computer program for the design of transport satisfying the specifications such as maximum range, takeoff field length and installed engines, which involves the following functions; determination of aerodynamical characteristics, weight estimation, computation of direct operating cost and optimization. Using this program, a civil transport with 2-turbofan engines is designed on trial. (Author)

A74-15446 # **Rolling motion of variable sweep aircrafts. II.** T. Murayama (Defense Academy, Yokosuka, Japan) and M. Odamiya. *Japan, Defense Academy, Memoirs*, vol. 13, Sept. 1973, p. 337-356. 8 refs.

Questions regarding lateral motion are investigated, giving attention to the equation of motion, the solution for forward wing sweep, the solution for backward wing sweep, and the solution for wing-fixed conditions. Attention is given to eigenmotion, the motion during wing sweep, and aspects of wing sweep pattern. It is found that the disturbance caused by a gust is considerably smaller at large sweep angles than at small sweep angles. Conditions needed to maintain the gust response constant and independent of the speed of wing sweep motion are discussed. G.R.

A74-15447 # **Feedback control of an airplane with time varying gain.** T. Murayama (Defense Academy, Yokosuka, Japan) and T. Ozaki. *Japan, Defense Academy, Memoirs*, vol. 13, Sept. 1973, p. 357-372. 5 refs.

The motion of an airplane with a large damping factor and stability following a disturbance may converge exponentially, but these injure the controllability. The motion of a conventional airplane following a disturbance is made oscillatory converging motion by compromising between stability and controllability. An airplane requiring high controllability, like the fighter, does not have good stability. Such an airplane usually has a stability augmentation system to obtain the necessary stability. The conventional stability augmentation system uses feedback controls of the rate of angle and displacement with fixed gains. The motion of an airplane with such a system following a disturbance is also an oscillatory converging motion. It is shown to be possible to make the motion of an airplane following a disturbance a nonoscillatory converging motion. F.R.L.

A74-15475 **Discretization of a vortex sheet, with an example of roll-up.** A. J. Chorin and P. S. Bernard. *Journal of Computational Physics*, vol. 13, Nov. 1973, p. 423-429. 12 refs. Contract No. N00014-69-A-0200-1052.

The point vortex approximation of a vortex sheet in two space dimensions is examined and a remedy for some of its shortcomings is suggested. The approximation is then applied to the study of the roll-up of a vortex sheet induced by an elliptically loaded wing. (Author)

A74-15567 **Control of laminar flow past a wing in free flight.** V. B. Zozulia and O. R. Cheranovskii (Khar'kovskii Aviatsionnyi Institut, Kharkov, Ukrainian SSR). *(Gidromekhanika*, vol. 20, 1972, p. 3-7.) *Fluid Mechanics - Soviet Research*, vol. 2, Sept.-Oct. 1973, p. 16-20. 6 refs. Translation.

It is shown as a result of investigating characteristics of the laminar velocity distribution in free flight that, due to smallness of the disturbances acting in free flight as compared with a wind tunnel, the laminar part of the boundary layer is larger and, as a result, the form drag is smaller. Hence the use of suction in free flight requires a smaller suction rate for obtaining the same size of the laminar zone. (Author)

A74-15573 **Concerning wave processes in a shell-gas system.** V. N. Buivol (Akademiia Nauk Ukrainskoi SSR, Institut Gidromekhaniki, Kiev, Ukrainian SSR). *(Gidromekhanika,* vol. 20, 1972, p. 58-62.) *Fluid Mechanics - Soviet Research,* vol. 2, Sept.-Oct. 1973, p. 82-87. 12 refs. Translation.

On the basis of the linear theory of shells and linearized equations of hydrodynamics of an inviscid compressible fluid a method is suggested for calculating critical velocities of flow past a thin elastic cylindrical shell of finite length and of the frequencies of oscillations of such a shell placed in a potential gas flow and containing an incompressible fluid. The aerodynamic forces are calculated in the long-wave approximation which made it possible to obtain simple expressions for the critical velocity and oscillatory frequencies. (Author)

A74-15575 **Calculation of aerodynamic characteristics of bodies with relatively large trailing sections.** V. M. Epifanov (Moskovskoe Vysshee Tekhnicheskoe Uchilishche, Moscow, USSR). *(Gidromekhanika,* vol. 20, 1972, p. 67-69.) *Fluid Mechanics - Soviet Research,* vol. 2, Sept.-Oct. 1973, p. 93-95. 6 refs. Translation.

Analysis of a theory of edge losses in two-dimensional airfoil cascades with thick trailing edges. The analysis is performed in terms of a jet flow model involving the generation of constant-width, inviscid jets past the airfoil edges. Calculations performed for cascades of different edge thicknesses and shapes show satisfactory agreement with experimental values. M.V.E.

A74-15630 **Pilotage error and residual attention - The evaluation of a performance control system in airborne area navigation.** S. N. Roscoe (Illinois, University, Urbana, Ill.) and E. F. Kraus (McDonnell Douglas Corp., St. Louis, Mo.). *(International Navigation Congress, Hanover, West Germany, Oct. 4, 1973.) Navigation,* vol. 20, Fall 1973, p. 267-279. 18 refs.

'Area navigation' refers to any system of navigation that allows use of all the airspace, without restriction associated with the geographic locations of radio navigation facilities. To provide a rational basis for assessing system errors from all sources, including 'flight technical or pilotage error,' an error budget has been established, the presumably independent elements of which are combined geometrically as the square root of the sum of their squared variable errors. A common metric for flight system evaluation is developed. Experimental sessions were carried out consisting of a 35-min flight in the Link GAT-2 under simulated instrument flight conditions. The relevance of the results of the experiment to the certification of equipment lies in the fact that each pilot's residual attention, as measured by the rate at which he could cope with the information processing side task, varied in a sensitive, orderly, and statistically reliable manner with each change in equipment characteristics, despite the widely differing levels of residual attention exhibited by different pilots. F.R.L.

A74-15644 # **Test and evaluation of a quiet helicopter configuration HH-43B.** M. A. Bowes (Kaman Aerospace Corp., Bloomfield, Conn.). *Acoustical Society of America, Journal,* vol. 54, Nov. 1973, p. 1214-1218. 5 refs. Grant No. DAAJ02-70-C-0004. ARPA Order 1322.

A series of noise control modifications was made to the HH-43B helicopter. Modifications were made to the aircraft engine, drive, and rotor systems. Significant reductions were achieved in all octave bands of interest, i.e., 63 Hz to 4 kHz, with an average reduction exceeding 8.5 dB. A total of ten distinct aircraft configurations were tested and their respective noise control modifications evaluated. Greatest reductions in noise resulted from engine and rotor system modifications. Turbine engine noise reductions were obtained through the use of reactively lined inlet and exhaust silencers. Rotor system modifications included blade geometry changes and reduced tip speed. (Author)

A74-15708 # **Investigation of the effect of induction damping of vortices in their interaction with a wing (Issledovanie effekta gasheniia induktsii vikhrei pri vzaimodeistvii ikh s krylom).** A. Iu. Liss and A. A. Usol'tsev. *Aviatsionnaia Tekhnika,* vol. 16, no. 3, 1973, p. 5-10. 5 refs. In Russian.

The damping of the velocity fields induced by the vortex system of a multiblade helicopter rotor is analyzed. It is shown that the circulation at the following blades is of opposite sign to the circulation of the vortex at the first blade, and that the disturbances induced at a following blade are smaller by a factor of 3 to 5 than those induced at the first blade. This means that only the interaction of discrete vortices with the first blade need be taken into consideration in the calculations. The analysis is performed for vortices perpendicular and parallel to the airfoil span. V.P.

A74-15709 # **A problem of designing the optimal external contours of an aircraft (Ob odnoi zadache optimal'nogo proektirovaniia vneshnikh obvodov samoleta).** V. A. Osipov and A. M. Tereshchenko. *Aviatsionnaia Tekhnika,* vol. 16, no. 3, 1973, p. 11-17. In Russian.

An attempt is made to satisfy the basic optimality criteria that ensure irrotational flow past aircraft contours at zero incidence. The formulas derived are readily adaptable to a computer and satisfy the requirements placed on such aerodynamic optimality criteria as the lift and drag coefficients. V.P.

A74-15710 # **Designing a dynamically stable body with lifting surfaces for a follower load (Raschet dinamicheskoi ustoichivosti korpusa s nesushchimi poverkhnostiami pri slediashchei nagruzke).** M. B. Vakhitov and I. S. Selin. *Aviatsionnaia Tekhnika,* vol. 16, no. 3, 1973, p. 18-24. 7 refs. In Russian.

Some aspects of the dynamic stability and torsional bending vibrations of a finned rocket body under the action of a follower load are examined. The system is simulated by a three-dimensional truss with variable rigidity and mass characteristics. The influence of the ambient medium is taken into account in terms of aerodynamic forces (determined within the framework of piston theory). A system of equations describing the torsional bending vibrations is derived under the assumption that the rigidity axes of the elements are straight. The determination of the mode shapes and frequencies of the free vibrations is reduced to the calculation of some eigenvalues and vectors of the dynamic matrix that are maximal with respect to the modulus. V.P.

A74-15719 # **Velocity characteristics of a turbine with adjustable nozzle diaphragms (Skorostnye kharakteristiki turbiny s reguliruemymi soplovymi apparatami).** I. A. Barskii. *Aviatsionnaia Tekhnika,* vol. 16, no. 3, 1973, p. 64-68. In Russian.

The velocity characteristics are understood to mean the dependence of the principal turbine parameters on the ratio of the circumferential velocity to the critical flow rate at a constant expansion ratio and a constant exit angle from the nozzle diaphragms. The influence of a variable exit angle on the velocity characteristics is determined experimentally. It is shown that the optimal ratio of the circumferential velocity to the critical flow rate, and the relative dependence of the turbine efficiency on this ratio are independent of the exit angle from the nozzle diaphragms. Empirical relations for calculating the efficiency and thrust ratio of a turbine with adjustable nozzle diaphragms are proposed. V.P.

A74-15721 # **Determination of the gas temperature in front of the turbine of a bypass turbofan engine (Opredelenie temperatury gaza pered turbinoi dvukhval'nogo vysokotemperaturnogo DTRD).** N. D. Korzh, V. V. Kulagin, V. D. Ronzin, and N. A. Gachegov. *Aviatsionnaia Tekhnika,* vol. 16, no. 3, 1973, p. 76-78. In Russian.

An indirect method is proposed for estimating the gas temperature in front of the turbine of an aircraft engine of complex design. The method is based on the simultaneous solution of the heat balance equation and the equation for the gas flow rate in the minimum flow passage cross-sectional area of the first nozzle diaphragm of the turbine. The method is illustrated by applying it to the D-20P turbofan engine. The method is shown to hold also for subcritical gas flows through the first nozzle diaphragm. V.P.

A74-15728 # **The equation of flight vehicle roll motion (Ob uravnenii dvizheniia krena letatel'nykh apparatov).** V. N. Borozdin. *Aviatsionnaia Tekhnika*, vol. 16, no. 3, 1973, p. 111-113. In Russian.

Consideration of the validity of using a certain equation for the roll motion of a flight vehicle of axisymmetric configuration in the design of a stabilization and control system. The inadmissibility of separating the lateral motion of a flight vehicle into isolated roll and yaw motions is demonstrated, as well as the incorrectness of using the investigated equation for design purposes. It is shown that this equation can be corrected by supplementing it with a position term which takes into account the dependence of the transverse moment on the roll angle. A.B.K.

A74-15731 # **An approach to optimal design of passenger aircraft (Ob odnom podkhode k optimal'nomu proektirovaniiu passazhirskikh samoletov).** G. N. Iun. *Aviatsionnaia Tekhnika*, vol. 16, no. 3, 1973, p. 121-124. 6 refs. In Russian.

Consideration of the problem of choosing the optimal aircraft in a generalized formulation which would include an entire network of airlines and the entire aircraft pool servicing these lines. An algorithm for obtaining a general solution to this problem is proposed which differs from the well-known model of a distribution problem by the presence of constraints of redundant type. In addition, local solutions are obtained for the problem of generating a manifold of admissible variants. A.B.K.

A74-15733 # **Influence of the compressor characteristic on gas-turbine engine operation under variable pressure conditions at the exit section of the propelling nozzle (Vliianie kharakteristiki kompressora na rabochii protsess GTD pri izmenenii davleniia na sreze reaktivnogo sopla).** Iu. A. Bordovitsyn and L. E. Sharapov. *Aviatsionnaia Tekhnika*, vol. 16, no. 3, 1973, p. 126-128. In Russian.

The method of small deviations (Cherkez, 1965) is applied to an analysis of the influence of compressor performance on the various modes of gas-turbine engine operation for a wide range of pressure ratios and temperatures in front of the turbine. The influence of changes in the static pressure at the nozzle exit section on turbine engine operation is examined. It is shown that under critical flow conditions at the nozzle outlet, the influence of pressure variations behind the nozzle is independent of the compressor performance. Under subcritical conditions, compressor performance has a substantial influence on the engine parameters, the influence increasing as the compression ratio decreases. V.P.

A74-15747 # **Note on the aerodynamic theory of oscillating T-tails. I - Theory of wings oscillating in yaw and sideslip.** T. Ichikawa and K. Isogai (National Aerospace Laboratory, Tokyo, Japan). *Japan Society for Aeronautical and Space Sciences, Transactions*, vol. 16, no. 33, 1973, p. 173-194. 16 refs.

As a preliminary step in the development of a theory of oscillating T tails, a problem of rigid wings oscillating in yaw and sideslip is treated in detail. Wing-fixed moving coordinate axes are used, and equations are divided into spanwise symmetrical and antisymmetrical parts. With the aid of these techniques, the formulation of the problem is made possible in terms of integral equations of lifting-surface theory. M.V.E.

A74-15757 # **The behavior of a wing panel in a stream of gas under transient conditions.** A. S. Vol'mir, A. T. Ponomarev, and S. A. Popytalov. *(Prikladnaia Matematika i Mekhanika*, vol. 37, Mar.-Apr. 1973, p. 247-253.) *PMM - Journal of Applied Mathematics and Mechanics*, vol. 37, no. 2, 1973, p. 231-237. Translation.

The Bubnov-Galerkin method is applied to derive equations describing the dynamic reaction of an elastic wing skin panel to abrupt changes in flow parameters during rapid shifts of the angle of attack. A thin carrying surface is substituted for a wing skin panel in the calculation of the distribution of aerodynamic pressure over such a panel under transient airflow conditions of this type. V.Z.

A74-15779 **Asymptotic behavior of the solution of the Navier-Stokes equations near fins.** V. G. Maz'ia (Leningradskii Gosudarstvennyi Universitet, Leningrad, USSR) and B. A. Plamenevskii (Leningradskii Institut Tekstil'noi i Legkoi Promyshlennosti, Leningrad, USSR). *(Akademiia Nauk SSSR, Doklady*, vol. 210, June 1, 1973, p. 803-806.) *Soviet Physics - Doklady*, vol. 18, Dec. 1973, p. 379-381. Translation.

Consideration of the asymptotic behavior of a generalized solution of the Navier-Stokes equations in a three-dimensional region with a boundary which contains smooth nonintersecting ribs. Estimates of the solution and of the Green's tensor of the linearized problem are obtained, from which it is demonstrated that the solution of the nonlinear problem possesses Hölder continuity under a certain condition. An asymptotic expansion of the solution to the nonlinear problem near the ribs is carried out. The main term of this expansion, which is determined by the linear part of the problem, is written out explicitly. A.B.K.

A74-15784 **Role of aerodynamic damping in problems of the flutter of sandwich panels and circular cylindrical shells.** A. I. Smirnov, Ia. I. Alikhashkin, and V. M. Mikhailenko (Akademiia Nauk SSSR, Vsesoiuznyi Institut Nauchnoi i Tekhnicheskoi Informatsii, Moscow, USSR). *(Akademiia Nauk SSSR, Doklady*, vol. 210, June 21, 1973, p. 1314-1316.) *Soviet Physics - Doklady*, vol. 18, Dec. 1973, p. 447, 448. Translation.

For both sandwich columns and sandwich plates, it is shown that, throughout the range of aerodynamic damping coefficient values encountered in current practice, the effect of this coefficient on the critical flutter speed is insignificantly small and can be neglected. For sandwich-structured circular-cylinder shells, the importance of the aerodynamic damping coefficient grows with the length-to-width ratio of the shell and can, in the case of large values of this ratio, lead to significant errors in the estimated critical flutter speed. M.V.E.

A74-15810 # **The aerodynamic characteristics of some variable geometry wing forms, derived from delta wings, gothic and mild-ogee wings.** E. Carafoli and I. Paraschivoiu (Bucuresti, Institutul Politehnic Gheorghe Gheorghiu-Dej, Bucharest, Rumania). *Revue Roumaine des Sciences Techniques, Série de Mécanique Appliquée*, vol. 18, no. 5, 1973, p. 789-812. 10 refs.

A74-15817 # **Torsion of conical thin-walled aircraft components (Kruchenie konicheskikh tonkostennykh aviakonstruktsii).** Iu. V. Vasil'ev. *Revue Roumaine des Sciences Techniques, Série de Mécanique Appliquée*, vol. 18, no. 5, 1973, p. 963-997. 13 refs. In Russian.

Analysis of the stressed state of an aircraft semimonocoque fuselage structure under the action of concentrated torsional moments applied to the rigid elements of the transverse reinforcement system of the structure. A variational method is applied to the strength analysis of this structure under these loads. Engineering formulas are given for designing a single-section semimonocoque structure. The formulas are extended to a thin-walled conical structure consisting of finite number of sections which are separated by rigid elements. V.Z.

A74-15820 # **Calculation method for the supersonic spanwise twisted rectangular wings.** E. Carafoli and D. Mateescu. *Revue Roumaine des Sciences Techniques, Série de Mécanique Appliquée*, vol. 18, no. 6, 1973, p. 1021-1033. 9 refs.

Study of spanwise variable incidence wings (defined as twisted wings) often used in supersonic aircraft. The authors determine the formulas for the spanwise wing twist effect, avoiding any laborious calculation necessary for calculating the triangular wings of symmetrical thickness and, then, for passing to limit, making the leading edges tend to infinity. The results obtained show that the formulas are explicit and simple. (Author)

A74-15862 **QTOL and tomorrow's airport environment.** B. Bainbridge (Hamburger Flugzeugbau GmbH, Hamburg, West Germany). *Airport Forum*, Dec. 1973, p. 17, 18 (6 ff.). In English and German.

Description of projected design and operational aspects of the Europlane quiet takeoff and landing (QTOL) short/medium haul airliner intended to meet the needs of European airspace and terminals in the 1980's. The chosen aircraft configuration has a modestly swept low wing, a tee tail, and a double-bubble fuselage capable of carrying eight LD1 or LD3 containers in the lower hold and up to 191 tourist class passengers in the hold. Power is supplied either by two Rolls-Royce RB.211 or two General Electric CF-6 engines mounted off the fuselage behind the wing. Special acoustic measures taken to minimize the emitted noise level are described together with benefits to air traffic control operations expected with this aircraft. T.M.

A74-15863 **Dynamic Manchester air transport region.** R. Allen (Aviation Literary Services, Northampton, England). *Airport Forum*, Dec. 1973, p. 35, 37-39, 41-45. In English and German.

The development of the Manchester International Airport is described in terms of investments in facilities designed to meet the growing air traffic requirements in the north of England. Passenger and cargo handling areas being added to accommodate the new 747-type aircraft are discussed along with runway and taxiway modifications. Financing schemes and political constraints are also considered. T.M.

A74-15864 **Forgotten airport aesthetics.** K. Klatt. *Airport Forum*, Dec. 1973, p. 52-54, 56-59. In English and German.

Terminal facilities in airports around the world are critically reviewed from an architectural viewpoint that considers aesthetics as well as functional aspects. Examples of poor terminal planning are confronted with more successful structures, considering demands placed on passenger comfort by long and tedious access routes, general appearance of corridors, maintenance of surrounding grounds, and a pleasing design of buildings and towers. T.M.

A74-15865 **Aircraft recovery - There is a solution.** W. Buschky (Deutsche Lufthansa AG, Hamburg, West Germany). *Airport Forum*, Dec. 1973, p. 73, 76-82, 84-87. In English and German.

Description of new equipment and procedures used to recover damaged or disabled aircraft from operational areas of airports. Progress in aircraft recovery has been achieved mainly through the recent availability of reliable equipment specially designed to lift and remove particular aircraft. Attention is given to the use and design of air-bag lifting systems, recovery jacks, and general costly equipment maintained by the airports rather than airlines. T.M.

A74-15866 **Concrete or black top.** B. Probst (Flughafen Basel-Mülhausen, Basel, Switzerland) and E. Zipkes (Eidgenössische Technische Hochschule, Zurich, Switzerland). *Airport Forum*, Dec. 1973, p. 97, 98 (8 ff.). In English and German.

The properties of concrete and bituminous pavements when used as runway surfaces are compared on the basis of experimental data obtained during runway extension operations at the Basel-Mulhouse airport. Detailed information is presented on the comparative textures of the two pavements, friction properties, temperature response, optical properties, thermal currents, polishing effects, frost sensitivity, fire resistance, ease of repairs, and other pertinent features. T.M.

A74-15930 # **Accelerating test stand for rotating elements of turbomachines (Razgonnyi stend dlia ispytaniia vrashchaiushchikhsia elementov turbomashin).** V. I. Gornostai, V. G. Bazhenov, and N. I. Toniuk (Kievskii Politekhnicheskii Institut, Zhitomir, Ukrainian SSR). *Problemy Prochnosti*, vol. 5, Oct. 1973, p. 100-103. In Russian.

A universal test stand is described which can be used to study the plastic deformation and failure characteristics of rotors and of turbine, compressor, and blower disks at speeds of up to 80,000 rpm. The stress strain state of such components can be studied with the aid of strain gauges. A schematic diagram of the test stand is discussed. V.P.

A74-15933 # **Method for calculating the impellers of centrifugal superchargers with allowance for the deformation of the cover plate (Metod rascheta koles tsentrobezhnykh magnetatelei, uchityvaiushchii nesimmetrichnuiu deformatsiiu pokryvaiushchego diska).** S. I. Volk (Kievskii Politekhnicheskii Institut, Zhitomir, Ukrainian SSR). *Problemy Prochnosti*, vol. 5, Oct. 1973, p. 114-116. In Russian.

The stress-strain state of an impeller in the area with a cover plate is studied on the basis of a design diagram in the form of two elastic shallow shells of revolution of variable thickness coupled to each other by radial struts. The shell/strut system may experience both physical and thermal loads that vary along the radius and across the thickness of the system's elements. The design diagram takes into account the discrete nature of the application of contact forces to the cover plate and the interaction between the cover plate and the impeller vanes. The vaned impeller is treated as a structurally orthotropic system. A resolvent system of ordinary differential equations is derived in terms of the displacement amplitudes. V.P.

A74-15949 # **Turbulent heat transfer measurements in a Mach 15 flow.** B. E. Richards and C. Appels (Institut von Karman de Dynamique des Fluides, Rhode-Saint-Genèse, Belgium). *EUROMECH, Colloquium on Heat Transfer in Turbulent Boundary Layers with Variable Fluid Properties, Göttingen, West Germany, May 14-16, 1973, Preprint 73-2.* 36 p. 19 refs. Research supported by the Instituut tot Aanmoediging van der Wetenschappelijk Onderzoek.

Turbulent boundary layer heat transfer data were generated on various model geometries, both simple and complicated, in the Mach 15 high unit Reynolds flow of the von Karman Institute Longshot Free-Piston Tunnel. Thin film platinum resistance gauges were used to measure heat transfer rates on surfaces at small angles to the flow; calorimeter sensors were used on surfaces at large angles. Results of experiments on the wedge- and vertical fin-interaction with the Mach 12 boundary layer are given. Large heat transfer peaks were measured, caused by the interaction of a vertical fin with the boundary layer. In each of these interaction experiments, higher heat transfer rates than found for undisturbed flow is found in the separated regions on the flat plate. F.R.L.

A74-15953 **The light-weight high-performance YF-17.** J. P. Geddes. *Interavia*, vol. 28, Dec. 1973, p. 1315-1318.

The USAF outlined clear design objectives of the light-weight fighter, based on a 'day fighter', i.e., one that would operate in clear weather, usually under visual flight rules. The emphasis in performance is on transonic maneuverability. The aircraft is a twin-engined single seat model with a hybrid wing planform, set at mid-fuselage position. Distinguishing features are the large bubble cockpit, angled twin vertical tails set well forward of the large horizontal tail, and long leading edge extensions or strakes extending over the nostril engine inlets. The main design objective for the flight control system on the YF-17 was to provide a basic aerodynamic design that is stable and spin resistant without stability augmentation. The structure of the design is largely conventional. F.R.L.

A74-15962 # **Flight noise reduction in propeller-driven aircraft (Flugiärmbekämpfung bei Propellerflugzeugen).** G. Dübener. *Aero-Revue*, Dec. 1973, p. 628-630. In German.

A procedure for calculating the noise levels of propeller-driven aircraft is discussed. The procedure applies to noise measurements at a distance of 100 ft from aircraft at M 0.62 to 0.90 and blade tip frequencies from 50 to 500 Hz, for two-to-four blade propellers. Comparisons of noise calculations with measurements show good agreements for a large number of different propeller-driven aircraft types. The effects of propeller blade geometries on calculations by this procedure are evaluated. Exhaust noise is also considered. V.Z.

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A74-15963 # Observations of atmospheric effects on vortex wake behavior. I. Tombach (Aero Vironment, Inc., Pasadena, Calif.). *Journal of Aircraft*, vol. 10, Nov. 1973, p. 641-647. 22 refs. Research supported by the U.S. Department of Transportation and U.S. Air Force.

Smoke-marked trailing vortices were generated by a light aircraft under a hierarchy of measured atmospheric stability and turbulence levels, and their motion and decay were recorded photographically. Decay from both sinuous vortex interaction and core bursting type instabilities occurred, with bursting being the dominant mode. Turbulence had a strong effect on wake life, with time-to-breakup for both modes varying as epsilon to the one-third power where epsilon is the turbulent dissipation rate. Observed lifetimes ranged from 6 sec in light-to-moderate turbulence to more than 80 sec in calm, stable air. One exceptionally long-lived solitary vortex was observed for more than 3 min. Atmospheric stratification had a weak influence on wake life, and its effect on wake descent could not be determined, since descent was often stopped by a rolling of the plane of the vortices. The observed data correlate well with a new theory for time-to-breakup. (Author)

A74-15964 * # On the inviscid rolled-up structure of lift-generated vortices. V. J. Rossow (NASA, Ames Research Center, Moffett Field, Calif.). *Journal of Aircraft*, vol. 10, Nov. 1973, p. 647-650. 5 refs.

A simple form is presented of the relationships derived by Betz for the inviscid, fully developed structure of lift-generated vortices behind aircraft. An extension is then made to arbitrary span-load distributions by inferring guidelines for the selection of rollup centers for the vortex sheet. These techniques are easier to use and yield more realistic estimates of the rolled-up structure of vortices than the original form of Betz' theory when the span loading differs appreciably from elliptic loading. (Author)

A74-15965 # Exact method of designing airfoils with given velocity distribution in incompressible flow. T. Strand (Air Vehicle Corp., San Diego, Calif.). *Journal of Aircraft*, vol. 10, Nov. 1973, p. 651-659. 7 refs. Contract No. N00600-71-C-0709.

The inverse problem of airfoil theory, i.e., from a given surface velocity distribution determine the airfoil shape, is solved by conformal mapping procedures. The method is based upon prior work by Arlinger, which in turn is an extension of Lighthill's basic development. It involves the use of least squares and Lagrangian multipliers to modify the prescribed velocity distribution along a portion of the lower surface of the airfoil, thus ensuring that the modifications required for profile closure are minimized. The method developed should be of particular importance for calculating the shapes of new types of airfoils with high design lift coefficients, i.e., under conditions when conventional linearized theory breaks down. The method is exact in the sense of potential flow theory. Sample calculations are presented for a prescribed velocity distribution having an upper-surface constant-velocity region, followed by a Stratford-type zero-skin-friction portion, designed for Reynolds number 3,000,000 and turbulent flow on both upper and lower surfaces. (Author)

A74-15966 # Minimum induced drag of a hemi-circular ground effect wing. H. Mamada (Aichi University of Education, Kariya, Aichi, Japan) and S. Ando (Nagoya University, Nagoya, Japan). *Journal of Aircraft*, vol. 10, Nov. 1973, p. 660-663.

The induced drag is considered for a hemi-circular front view wing with both tips in close proximity to the ground surface. The integral equation is exactly solved using Söhngen's inversion formula. Assuming an optimum downwash distribution, the exact expression of the span-efficiency-factor is discussed analytically and numerically. (Author)

A74-15967 * # Effect of steady state coning angle and damping on whirl flutter stability. K. R. V. Kaza (Stanford University, Stanford, Calif.). *Journal of Aircraft*, vol. 10, Nov. 1973, p. 664-669. 9 refs. Grant No. NGL-05-020-243.

The main object of this investigation is to find the effect of the steady state coning angle and the damping at the flapping hinge of the blades on the whirl flutter stability boundary and thus to determine the role they can play in narrowing down the gap between theory and experiment. The governing equations of motion, with these two parameters included are derived by the classical Lagrangian approach using quasi-steady blade element theory for aerodynamic forces. A linearized analysis of these equations is applied to two of the wind tunnel models of the previous investigations. The results indicate that these parameters have a marked effect on stability boundary and they may even change the mode of flutter from backward whirl to forward whirl. (Author)

A74-15968 # Fracture mechanics applications in materials selection, fabrication sequencing and inspection. W. E. Krupp and D. W. Hoeppner (Lockheed-California Co., Burbank, Calif.). *(AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 13th, San Antonio, Tex., Apr. 10-12, 1972, AIAA Paper 72-383.) Journal of Aircraft*, vol. 10, Nov. 1973, p. 682-688. 40 refs.

Description of the use of fracture mechanics concepts in quantitative comparisons of the effects of various alternatives involved in the design, manufacture, assembly, and quality assurance of critical parts and, in particular, of fracture-critical aircraft components. Specific examples are presented for illustration. M.V.E.

A74-15970 # Structure of Betz vortex cores. P. F. Jordan (Martin Marietta Laboratories, Baltimore, Md.). *Journal of Aircraft*, vol. 10, Nov. 1973, p. 691-693. 6 refs. Contract No. F44620-69-C-0996.

The radial distribution of the tangential speed in a rolled-up vortex behind a lifting wing is considered. Special attention is given to the situation when the roll-up is just completed, the flow has become essentially two-dimensional, but vortex decay has not yet set in measurably. An attempt is made to determine to what extent is the vortex structure at this stage defined by the roll-up process as the potential flow mechanism, and how important, by contrast, is the role of viscosity or of turbulent shear. M.V.E.

A74-15971 # Design of crashworthy aircraft cabins based on dynamic buckling. C. A. Fisher and C. W. Bert (Oklahoma, University, Norman, Okla.). *Journal of Aircraft*, vol. 10, Nov. 1973, p. 693-695. 8 refs.

A nonlinear analysis method, developed by Fisher and Bert (1973) for the treatment of dynamic buckling in an axially compressed shell with discrete rings and stringers, is applied to an idealized stiffened-cylinder model representative of current-design light-aircraft cabins. Several parameters relating to the stiffeners are varied parametrically to elucidate design concepts for increasing cabin crashworthiness. M.V.E.

A74-15972 # A criterion for assessing wind-tunnel wall interference at Mach 1. T. R. Goodman (Oceanics, Inc., Plainview, N.Y.). *Journal of Aircraft*, vol. 10, Nov. 1973, p. 695-697. 6 refs. Contract No. F44620-72-C-0079.

The concept of local linearization introduced by Spreiter and Alksne (1958) for the calculation of pressures on airfoils at Mach numbers near one, subsequently extended to bodies of revolution, is shown to be useful in the determination of a criterion for assessing wind tunnel wall interference. The use of this criterion makes it possible to design virtually interference-free transonic wind tunnel experiments with the aid of transonic similarity laws. M.V.E.

A74-16038 # Analysis of the use of an auxiliary wing on a helicopter. II (Analiza zastosowania skrzydla pomocniczego na smiglowcu. II). K. Szumanski. *Technika Lotnicza i Astronautyczna*, vol. 23, Nov. 1973, p. 25-28. In Polish.

The flight mechanics of winged helicopters and the physical aspects of wing-rotor interaction were considered in the first part of this article. The second part is devoted to principles governing design

specification of structural parameters for the wing and rotor support system. Attention is given to wing mounting and positioning in order to maintain the highest performance in hover, forward-flight, and vertical flight modes. T.M.

A74-16039 # **Aerodynamics of rotating disks (Aerodynamika wirujacych krazkow).** G. A. Mokrzycki. *Technika Lotnicza i Astronautyczna*, vol. 23, Nov. 1973, p. 29-31. In Polish.

The drag and lift of two thin elliptical-section disks rotating in opposite directions in the same plane were measured in an annular water tank. The disks were spinning at rates from 500 to 3000 rpm, the annular water tank was rotating at an angular velocity of 5 to 40 deg/sec, and the disk angle of attack in the tank ranged from 0 to 12 deg. The rotating disks show higher lift and lower drag than corresponding stationary disks, and V/STOL aircraft configurations employing such disk lift systems are suggested. T.M.

A74-16074 Some trends in air traffic control. R. M. Soward. *Eurocontrol*, vol. 3, no. 2, 1973, p. 3-11. 15 refs.

Some trends in air traffic control are discussed which have emerged in recent years and which, if continued, may largely influence the traffic-handling capacity provided in the mid-1980s. Traffic characteristics and traffic distribution are considered, as well as problems posed by the SST and short takeoff and landing (STOL) aircraft. The strategic-tactical balance, route structure, and the navigational capability involved in separation between parallel routes are treated. Attention is given to profile navigation, advance traffic planning, display to the planning controller and display of complex route patterns, and data acquisition and exchange. 'Special handling' problems are briefly discussed. F.R.L.

A74-16075 Eurocontrol evaluation of the Standard Elektrik Lorenz /SEL/ Doppler VOR-DME and Decca Omnitrac computing, navigation and display system for area navigation. Phase III - Flight trials 1971-1972. F. Jesson. *Eurocontrol*, vol. 3, no. 2, 1973, p. 12-18.

A74-16240 # **ACV icing problems.** J. R. Stallabrass and T. R. Ringer (National Research Council, Ottawa, Canada). *Canadian Aeronautics and Space Journal*, vol. 19, Dec. 1973, p. 493-495.

Brief review of the problems generated by droplet and snow melt icing resulting in ice accretion about air cusion vehicles operating at subfreezing temperatures over rivers, lakes, muskeg, or loose snow. Special attention is given to the vehicle design considerations induced by these problems and to protective measures. M.V.E.

A74-16246 # **A new system for recording aircraft attitude.** U. Nielsen (Department of the Environment, Ottawa, Canada). *Canadian Aeronautics and Space Journal*, vol. 19, Dec. 1973, p. 525-527.

An airborne, gyro-stabilized system is described that continuously measures and records aircraft or aerial camera pitch and roll angles. The system consists of a gyroscope, sensing units, electronics, display and aerial camera. The longitudinal and lateral tilt angles measured at the gimbals of the gyroscope are binary coded and are recorded on each photographic frame through the secondary optics of the camera. The range of the system is 6.0 deg in any direction, and the resolution is 6 minutes of arc. The system is designed to reduce the need for ground control in calibrating aerial photographs with a scale of about 1:2,000, which are used for forest inventories. (Author)

A74-16306 # **Investigation of machining errors caused by geometrical inaccuracies of the bench in rotary milling of turbine blade profiles (K issledovaniiu pogreshnosti obrabotki iz-za geometricheskikh netochnostei stankov pri krugovom frezerovanii profilia turbinnykh lopatok).** V. S. Mamaev and A. I. Kotel'nikov. *Mashinostroenie*, no. 11, 1973, p. 174-176. In Russian.

STAR ENTRIES

N74-11804 Stanford Univ., Calif.
AERODYNAMIC SOUND GENERATION DUE TO VORTEX-AEROFOIL INTERACTION Ph.D. Thesis
Rangaswamy Parthasarathy 1973 150 p
Avail: Univ. Microfilms Order No. 73-14954

The aerodynamic sound produced by a vortex passing past an airfoil in uniform motion is studied. Following the procedure proposed by Lighthill to study how aerodynamic flows produce noise, the complete flow field is broadly divided into two separate regions: (1) a region of sound generation in the neighborhood of the airfoil, and (2) a uniform medium at rest where sound, due to the fluid fluctuations in the region (3) is being propagated. The vortex-airfoil interaction problem is formulated as a vortex of strength K being released ahead of an airfoil of chord C, at a specific location, at time t = 0. Classical two dimensional incompressible, inviscid, unsteady potential airfoil theory has been employed to determine the trajectory of the vortex, the forces acting on the airfoil, and the complete flow field around the airfoil. Dissert. Abstr.

N74-11805 Engineering Sciences Data Unit, London (England).
STABILITY DERIVATIVE. CONTRIBUTION OF FULL-SPAN DIHEDRAL TO ROLLING MOMENT DUE TO SIDESLIP
Apr. 1973 5 p
(ESDU-Aircraft-06.01.03-A-B) Copyright. Avail: Issuing Activity

A numerical method for determining the stability derivative associated with full span dihedral contribution to the rolling moment of an aircraft due to sideslip is presented. Mathematical models are developed for four values of the taper ratio for wings having constant dihedral over the entire wing semi-span. It was determined that the contribution of dihedral to the rolling moment due to sideslip varies linearly with dihedral angle and is independent of the lift coefficient provided the latter is below about sixty percent of its stalling value. Author

N74-11807*# Boeing Co., Wichita, Kans.
ANALYSIS AND TESTING OF AEROELASTIC MODEL STABILITY AUGMENTATION SYSTEMS Final Report
Francis D. Sevart and S. M. Patel 15 Oct. 1973 167 p refs Original contains color illustrations
(Contract NAS1-11833)
(NASA-CR-132345; D3-9245) Avail: NTIS HC $10.50 CSCL 01A

Testing and evaluation of a stability augmentation system for aircraft flight control were performed. The flutter suppression system and synthesis conducted on a scale model of a supersonic wing for a transport aircraft are discussed. Mechanization and testing of the leading and trailing edge surface actuation systems are described. The ride control system analyses for a 375,000 pound gross weight B-52E aircraft are presented. Analyses of the B-52E aircraft maneuver load control system are included. Author

N74-11808*# Boeing Commercial Airplane Co., Seattle, Wash.
THE RESULTS OF LOW-SPEED WIND TUNNEL TESTS TO INVESTIGATE THE EFFECTS OF THE NASA REFAN JT8D ENGINE NACELLES ON THE STABILITY AND CONTROL CHARACTERISTICS OF THE BOEING 727-200
M. D. Shirkey Oct. 1973 31 p
(Contracts NAS3-16815; NAS3-17842)
(NASA-CR-134503; BCAC-D6-41312) Avail: NTIS HC $3.75 CSCL 01A

The results from two low-speed wind tunnel tests of the Boeing 727-200 airplane as configured with the NASA refan JT8D-109 turbofan engines are presented. The objective of these tests was to determine the effects of the refan installation on the low-speed stability and control characteristics of the 727 airplane. Four side nacelle locations were tested to insure that aerodynamic interactions of the nacelles and empennage would be optimized. The optimum location was judged to be the same as that of the production JT8D-9 engines; the current production engine mounts can be used for this location. Some small changes in the basic airplane characteristics are attributable to the refan nacelles. The flaps up longitudinal and lateral-directional stability are both slightly increased for low angles of attack and sideslip respectively. The longitudinal stability at stall is improved for both the flaps up and landing flap configurations. The high attitude characteristics of the basic airplane are not significantly altered by the refan nacelle installation. Directional control capability is not affected by the refan nacelles. Author

N74-11809*# Boeing Co., Wichita, Kans.
ANALYSIS AND TESTING OF STABILITY AUGMENTATION SYSTEMS Final Report
F. D. Sevart, S. M. Patel, and W. J. Wattman 13 Jun. 1972 125 p refs
(Contract NAS1-10885)
(NASA-CR-132349; D3-8884) Avail: NTIS HC $8.25 CSCL 01C

Testing and evaluation of stability augmentation systems for aircraft flight control were conducted. The flutter suppression system analysis of a scale supersonic transport wing model is described. Mechanization of the flutter suppression system is reported. The ride control synthesis for the B-52 aeroelastic model is discussed. Model analyses were conducted using equations of motion generated from generalized mass and stiffness data. Author

N74-11810*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
GEOMETRY PROGRAM FOR AERODYNAMIC LIFTING SURFACE THEORY
Richard T. Medan Sep. 1973 108 p refs
(NASA-TM-X-62309) Avail: NTIS HC $7.50 CSCL 01A

A computer program that provides the geometry and boundary conditions appropriate for an analysis of a lifting, thin wing with control surfaces in linearized, subsonic, steady flow is presented. The kernel function method lifting surface theory is applied. The data which is generated by the program is stored on disk files or tapes for later use by programs which calculate an influence matrix, plot the wing planform, and evaluate the loads on the wing. In addition to processing data for subsequent use in a lifting surface analysis, the program is useful for computing area and mean geometric chords of the wing and control surfaces. Author

N74-11812*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF SUBSONIC INLET LIP GEOMETRY ON PREDICTED SURFACE AND FLOW MACH NUMBER DISTRIBUTIONS
James A. Albers and Brent A. Miller Washington Dec. 1973 56 p refs
(NASA-TN-D-7446; E-7522) Avail: NTIS HC $3.00 CSCL 20D

The effect of subsonic inlet lip geometry on predicted surface and flow Mach number distributions is illustrated. The theoretical results were obtained from incompressible potential flow calculations corrected for compressibility. The major emphasis of this investigation is on the low-speed (takeoff and landing) operating conditions. The low-speed results were obtained for a range of three geometric variables of interest: contraction ratio,

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defined as the ratio of highlight area to throat area; internal lip major - to minor-axis ratio; and internal lip shape. The low-speed results were obtained at both static conditions and a free-stream velocity of 42.6m/sec, with incidence angles ranging from 0 deg to 50 deg. The results indicate that of the three geometric variables considered, contraction ratio had the largest effect on the surface Mach number distributions. The effects of inlet diameter ratio and blunting of the external forebody on maximum external surface Mach numbers are illustrated at a cruise Mach number of 0.8. Author

N74-11813*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NOISE TESTS ON AN EXTERNALLY BLOWN FLAP WITH THE ENGINE IN FRONT OF THE WING
Allen M. Karchmer and Robert Friedman Washington Dec. 1973 17 p refs
(NASA-TM-X-2942; E-7564) Avail: NTIS HC $2.75 CSCL 01A

Noise tests were conducted with a nozzle exhausting over a small scale model of an externally blown flap (EBF) lift-augmentation system, with exhaust impingement on the wing leading edge. Two series of tests were conducted: with wing leading edge inside the nozzle; and with leading edge set back from the nozzle exit plane 1 diameter on the jet axis. The results indicated no significant differences in spectral shape, level, or directivity pattern. Static lift and thrust tests were conducted on the same model indicated considerable flow attachment on both configurations, with slightly greater attachment and turning for the wing outside the nozzle. Finally, a comparison with engine-above- and engine-below-the-wing EBF's tested by previous investigators shows the acoustic performance of the configurations tested for this report to lie between the other two. Author

N74-11814*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
RESULTS OF A FEASIBILITY STUDY USING THE NEWTON-RAPHSON DIGITAL COMPUTER PROGRAM TO IDENTIFY LIFTING BODY DERIVATIVES FROM FLIGHT DATA
Alex G. Sim Washington Oct. 1973 41 p refs
(NASA-TM-X-56017) Avail: NTIS HC $4.25 CSCL 01A

A brief study was made to assess the applicability of the Newton-Raphson digital computer program as a routine technique for extracting aerodynamic derivatives from flight tests of lifting body types of vehicles. Lateral-direction flight data from flight tests of the HL-10 lifting body reserch vehicle were utilized. The results in general, show the computer program to be a reliable and expedient means for extracting derivatives for this class of vehicles as a standard procedure. This result was true even when stability augmentation was used. As a result of the study, a credible set of HL-10 lateral-directional derivatives was obtained from flight data. These derivatives are compared with results from wind-tunnel tests. Author

N74-11815*# Scientific Translation Service, Santa Barbara, Calif.
CALCULATION OF FLOWS AROUND ZERO THICKNESS WINGS WITH EVOLUTIVE VORTEX SHEETS
Colmar Rehbach Washington NASA Dec. 1973 25 p refs Transl. into ENGLISH from Rech. Aerosp. (France), No. 2, Mar. - Apr. 1972 p 53-61
(Contract NASw-2483)
(NASA-TT-F-15183) Avail: NTIS HC $3.25 CSCL 01A

The correct evaluation of the aerodynamic characteristics of some wing shapes requires the knowledge of the geometry of their vortex sheets. Out of the many calculations performed in this field, two are presented. The first one concerns a rectangular wing of very small aspect ratio (AR = 1), the second a sweptback wing of moderate aspect ratio (AR = 3.78). In both cases they are without thickness in incompressible flow. Their vortex sheets originate at the trailing edge and the wing tips. Author

N74-11819*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
CANARD-WING LIFT INTERFERENCE RELATED TO MANEUVERING AIRCRAFT AT SUBSONIC SPEEDS
Blair B. Gloss and Linwood W. Mckinney Washington Dec. 1973 35 p refs
(NASA-TM-X-2897; L-9096) Avail: NTIS, HC $3.00 CSCL 01A

An investigation was conducted at Mach numbers of 0.7 and 0.9 to determine the lift interference effect of canard location on wing planforms typical of maneuvering fighter configurations. The canard had an exposed area of 16.0 percent of the wing reference area and was located in the plane of the wing or in a position 18.5 percent of the wing mean geometric chord above the wing plane. In addition, the canard could be located at two longitudinal stations. Two different wing planforms were tested: one with a leading-edge sweep angle of 60 deg and the other with a leading-edge sweep angle of 44 deg. The results indicated that although downwash from the canard reduced the wing lift at angles of attack up to approximately 16 deg, the total lift was substantially greater with the canard on than with the canard off. At angles of attack above 16 deg, the canard delayed the wing stall. Changing canard deflection had essentially no effect on the total lift, since the additional lift generated by the canard deflection was lost on the wing due to an increased downwash at the wing from the canard. Author

N74-11821*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
LOW SPEED AERODYNAMIC CHARACTERISTICS OF A 17 PERCENT THICK AIRFOIL SECTION DESIGNED FOR GENERAL AVIATION APPLICATIONS
Robert J. McGhee and William D. Beasley Washington Dec. 1973 71 p refs
(NASA-TN-D-7428; L-9132) Avail: NTIS HC $3.50 CSCL 01A

Wind-tunnel tests have been conducted to determine the low-speed two-dimensional aerodynamic characteristics of a 17-percent-thick airfoil designed for general aviation applications (GA(W)-1). The results were compared with predictions based on a theoretical method for calculating the viscous flow about the airfoil. The tests were conducted over a Mach number range from 0.10 to 0.28. Reynolds numbers based on airfoil chord varied from 2.0 million to 20.0 million. Maximum section lift coefficients greater than 2.0 were obtained and section lift-drag ratio at a lift coefficient of 1.0 (climb condition) varied from about 65 to 85 as the Reynolds number increased from about 2.0 million to 6.0 million. Author

N74-11822*# Rochester Applied Science Associates, Inc., N.Y.
EFFECT OF SWEEP ANGLE ON THE PRESSURE DISTRIBUTIONS AND EFFECTIVENESS OF THE OGEE TIP IN DIFFUSING A LINE VORTEX
John C. Balcerak and Raymond F. Feller 1973 123 p refs
(Contract NAS1-12012)
(NASA-CR-132355; RASA-73-07) Avail: NTIS HC $8.25 CSCL 01A

Low-speed wind tunnel tests were conducted to study the influence of sweep angle on the pressure distributions of an ogee-tip configuration with relation to the effectiveness of the ogee tip in diffusing a line vortex. In addition to the pressure data, performance and flow-visualization data were obtained in the wind tunnel tests to evaluate the application of the ogee tip to aircraft configurations. The effect of sweep angle on the performance characteristics of a conventional-tip model, having equivalent planform area, was also investigated for comparison with the ogee-tip configuration. Results of the investigation generally indicate that sweep angle has little effect on the characteristics of the ogee in diffusing a line vortex. Author

N74-11823*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THEORETICAL AND EXPERIMENTAL INVESTIGATION OF

THE PERFORMANCE OF A FAN-IN-WING VTOL CONFIGURATION
Harry H. Heyson Washington Dec. 1973 75 p refs
(NASA-TN-D-7498; L-9219) Avail: NTIS HC $3.50 CSCL 01C

The incompressible-flow momentum theory is extended to the case of lifting fans. The resulting theory includes many of the known experimentally determined characteristics of fan-in-wing aircraft. These characteristics include the negligible effect of forward speed on fan thrust, the large momentum drag, and the generally inefficient performance throughout the transition speed range. Although mutual interference between the fans and the wing was totally neglected, the theory is confirmed by experimental results for the configuration tested. Examination of the results of an investigation of wall interference leads to the conclusion that the large fan-induced lift reported in many earlier investigations was largely the result of neglecting wall interference in the reduction of wind-tunnel data. Author

N74-11824 California Univ., Los Angeles.
THE DESIGN OF AN OPTIMAL ADAPTIVE LATERAL-DIRECTIONAL FLIGHT CONTROL SYSTEM FOR A HIGH-PERFORMANCE AIRCRAFT Ph.D. Thesis
Vincent James Darcy 1973 111 p
Avail: Univ. Microfilms Order No. 73-13133

The lateral-directional dynamics of a high-performance aircraft are modeled by a set of linear time-varying differential equations. Because a high-performance aircraft is capable of performing a wide variety of rapid maneuvers, the dynamic equations do not contain small-perturbation assumptions. An on-line real-time parameter identification scheme is developed to identify the time-varying parameters of the lateral-directional dynamic aircraft model. The identification scheme is an approximation technique with the practical assumption that the system noise statistics are not known. An adaptive lateral-directional flight controller is then developed based on a handling-quality model and the dynamic model of the aircraft. The controller combines the benefits of state-variable feedback with the benefits of series compensators. Dissert. Abstr.

N74-11825*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STUDY OF A CONTROL SYSTEM TO ALLEVIATE AIRCRAFT RESPONSE TO HORIZONTAL AND VERTICAL GUSTS
William H. Phillips Washington Dec. 1973 40 p refs
(NASA-TN-D-7278; L-8844) Avail: NTIS HC $3.00 CSCL 01C

A study is made of the longitudinal response of a STOL airplane equipped with a vanecontrolled gust-alleviation system. Effects of various combinations of design parameters on the responses to horizontal and vertical gusts and to elevator inputs are presented. Almost complete gust alleviation may be obtained with this system when the center of gravity of the STOL airplane is at rearward locations, but pitch stability augmentation is required for satisfactory control characteristics. Author

N74-11826*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AERODYNAMIC CHARACTERISTICS OF A LARGE-SCALE MODEL WITH A SWEPT WING AND A JET FLAP HAVING AN EXPANDABLE DUCT
Thomas N. Aiken, Kiyoshi Aoyagi, and Michael D. Falarski Sep. 1973 96 p refs Prepared in cooperation with Army Air Mobility R and D Lab., Moffet Field, Calif.
(NASA-TM-X-62281) Avail: NTIS HC $7.00 CSCL 01C

The data from an investigation of the aerodynamic characteristics of the expandable duct-jet flap concept are presented. The investigation was made using a large-scale model in the Ames 40- by 80-foot Wind Tunnel. The expandable duct-jet flap concept uses a lower surface, split flap and an upper surface, Fowler flap to form an internal, variable area cavity for the blowing air. Small amounts of blowing are used on the knee of the upper surface flap and the knee of a short-chord, trailing edge control flap. The bulk of the blowing is at the trailing edge. The flap could extend the full span of the model wing or over the inboard part only, with blown ailerons outboard. Primary configurations tested were two flap angles, typical of takeoff and landing; symmetric control flap deflections, primarily for improved landing performance; and asymmetric aileron and control flap deflections, for lateral control. Author

N74-11827*# Kanner (Leo) Associates, Redwood City, Calif.
ON THE RELIABILITY OF RESULTS FROM THE TOWER TEST FOR FREE FLIGHT TESTS
H. Goerlich Washington NASA Nov. 1973 15 p Transl. *into ENGLISH from West Ger. report DLR-Mitt-72-18, Oct. 1972* p 79-92 Presented at the 3rd meeting of the DGLR-Symposium, Flight Testing Technology: Reliability of Results Derived from Simulation in Comparison with Results of Actual Flight, Bremen, 28 Apr. 1972
(Contract NASw-2481)
(NASA-TT-F-15174; DLR-Mitt-72-18) Avail: NTIS HC $3.00 CSCL 01B

The determination of aerodynamic characteristics of aircraft while mounted on a fixed column is discussed. The construction of the test equipment to measure pitching and rolling moments is described. The advantages of using such a method as a complement to flight tests are outlined. Specific examples of tests conducted and the results obtained during captive tests are analyzed. Author

N74-11828# National Aviation Facilities Experimental Center, Atlantic City, N.J.
AIRCRAFT FUEL SYSTEM TESTS WITH GELLED FUEL-FLOWMETER CALIBRATION, FUEL BOOST PUMP AND JETTISON TESTS Final Report, Dec. 1971 - Nov. 1972
Joseph A. Avbel Nov. 1973 29 p refs
(FAA Proj. 181-520-020)
(FAA-NA-73-43; FAA-RD-73-138) Avail: NTIS HC $3.00

The feasibility of using gelled fuel (nominal 250 centipoise viscosity) with full scale aircraft fuel system components was investigated. Tests indicated that turbine-type flowmeters are suitable for measuring flow rates with accuracies of 1 percent. Jettison and fuel feed operations were conducted using a B-57 wing fuel tank. Approximately 3 percent more gelled fuel than JP-5R remained in the tank after emptying the tank in both boost pump and jettison tests. Flow rates and times to empty the tank were significantly poorer with the gelled fuel when compared to the results obtained with the JP-5R fuel. The gelled fuel tested is considered unsatisfactory because of its instability in storage, causing wide variations in viscosity. Author

N74-11829*# *Boeing Co., Wichita, Kans.*
ANALYSIS OF AEROELASTIC MODEL STABILITY AUGMENTATION SYSTEMS Final Report
Frank D. Sevart Mar. 1971 202 p refs
(Contract NAS1-9808)
(NASA-CR-132354; D3-8390-4) Avail: NTIS HC $12.25 CSCL 01C

An analytical and mechanization study was conducted for two flutter stability augmentation systems. One concept uses only the wing trailing edge control surface. Another concept uses leading and trailing edge control surfaces operating simultaneously. The combined use of leading and trailing edge control surfaces should improve the surface coupling (controllability) with vertical bending and torsional structural modes and decrease the coupling between bending and torsional modes. The study was directed toward stability augmentation systems characteristics for the supersonic transport aircraft. Author

N74-11830# National Transportation Safety Board, Washington, D.C.
AIRCRAFT ACCIDENT REPORT: CONTINENTAL AIRLINES, SABRELINER MODEL NA-265-60, N743R, MONTROSE, COLORADO, 13 APRIL 1973
7 Nov. 1973 24 p
(NTSB-AAR-73-19) Avail: NTIS HC $3.25

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An aircraft accident involving a Sabreliner aircraft which crashed after takeoff from the Montrose, Colorado airport on 13 April 1973 is reported. The aircraft struck the ground while in a steep left turn and nose down attitude. It was determined that the cause of the accident was continued operation of the left engine at climb power, after an unwanted in-flight deployment of the left engine thrust reverser, causing an uncontrollable flight condition. Author

N74-11831*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HYPERSONIC AERODYNAMIC CHARACTERISTICS OF AN ALL-BODY RESEARCH AIRCRAFT CONFIGURATION
Louis E. Clark Washington Dec. 1973 46 p refs
(NASA-TN-D-7358; L-8971) Avail: NTIS HC $3.00 CSCL 01C

An experimental investigation was conducted at Mach 6 to determine the hypersonic aerodynamic characteristics of an all-body, delta-planform, hypersonic research aircraft (HYFAC configuration). The aerodynamic characteristics were obtained at Reynolds numbers based on model length of 2.84 million and 10.5 million and over an angle-of-attack range from minus 4 deg to 20 deg. The experimental results show that the HYFAC configuration is longitudinally stable and can be trimmed over the range of test conditions. The configuration had a small degree of directional stability over the angle-of-attack range and positive effective dihedral at angles of attack greater than 2 deg. Addition of canards caused a decrease in longitudinal stability and an increase in directional stability. Oil-flow studies revealed extensive areas of separated and vortex flow on the fuselage lee surface. A limited comparison of wind-tunnel data with several hypersonic approximations indicated that, except for the directional stability, the tangent-cone method gave adequate agreement at control settings between 5 deg and minus 5 deg and positive lift coefficient. A limited comparison indicated that the HYFAC configuration had greater longitudinal stability than an elliptical-cross-section configuration, but a lower maximum lift-drag ratio. Author

N74-11832*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
WIND TUNNEL INVESTIGATION OF AN UPPER SURFACE BLOWN JET-FLAP POWERED-LIFT CONFIGURATION
Arthur E. Phelps, III (Army Air Mobility R and D Lab., Hampton, Va.) and Charles C. Smith, Jr. Washington Dec. 1973 61 p refs Prepared in cooperation with Army Air Mobility R and D Lab., Hampton, Va.
(NASA-TN-D-7399; L-9051) Avail: NTIS HC $3.50 CSCL 01A

An investigation has been conducted in the Langley full-scale tunnel to determine the performance and static stability and control characteristics of a four-engine, upper surface blown jet-flap powered-lift configuration with a swept wing. The investigation included test performed over a range of angle of attack (-4 deg to 36 deg), angle of sideslip (-5 deg to 5 deg), and thrust coefficients (0 to 4.32) for both symmetric and engine-out power conditions and for horizontal and vertical tails both on and off. In addition to the four-engine tests, a few tests were made with the outboard engines removed to simulate a twin-engine powered-lift transport configuration. Author

N74-11833*# Bell Helicopter Co., Fort Worth, Tex.
ADVANCEMENT OF PROPROTOR TECHNOLOGY. TASK 1: DESIGN STUDY SUMMARY
3 Sep. 1969 209 p refs
(Contract NAS2-5386)
(NASA-CR-114682; Rept-300-099-003) Avail: NTIS HC $12.50 CSCL 01C

A tilt-proprotor proof-of-concept aircraft design study has been conducted. The results are presented. The ojective of the contract is to advance the state of proprotor technology through design studies and full-scale wind-tunnel tests. The specific objective is to conduct preliminary design studies to define a minimum-size tilt-proprotor research aircraft that can perform proof-of-concept flight research. The aircraft that results from these studies is a twin-engine, high-wing aircraft with 25-foot, three-bladed tilt proprotors mounted on pylons at the wingtips. Each pylon houses a Pratt and Whitney PT6C-40 engine with a takeoff rating of 1150 horsepower. Empty weight is estimated at 6876 pounds. The normal gross weight is 9500 pounds, and the maximum gross weight is 12,400 pounds. Author

N74-11834*# Bell Helicopter Co., Fort Worth, Tex.
ADVANCEMENT OF PROPROTOR TECHNOLOGY. TASK 2: WIND-TUNNEL TEST RESULTS
30 Sep. 1971 224 p refs
(Contract NAS2-5386)
(NASA-CR-114363; Rept-300-099-004) Avail: NTIS HC $13.25 CSCL 01C

An advanced-design 25-foot-diameter flightworthy proprotor was tested in the NASA-Ames Large-Scale Wind Tunnel. These tests, have verified and confirmed the theory and design solutions developed as part of the Army Composite Aircraft Program. This report presents the test results and compares them with theoretical predictions. During performance tests, the results met or exceeded predictions. Hover thrust 15 percent greater than the predicted maximum was measured. In airplane mode, propulsive efficiencies (some of which exceeded 90 percent) agreed with theory. Author

N74-11835*# 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 Dec. 1973 76 p refs
(Contract NAS2-6995)
(NASA-CR-2355) Avail: NTIS HC $3.75 CSCL 01C

Conceptual designs of Quiet Turbofan STOL Short-Haul Transport Aircraft for the mid-1980 time period are developed and analyzed to determine their technical, operational, and economic feasibility. A matrix of aircraft using various high-lift systems and design parameters are considered. Variations in aircraft characteristics, airport geometry and location, and operational techniques are analyzed systematically to determine their effects on the market, operating economics, and community acceptance. In these studies, the total systems approach is considered to be critically important in analyzing the potential of STOL aircraft to reduce noise pollution and alleviate the increasing air corridor and airport congestion. Author

N74-11836*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
RESULTS OF THE FLIGHT NOISE MEASUREMENT PROGRAM USING A STANDARD AND MODIFIED SH-3A HELICOPTER
Robert J. Pegg, Herbert R. Henderson, and David A. Hilton Washington Dec. 1973 91 p refs
(NASA-TN-D-7330; L-8950) Avail: NTIS HC $3.75 CSCL 20A

A field noise measurement program has been conducted using both a standard SH-3A helicopter and an SH-3A helicopter modified to reduce external noise levels. Modifications included reducing rotor speed, increasing the number of rotor blades, modifying the blade-tip shapes, and acoustically treating the engine air intakes and exhaust. The purpose of this study was to document the noise characteristics recorded on the ground of each helicopter during flyby, hover, landing, and take-off operations. Based on an analysis of the measured results, the average of the overhead, overall, ontrack noise levels was approximately 4 db lower for the modified helicopter than for the standard helicopter. The improved in-flight noise characteristics, and associated small footprint areas and time durations, were judged to be mainly due to tail-rotor noise reductions. The noise reductions were obtained at the expense of required power increases at airspeeds greater than 70 knots for the modified helicopter. Author

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N74-11837*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AN EXPLORATORY SIMULATION STUDY OF A HEAD-UP DISPLAY FOR GENERAL AVIATION LIGHTPLANES
Randall L. Harris, Sr. and Donald E. Hewes Washington Dec. 1973 52 p refs
(NASA-TN-D-7456; L-8897) Avail: NTIS HC $3.50 CSCL 01C

The concept of a simplified head-up display referred to as a landing-site indicator (LASI) for use in lightplanes is discussed. Results of a fixed-base simulation study exploring the feasibility of the LASI concept are presented in terms of measurements of pilot performance, control-activity parameters, and subjective comments of four test subjects. These subjects, all of whom had various degrees of piloting experience in this type aircraft, performed a series of simulated landings both with and without the LASI starting from different initial conditions in the final approach leg of the landing maneuver. Author

N74-11839# Laboratorium fuer Betriebsfestigkeit, Darmstadt (West Germany).
FLIGHT-BY-FLIGHT TESTS WITH NOTCHED SPECIMENS USING A WING UPPER SURFACE LOAD SPECTRUM [EINZELFLUGVERSUCHE AN KERBSTAEBEN MIT DEM KOLLEKTIV DER TRAGFLAECHENOBERDECKE]
D. Schuetz, H. Lowak, and E. Gassner 20 Dec. 1972 52 p refs In GERMAN Sponsored by Bundesmin. fuer Verteidigung
(LBF-FB-104/72) Avail: NTIS HC $4.75

Using a loading spectrum typical for wing upper surfaces of transport airplanes, flight-by-flight and constant amplitude tests with open hole specimens were carried out. The influence of omitting load cycles of the ground and airloads were determined. The validity of palmgren Miner rule was studied and improved by the incorporation of notch root residual stresses.
Author (ESRO)

N74-11840# Laboratorium fuer Betriebsfestigkeit, Darmstadt (West Germany).
GUST VELOCITIES ENCOUNTERED BY A 720-B TYPE AIRPLANE AND DERIVED BY MEANS OF A MODEL FOR CONTINUOUS TURBULENCE
O. Buxbaum and J. M. Zaschel May 1973 58 p refs Sponsored by Bundesmin. fuer Verteidigung
(LBF-FB-105/73) Avail: NTIS HC $5.00

The load factor increments for a Boeing 720 aircraft were recorded using a flight data recorder. Measurements were made of altitude and airspeed during 620 hours of flight tests. The vertical gust velocities were derived by assuming a von Karman spectrum of turbulence and by means of the transfer function of the aircraft. The transfer function was calculated for eight degrees of freedom. The results are presented in functions of flight altitudes, routes of operation, and flight segments.
Author (ESRO)

N74-11841# Laboratorium fuer Betriebsfestigkeit, Darmstadt (West Germany).
A STANDARDIZED LOAD SEQUENCE FOR FLIGHT SIMULATION TESTS ON TRANSPORT AIRCRAFT WING STRUCTURES [STANDARDISIERTER EINZELFLUG-BELASTUNGSABLAUF FUER SCHWINGFESTIGKEITSVERSUCHE AN TRAGFLAECHENBAUTEILEN VON TRANSPORTFLUGZEUGEN]
D. Schuetz, H. Lowak, J. B. DeJonge, and J. Schijve 29 Mar. 1973 58 p refs In GERMAN Sponsored by Bundesmin. fuer Verteidigung Prepared jointly with Natl. Lucht- en Ruimtevaartlab.
(LBF-FB-108/73; NLR-TR-73) Avail: NTIS HC $5.00

A standardized load sequence was derived by averaging the theoretical and experimental frequency distributions of loads on the wing roots of transport aircraft. The sequence is considered to be representative for the load history of the wing root of transport aircraft. It is proposed to adopt the standardized sequence for various aeronautical fatigue testing purposes.
ESRO

N74-11842# National Aerospace Lab., Amsterdam (Netherlands). The Netherlands V/STOL Working Group.
THE FUTURE OF SHORT-HAUL AIR TRANSPORT WITHIN WESTERN EUROPE
Jun. 1973 69 p refs
(Rept-SP-73-001) Avail: NTIS HC $5.50

The potential growth of air transport in Western Europe is outlined. Some measures for the temporary solution of difficulties created by conventional takeoff and landing aircraft are discussed and it is concluded that the existing system will not be able to cope with the expected growth without extensive new facilities. The technology and prospects of several categories of aircraft with reduced, vertical or short takeoff and landing facilities are discussed. It is concluded that an extension of the present system by the incorporation of short-haul jet aircraft with reduced takeoff and landing offers the best compromise between relieving the noise and congestion problems and the economic penalties involved. A number of recommendations are given primarily related to relieving the problems of the present air traffic system and the introduction of the new aircraft categories. ESRO

N74-11843# Laboratorium fuer Betriebsfestigkeit, Darmstadt (West Germany).
REVIEW OF INVESTIGATIONS ON AERONAUTICAL FATIGUE IN THE FEDERAL REPUBLIC OF GERMANY, MAY 1969 - JUNE 1973
E. Gassner and O. Buxbaum Jun. 1973 140 p refs Presented at the 13th Conf. of the Intern. Comm. on Aeron. Fatigue, London, 1973
(LBF-S-108) Avail: NTIS HC $9.00

A review is presented of the work carried out in the field of fatigue of aircraft structures in Germany. Most of the subjects treated are fatigue test results from specimens and components including effects of surface treatment and corrosive environment. Other reports concern loads measured in service and their analysis. Investigations concerning cyclic stress-strain behavior as well as crack propagation, residual strength, and fracture toughness are also reported. ESRO

N74-11844# Technische Hochschule, Darmstadt (West Germany). Inst. fuer Flugtechnik.
STUDY OF THE TEMPERATURE INFLUENCE ON INDUCED FLOW EFFECTS. PART 1: TEST EQUIPMENT FOR GROUND EFFECT INVESTIGATIONS USING CIRCULAR HOT AIR JETS Annual Report [UNTERSUCHUNGEN ZUM TEMPERATUREINFLUSS AUF INDUZIERTE STRAHLEFFEKTE. TEIL 1: VERSUCHSANLAGE FUER BODENEFFEKT-UNTERSUCHUNGEN MIT RUNDEN HEISSLUFTSTRAHLEN JAHRESBERICHT ZUM FORSCHUNGSVORHABEN HA 514/3/19/26]
Manfred Strauber 20 Dec. 1971 60 p refs In GERMAN
(Grant NGL-39-007-040)
(IFD-8/71-Pt-1) Avail: NTIS HC $5.00

The design of a model vertical takeoff aircraft, consisting of an air heater, an air exhauster, a model propulsion system and ground plate, is described. Specifications for the various construction elements are given, control and operating ranges of the elements are discussed and the measuring devices applied are detailed. Calibration measurements were carried out. ESRO

N74-11845# Technische Hochschule, Darmstadt (West Germany). Inst. fuer Flugtechnik.
STUDY OF THE TEMPERATURE INFLUENCE ON INDUCED FLOW EFFECTS. PART 2: INFLUENCE OF GROUND EFFECTS ON HOT-AIR JET MIXING IN STEADY ATMOSPHERIC AIR Annual Report [UNTERSUCHUNGEN ZUM TEMPERATUREINFLUSS AUF INDUZIERTE STRAHLEFFEKTE. TEIL 2: MISCHUNG EINES HEISSLUFTSTRAHLES IN RUHENDER UMGEBUNGSLUFT UNTER DEM EINFLUSS DES BODENS JAHRESBERICHT ZUM FORSCHUNGSVORHABEN HA 514/3]
Manfred Strauber 20 Dec. 1971 138 p refs In GERMAN
(IFD-9/71-Pt-2) Avail: NTIS HC $9.00

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Jet speed, jet temperature, jet and nozzle geometry and height of propulsive unit measurements were carried out on a specially designed model of a vertical takeoff aircraft. The influence of ground effects on the jet properties was established. The model used was shown to be an acceptable simulation apparatus for measuring jet mixing. ESRO

N74-11846# Boeing Aerospace Co., Seattle, Wash.
STOL TACTICAL AIRCRAFT INVESTIGATION. VOLUME 4: ANALYSIS OF WIND TUNNEL DATA: VECTORED THRUST/MECHANICAL FLAPS AND INTERNALLY BLOWN JET FLAPS Final Technical Report, 8 Jun. 1971 - 8 Dec. 1972
John R. Monk, Jerry L. Lee, and J. Patrick Palmer Wright-Patterson AFB, Ohio AFFDL May 1973 304 p refs 6 Vol.
(Contract F33615-71-C-1757; AF Proj. 653A)
(AD-766641; D180-14411-1-Vol-4; AFFDL-TR-73-19-Vol-4) Avail: NTIS CSCL 01/3

The report presents the analysis of 728 hours of testing, conducted in the Boeing V/STOL 20 x 20 ft. Wind Tunnel, on a model of a medium STOL transport with vectored thrust and jet flap powered-lift systems. The interactions between the two powered lift systems and the basic airplane aerodynamics are presented for a systematic series of configuration changes which include sweep and nacelle location. (Modified author abstract) GRA

N74-11847# Boeing Aerospace Co., Seattle, Wash.
STOL TACTICAL AIRCRAFT INVESTIGATION. VOLUME 5, PART 1: FLIGHT CONTROL TECHNOLOGY: SYSTEM ANALYSIS AND TRADE STUDIES FOR A MEDIUM STOL TRANSPORT WITH VECTORED THRUST/MECHANICAL FLAPS Final Technical Report, 8 Jun. 1971 - 8 Dec. 1972
Kenneth J. Crandall, David J. Maund, William E. Gerken, and James H. Vincent Wright-Patterson AFB, Ohio AFFDL Jan. 1973 254 p refs 6 Vol.
(Contract F33615-71-C-1757; AF Proj. 643A)
(AD-766642; D180-14412-1-Vol-5-Pt-1) Avail: NTIS CSCL 01/3

A program of flight control technology applicable to an Advance Medium STOL Transport (AMST) airplane equipped with a vectored-thrust powered lift system has been conducted. Low q moment producers were evaluated. Mathematical models (control laws) of control systems suitable for the STOL landing approach were defined. The effect of control system mechanization complexity on performance, weight, cost, safety, design risk, and vulnerability to small arms fire was evaluated. A candidate control system was selected and its performance was validated using a piloted moving base simulation. While this study specifically concerned control technology for airplanes equipped with the vectored thrust form of powered lift, the results are considered to have direct application to airplanes with other forms of powered lift, such as internally blown jet flaps and upper surface blown flaps. Author (GRA)

N74-11973# IIT Research Inst., Annapolis, Md.
THE ELECTROMAGNETIC COMPATIBILITY OF AERONAUTICAL COMMUNICATION AND NAVIGATION SYSTEMS WITH RADIO FREQUENCY DIELECTRIC HEATERS AND SUPERREGENERATIVE RECEIVERS Final Report
Fred Tabor and Harry Martin Oct. 1972 130 p refs
(Contract DOT-FA70WAI-175; FAA Proj. 213-516-035)
(ECAC-PR-72-045; FAA-RD-72-80-2) Avail: NTIS

Degradation thresholds of interference from radio frequency dielectric heaters and superregenerative receivers to aircraft communication and navigation receivers were established. Degradation thresholds so established were employed to assess the degradation to the aeronautical communication and navigation services under operational conditions. The adequacy of the present regulatory limits governing the radiation from dielectric heaters and superregenerative receivers was examined from the standpoint of prevention of interference to the aeronautical services. Author

N74-12015*# Kanner (Leo) Associates, Redwood City, Calif.
ON THE EFFECT OF RELIABILITY OF SIMULATION RESULTS ON THE METHODOLOGY OF FLIGHT TESTING AND SIMULATION
R. Kaestner Washington NASA Nov. 1973 10 p Transl. into ENGLISH from DGLR report DLR-Mitt-72-18, Oct. 1972 p 93-99 Presented at the 3rd meeting of the DGLR-Symposium, Flight Testing Technology: Reliability of Results Derived from Simulation in Comparison with Results of Actual Flight, Bremen, 28 Apr. 1972
(Contract NASw-2481)
(NASA-TT-F-15175; DLR-Mitt-72-18) Avail: NTIS HC $3.00 CSCL 14B

Various methods of flight simulation are described and a comparison of the results obtained by flight simulators are discussed. The VAK 191 B aircraft is used as an example of typical takeoff and landing performance for STOL aircraft. Diagrams of the aircraft attitude control during transition phases following takeoff and during landing approach are provided. Techniques used by the test pilot in conducting the flight tests are described. Author

N74-12019# Air Transport Association of America, Washington, D.C.
THE APRON-TERMINAL COMPLEX: ANALYSIS OF CONCEPTS FOR EVALUATION OF TERMINAL BUILDINGS Final Report, May 1972 - Sep. 1973
Sep. 1973 157 p refs Prepared in cooperation with Ralph M. Parsons Co., Los Angeles
(Contract DOT-FA72WA-2950)
(FAA-RD-73-82) Avail: NTIS HC $10.00

The principal considerations in the planning of airport apron-terminal areas are described. The apron-terminal area is defined as the area limited by the curb on the landside and the taxiway access to the apron on the airside. The major functional areas of the apron-terminal complex (curb, terminal, connector, and apron) are defined and described. The four principal concepts for apron-terminal complexes (pier, satellite, linear, and transporter) are analyzed and evaluated for suitability to specific airport situations, based primarily upon traffic levels, physical limitations, and station characteristics. The final report presents a consolidation of the conclusions, technical, economic, and operational advantages and limitations; and underlying assumptions related to each apron-terminal area complex concept. Included are tabular and graphic materials to help in evaluating concepts. Author

N74-12034 New York Univ., N.Y. School of Engineering and Science.
ANALYSIS OF THE LOW-SPEED FLOW OVER A SLENDER SHARP EDGED DELTA WING AT ANGLES OF ATTACK Ph.D. Thesis
Paul LeRoy Coe, Jr. 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. Recent investigations indicate that these vortices exhibit large effects on the longitudinal and lateral stability of these configurations. A better understanding of the effect of this separated-vortex phenomena is therefore essential for the efficient design of stable high lift aircraft at subsonic speeds. 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. (5) conical flow over the major portion of the wing (with the exception of the apex and trailing edge).
Dissert. Abstr.

N74-12091*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
OFF-CENTER-LINE SHOCK INTERFERENCE HEATING

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PATTERNS ON BASIC SHAPES IN HYPERSONIC FLOWS
J. Wayne Keyes Washington Dec. 1973 96 p refs
(NASA-TM-X-2866; L-8942) Avail: NTIS HC $3.75 CSCL 20D

The results of an experimental study of off-center-line shock-interference heating on basic shapes at hypersonic speeds are presented. The study covered three types of shock-interference patterns over a range of nominal Mach numbers (6 to 20), specific heat ratios (1.40 and 1.67), free-stream Reynolds numbers(8 million to 26 million per meter), and impinging shock strengths. Heat-transfer rates higher than stagnation levels were measured over much of the off-center-line model surface. Peak heating up to 17 times the stagnation heating was measured.
Author

N74-12167# General Electric Co., Pittsfield, Mass. High-Voltage Lab.
LIGHTNING EFFECTS ON GENERAL AVIATION AIRCRAFT Final Report, Jan. - Sep. 1972
J. A. Plumer Oct. 1973 151 p refs
(Contract DOT-FA72NA-656)
(FAA-RD-73-99; FAA-NA-73-32) Avail: NTIS HC $9.75

To determine the actual lightning vulnerability of typical light aircraft systems and components, and demonstrate the required vulnerability assessment techniques, analyses and laboratory tests were performed on several typical light aircraft and some of their systems and components. The engineering and laboratory evaluation of component or system vulnerability is discussed.
Author

N74-12187*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FLIGHT MONITOR FOR JET ENGINE DISK CRACKS AND THE USE OF CRITICAL LENGTH CRITERION OF FRACTURE MECHANICS
John P. Barranger Washington Nov. 1973 21 p refs
(NASA-TN-D-7483; E-7570) Avail: NTIS HC $2.75 CSCL 21E

A disk crack detector is discussed which is intended to operate under flight conditions. It monitors the disk rim for surface cracks emanating from the blade root interface. An eddy current type sensor, with a remotely located capacitance/conductance bridge and signal analyzer, can reliably detect a simulated crack 3 mm long. The sensor was tested on a spinning turbine disk at 540 C. Tests indicate that the system is useful at disk rim velocities to 460 m/sec. By using fracture mechanics, it is shown for Inconel 718 th at a crack operating under a rim stress of 34 x ten to the 7th power N/sqm has a critical length of 18 mm.
Author

N74-12248# National Aerospace Lab., Amsterdam (Netherlands). Div. Structures and Materials.
FATIGUE CRACK GROWTH AND RESIDUAL STRENGTH OF ALUMINIUM ALLOY SHEET AT TEMPERATURES DOWN TO -75C
D. Broek Jun. 1972 51 p refs Sponsored by Neth. Agency for Aerospace Programs
(NLR-TR-72096-U) Avail: NTIS HC $4.75

Two aluminum alloy sheet materials used in aircraft structures were tested for the effect of temperature on the rate of fatigue, crack propagation, and residual strength. The materials tested were 2024-T3 and 7075-T6 clad sheets of 2 mm thickness and 7075-T6 clad sheets of 4 mm thickness. Testing temperatures varied from room temperature to -75 C. It was found that fatigue crack propagation was slower at low temperatures as a result of the low moisture content of cold air. The plane stress fracture touchness of 7075-T6 at -50 C was only 70% of the value at room temperature. Temperatures in the high layers of the stratosphere and troposphere have a beneficial effect on fatigue crack growth.
ESRO

N74-12261*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FATIGUE-TEST ACCELERATION WITH FLIGHT-BY-FLIGHT LOADING AND HEATING TO SIMULATE SUPERSONIC-TRANSPORT OPERATION
L. A. Imig and L. E. Garrett Washington Dec. 1973 50 p refs
(NASA-TN-D-7380; L-8992) Avail: NTIS HC $3.00 CSCL 01C

Possibilities for reducing fatigue-test time for supersonic-transport materials and structures were studied in tests with simulated flight-by-flight loading. In order to determine whether short-time tests were feasible, the results of accelerated tests (2 sec per flight) were compared with the results of real-time tests (96 min per flight). The effects of design mean stress, the stress range for ground-air-ground cycles, simulated thermal stress, the number of stress cycles in each flight, and salt corrosion were studied. The flight-by-flight stress sequences were applied to notched sheet specimens of Ti-8Al-1Mo-1V and Ti-6Al-4V titanium alloys. A linear cumulative-damage analysis accounted for large changes in stress range of the simulated flights but did not account for the differences between real-time and accelerated tests. The fatigue lives from accelerated tests were generally within a factor of two of the lives from real-time tests; thus, within the scope of the investigation, accelerated testing seems feasible.
Author

N74-12285*# Pratt and Whitney Aircraft, East Hartford, Conn.
IMPACT RESISTANCE OF COMPOSITE FAN BLADES Final Report
E. J. Premont and K. R. Stubenrauch May 1973 81 p
(Contract NAS3-16763)
(NASA-CR-134515; PWA-TM-4763) Avail: NTIS HC $6.25 CSCL 11D

The resistance of current-design Pratt and Whitney Aircraft low aspect ratio advanced fiber reinforced epoxy matrix composite fan blades to foreign object damage (FOD) at STOL operating conditions was investigated. Five graphite/epoxy and five boron/epoxy wide chord fan blades with nickel plated stainless steel leading edge sheath protection were fabricated and impact tested. The fan blades were individually tested in a vacuum whirlpit under FOD environments. The FOD environments were typical of those encountered in service operations. The impact objects were ice balls, gravel, stralings and gelatin simulated birds. Results of the damage sustained from each FOD impact are presented for both the graphite boron reinforced blades. Tests showed that the present design composite fan blades, with wrap around leading edge protection have inadequate FOD impact resistance at 244 m/sec (800 ft/sec) tip speed, a possible STOL operating condition.
Author

N74-12317*# Aeronautical Research Associates of Princeton, Inc., N.J.
SURVEY ON EFFECT OF SURFACE WINDS ON AIRCRAFT DESIGN AND OPERATION AND RECOMMENDATIONS FOR NEEDED WIND RESEARCH Final Report, Dec. 1971 - Aug. 1973
John C. Houbolt Washington NASA Dec. 1973 79 p refs
(Contract NAS8-28136)
(NASA-CR-2360; ARAP-194) Avail: NTIS HC $3.75 CSCL 04B

A survey of the effect of environmental surface winds and gusts on aircraft design and operation is presented. A listing of the very large number of problems that are encountered is given. Attention is called to the many studies that have been made on surface winds and gusts, but development in the engineering application of these results to aeronautical problems is pointed out to be still in the embryonic stage. Control of the aircraft is of paramount concern. Mathematical models and their application in simulation studies of airplane operation and control are discussed, and an attempt is made to identify their main gaps or deficiencies. Key reference material is cited. The need for better exchange between the meteorologist and the aeronautical engineer is discussed. Suggestions for improvements in the wind and gust models are made.
Author

N74-12330# World Meteorological Organization, Geneva (Switzerland).
FIFTH SESSION OF COMMISSION FOR AERONAUTICAL METEOROLOGY Abridged Final Report
1972 180 p Conf. held at Geneva, 4-16 Oct. 1971
(WMO-322) Avail: NTIS HC $11.00; WMO, Geneva

The developments in the field of aeronautical meteorology over the past four years are reviewed, with the emphasis on new problems caused by trends in civil aviation stressed. Activities are summarized in the areas of: training and qualifications of aeronautical meteorological personnel; briefing and documentation practices; terminal forecasting; clear air turbulence; supersonic transport, and application of satellite meteorology to aviation.
ESRO

N74-12354 California Univ., Los Angeles.
CONTROL OF AIR TRAFFIC BY AID OF SATELLITES Ph.D. Thesis
Charles Robert Johnson 1973 223 p
Avail: Univ. Microfilms Order No. 73-13147

The feasibility of a system of satellites for monitoring and controlling air-traffic on an intercontinental scale is analyzed. Satellites are essentially global in coverage and hence could establish the control of air-traffic on a real-time, intercontinental macro-scale basis. This multi-dimensional problem concerns the paths of many types of aircraft-departing, in normal flight, and in landing. The requirements for such monitoring and control obviously change with time, sometimes in ways predictable with confidence, sometimes in totally unforeseeable ways such as those forced by radical developments in technology. A unifying design approach is presented based upon an evolving-system program concept. The several satellite-system models that will need to be designed and flown for various stages of the overall program are described. Dissert. Abstr.

N74-12356# Lincoln Lab., Mass. Inst. of Tech., Lexington.
ATC SURVEILLANCE/COMMUNICATION ANALYSIS AND PLANNING Quarterly Technical Summary, 1 Jun. - 31 Aug. 1973
1 Sep. 1973 12 p
(Contracts DOT-FA72WAI-242; F19628-73-C-0002)
(FAA-RD-73-161) Avail: NTIS HC $3.00

A research project to improve air traffic control by the application of radar and electronics technology is discussed. The effectiveness of applying digital signal processing techniques to a search radar was investigated. Research projects were also conducted on the following: (1) airborne beacon interference locator, (2) transponder performance analyzer, and (3) electronically scanned antenna. Author

N74-12360*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EN ROUTE POSITION AND TIME CONTROL OF AIRCRAFT USING KALMAN FILTERING OF RADIO AID DATA
Leonard A. McGee and Jay V. Christensen Washington Dec. 1973 103 p refs
(NASA-TN-D-7509) Avail: NTIS HC $4.25 CSCL 17G

Fixed-time-of-arrival (FTA) guidance and navigation is investigated as a possible technique capable of operation within much more stringent en route separation standards and offering significant advantages in safety, higher traffic densities, and improved scheduling reliability, both en route and in the terminal areas. This study investigated the application of FTA guidance previously used in spacecraft guidance. These FTA guidance techniques have been modified and are employed to compute the velocity corrections necessary to return an aircraft to a specified great-circle reference path in order to exercise en route time and position control throughout the entire flight. The necessary position and velocity estimates to accomplish this task are provided by Kalman filtering of data from Loran-C, VORTAC/TACAN, Doppler radar, radio or barometric altitude,and altitude rate. The guidance and navigation system was evaluated using a digital simulation of the cruise phase of supersonic and subsonic flights between San Francisco and New York City, and between New York City and London. Author

N74-12361# National Aviation Facilities Experimental Center, Atlantic City, N.J.
AIR TRAFFIC CONTROL/COLLISION AVOIDANCE SYSTEM INTERFACE SIMULATION, PHASE 2 Final Report, Jul. 1972 - Jun. 1973
G. Jolitz Nov. 1973 194 p refs
(FAA Proj. 052-241-050)
(FAA-NA-73-40; FAA-RD-73-140) Avail: NTIS HC $11.75

A second phase of dynamic simulation was conducted to further investigate the nature and extent of interaction between the air traffic control (ATC) system and an airborne collision avoidance system (CAS). Objectives of the simulation were threefold: (1) to investigate the impact on ATC when the preemptive CAS diverted an equipped aircraft into an encounter with an unequipped aircraft, (2) to investigate the effectiveness of a strategy for switching the CAS threat detection from full system mode to landing mode, and (3) to explore the three-way interface between a proposed general aviation version of the CAS, the commercial CAS and the ATC system. The simulated ATC environment was a high-density terminal area which provided for simultaneous approaches to parallel runways. The CAS threat detection logic was modeled after a design which was developed by a technical working group under the auspices of the Air Transport Association (ATA). The general aviation CAS was a scaled down but compatible version of the ATA system. Results of the simulation showed that the mode-switching strategy generally had the effect of reducing ATC/CAS interaction to a level where its effect was below the controllers' threshold of perception. Author

N74-12362# Lincoln Lab., Mass. Inst. of Tech., Lexington.
DEVELOPMENT OF A DISCRETE ADDRESS BEACON SYSTEM Quarterly Technical Summary, 1 Jul. - 30 Sep. 1973
1 Oct. 1973 64 p refs
(Contracts DOT-FA72WAI-261; F19628-73-C-0002; FAA Proj. 034-241-012)
(FAA-RD-73-165) Avail: NTIS HC $5.25

The development of a discrete address beacon system for air traffic control applications is discussed. A description of operational problems peculiar to the discrete address beacon military interface is presented. Sensor design is reported under headings of antenna studies, reply processing, interrogation management, tracker studies, and use of radar data. The status of the experimental facility and the direction finding experiments are analyzed. Author

N74-12445*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EMISSION CALCULATIONS FOR A SCRAMJET POWERED HYPERSONIC TRANSPORT
Erwin A. Lezberg Nov. 1973 32 p
(NASA-TM-X-71464; E-7760) Avail: NTIS HC $3.75 CSCL 21E

Calculations of exhaust emissions from a scramjet powered hypersonic transport burning hydrogen fuel were performed over a range of Mach numbers of 5 to 12 to provide input data for wake mixing calculations and forecasts of future levels of pollutants in the stratosphere. The calculations were performed utilizing a one-dimensional chemical kinetics computer program for the combustor and exhaust nozzle of a fixed geometry dual-mode scramjet engine. Inlet conditions to the combustor and engine size was based on a vehicle of 227,000 kg (500,000 lb) gross take of weight with engines sized for Mach 8 cruise. Nitric oxide emissions were very high for stoichiometric engine operation but for Mach 6 cruise at reduced equivalence ratio are in the range predicted for an advanced supersonic transport. Combustor designs which utilize fuel staging and rapid expansion to minimize residence time at high combustion temperatures were found to be effective in preventing nitric oxide formation from reaching equilibrium concentrations. Author

N74-12449*# Pratt and Whitney Aircraft, West Palm Beach, Fla. Research and Development Center.
SINGLE-STAGE EXPERIMENTAL EVALUATION OF TAN-

DEM-AIRFOIL ROTOR STATOR BLADING FOR COMPRESSORS. PART 6: DATA AND PERFORMANCE FOR STAGE D

D. R. Clemmons 30 Nov. 1973 270 p refs
(Contract NAS3-11158)
(NASA-CR-134511; PWA-FR-5852-Pt-6) Avail: NTIS HC $15.50 CSCL 21E

An axial flow compressor stage, having single-airfoil blading, was designed for zero rotor prewhirl, constant rotor work across the span, and axial discharge flow. The stage was designed to produce a pressure ratio of 1.265 at a rotor tip velocity of 757 ft/sec. The rotor had an inlet hub/tip ratio of 0.8. The design procedure accounted for the rotor inlet boundary layer and included the effects of axial velocity ratio and secondary flow on blade row performance. The objectives of this experimental program were: (1) to obtain performance with uniform and distorted inlet flow for comparison with the performance of a stage consisting of tandem-airfoil blading designed for the same vector diagrams; and (2) to evaluate the effectiveness of accounting for the inlet boundary layer, axial velocity ratio, and secondary flows in the stage design. With uniform inlet flow, the rotor achieved a maximum adiabatic efficiency of 90.1% at design equivalent rotor speed and a pressure ratio of 1.281. The stage maximum adiabatic efficiency at design equivalent rotor speed with uniform inlet flow was 86.1% at a pressure ratio of 1.266. Hub radial, tip radial, and circumferential distortion of the inlet flow caused reductions in surge pressure ratio of approximately 2, 10 and 5%, respectively, at design rotor speed. Author

N74-12546 Stanford Univ., Calif.

NONLINEAR BENDING AND TORSION OF ROTATING BEAMS WITH APPLICATION TO LINEAR STABILITY OF HINGELESS HELICOPTER ROTORS Ph.D. Thesis

Dewey Harper Hodges 1973 174 p
Avail: Univ. Microfilms Order No. 73-14908

Nonlinear partial differential equations of motion suitable for describing bending in two directions (flap and lead-lag) and torsion (pitch) of a rotating, cantilevered beam are established. These equations are applied to a hingeless helicopter rotor in hovering flight and used to determine the stability characteristics and practical significance of the nonlinear terms for motion near the equilibrium position. The analysis proceeds by first postulating a set of nonlinear strain-displacement relations for a pretwisted, nonuniform beam. After the strain energy, kinetic energy, and virtual work of the generalized external forces are formulated, the equations of motion and respective boundary conditions follow by virtue of Hamilton's principle. Nonlinear terms are retained on the basis of a systematic scheme for ordering terms. The results are presented for a wide range of practical hingeless rotor configurations in the form of root-locus plots, damping plots, and stability boundaries. Dissert. Abstr.

N74-12555*# Douglas Aircraft Co., Inc., Long Beach, Calif.

NON-CLASSICAL ADHESIVE-BONDED JOINTS IN PRACTICAL AEROSPACE CONSTRUCTION

L. J. Hart-Smith Jan. 1973 97 p refs
(Contract NAS1-11234)
(NASA-CR-112238) Avail: NTIS HC $47.00 CSCL 20K

Solutions are derived for adhesive-bonded joints of non-classical geometries. Particular attention is given to bonded doublers and to selective reinforcement by unidirectional composites. Non-dimensionalized charts are presented for the efficiency limit imposed on the skin as the result of the eccentricity in the load path through the doubler. It is desirable to employ a relatively large doubler to minimize the effective eccentricity in the load path. The transfer stresses associated with selective reinforcement of metal structures by advanced composites are analyzed. Reinforcement of bolt holes in composites by bonded metal doublers is covered quantitatively. Also included is the adhesive joint analysis for shear flow in a multi-cell torque box, in which the bond on one angle becomes more critical sooner than those on the others, thereby restricting the strength to less than the total of each maximum strength when acting alone. Adhesive plasticity and adherend stiffness and thermal imbalances are included. A simple analysis/design technique of solution in terms of upper and lower bounds on an all-plastic adhesive analysis is introduced. Author

N74-12571*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

SPONTANEOUS IGNITION IN AFTERBURNER SEGMENT TESTS AT AN INLET TEMPERATURE OF 1240 K AND A PRESSURE OF 1 ATMOSPHERE WITH ASTM JET-A FUEL

Donald F. Schultz and J. Robert Branstetter Washington Dec. 1973 22 p refs
(NASA-TM-X-2952; E-7560) Avail: NTIS HC $2.75 CSCL 20M

A brief testing program was undertaken to determine if spontaneous ignition and stable combustion could be obtained in a jet engine afterburning operating with an inlet temperature of 1240 K and a pressure of 1 atmosphere with ASTM Jet-A fuel. Spontaneous ignition with 100-percent combustion efficiency and stable burning was obtained using water-cooled fuel spraybars as flameholders. Author

N74-12572*# Scientific Translation Service, Santa Barbara, Calif.

HEAT TRANSFER OF A DISK ROTATING IN A CASING

V. M. Kapinos Washington NASA 3 Dec. 1973 18 p refs Transl. into ENGLISH from Aviats. Tekhn. (USSR), v. 8, no. 2, 1965 p 76-86
(Contract NASw-2483)
(NASA-TT-F-15199) Avail: NTIS HC $3.00 CSCL 20M

A discussion is given of the heat transfer between a heated rotating disk and a cooling fluid flowing radially from the center to the periphery in the gap between between the disk and the casing of a gas turbine (with cooled rotors). The heat transfer coefficient is determined making use of the Reynolds analogy. Author

N74-12574# National Aviation Facilities Experimental Center, Atlantic City, N.J.

THE INFLUENCE OF ENGINE-DUCTED BY-PASS AIR ON A BURNER-CAN BURN-THROUGH FLAME Final Report, May - Jul. 1973

Richard Hill Nov. 1973 26 p refs
(FAA Proj. 181-522-010)
(FAA-NA-73-87; FAA-RD-73-155) Avail: NTIS HC $3.50

The effect is determined of by-pass air flow on a burner-can burn-through flame. A simulator was developed to produce a burn-through flame external of a J-57 engine. Bleed-air from a J-57 was ducted and used as by-pass air during testing. Temperatures of the outer duct wall were monitored. A large decrease in temperature was noted with air flow through the by-pass duct. Author

N74-12576*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

THERMODYNAMIC AND TRANSPORT PROPERTIES OF AIR AND ITS PRODUCTS OF COMBUSTION WITH ASTMA-A-1 FUEL AND NATURAL GAS AT 20, 30, AND 40 ATMOSPHERES

David J. Poferl and Roger A. Svehla Washington Dec. 1973 59 p refs
(NASA-TN-D-7488; E-7523) Avail: NTIS HC $3.50 CSCL 20M

The isentropic exponent, molecular weight, viscosity, specific heat at constant pressure, thermal conductivity, Prandtl number, and enthalpy were calculated for air, the combustion products of ASTM-A-1 jet fuel and air, and the combustion products of natural gas and air. The properties were calculated over a temperature range from 300 to 2800 K in 100 K increments and for pressures of 20, 30 and 40 atmospheres. The data for natural gas and ASTM-A-1 were calculated for fuel-air ratios from zero to stoichiometric in 0.01 increments. Author

N74-12631 Federal Aviation Administration, Washington, D.C. Microwave Landing System Branch.
MLS PROGRAM: PHASE 2
Jack W. Edwards *In* WESCON The 1973 WESCON Tech. Papers, Vol. 17 1973 9 p refs

Copyright.

The National Plan for Development of the Microwave Landing System is overviewed and its current status is discussed. Phase 2 of the program is described in terms of objectives, issues, planning considerations, and content. Author

N74-12638 Federal Aviation Administration, Washington, D.C.
POWER CONDITIONING SYSTEM FOR FAA AIR ROUTE TRAFFIC CONTROL CENTERS
Anthony J. Froehlich and Alexander Kusko (Kusko (Alexander), Inc., Needham Heights, Mass.) *In* WESCON The 1973 WESCON Tech. Papers, Vol. 17 1973 4 p refs

Copyright.

The FAA is presently installing 18,000 kVA of solid state UPS equipment to supply power at high reliability to critical electronic loads at 20 air route traffic control centers (ARTCC's) in the U.S. The requirements for a power conditioning system for ARTCC's are given, and two approaches to meet these requirements are discussed. D.L.G.

N74-12669# Boeing Commercial Airplane Co., Seattle, Wash.
WHERE ARE WE HEADED IN AIR TRANSPORT?
L. T. Goodmanson 17 Oct. 1973 19 p Presented at Airport Operators Council Intern. Ann. Conf., Dallas, 17 Oct. 1973
Avail: NTIS HC $3.00

Certain trends are indicated for the future of air transport and a discussion on both cargo and passenger aircraft design options are given. An example from today's fleet of passenger airplanes is used to illustrate design improvement possibilities for current aircraft. This is followed by a discussion of new airplanes for both the near and far term. The passenger aircraft section includes a discussion on terminal area compatibility. The future cargo aircraft section covers a broad spectrum of designs, from conventional types of air freighters to new, dedicated intermodal systems. Some long range thinking about energy conservation and its effect on aircraft design is included. Author

N74-12687# Committee on Science and Astronautics (U. S. House).
THE FEDERAL GOVERNMENT AND ENERGY: R AND D HISTORICAL BACKGROUND
Washington GPO Mar. 1973 111 p refs Presented to Comm. on Sci. and Astronaut., 93d Congr., 1st Sess., 20 Mar. 1973 Prepared by Library of Congr.
Avail: Subcomm. on Energy

Energy source R and D is traced for the Navy, the National Bureau of Standards, Federal Power Commission, Tennessee Valley Authority, Atomic Energy Commission, National Science Foundation, National Aeronautics and Space Administration, and Advisory boards and committees. A historical look at aviation technology is given along with research in the Dept. of Interior including geological surveys for the Bureau of Mines, and Offices of Oil, Gas, and Coal. T.M.R.

N74-12699# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
A SIMULATION STUDY OF THE FORCE MIX PROBLEM IN CLOSE AIR SUPPORT OPERATIONS M.S. Thesis
Dennis K. Leedom and Arnold R. Thomas Jun. 1973 216 p refs
(AD-766879; GSA/SM/73-11) Avail: NTIS CSCL 15/7

A computer program was designed and constructed which simulated the operation of a single combat aircraft squadron in a close air support situation. The simulation model was specifically designed to highlight differences in effectiveness, vulnerability, availability, and cost between two aircraft with two different degrees of avionics sophistication. A weather model included in the simulation was based upon an analysis of longterm climatological records compiled from hourly weather observations at Bitburg Air Base, Germany. A hypothetical example was used to demonstrate the utility of the simulation model. Specifically, two different types of aircraft were postulated and used in the close air support squadron. Results of this example showed that the increased costs of advanced avionic equipment can be justified on an attrition cost per target killed basis. Futhermore, the use of a mixed aircraft squadron was shown to result in higher target kill rates under certain conditions. Weather conditions were shown to have a significant effect on squadron performance, with attrition costs rising during bad weather conditions. (Modified author abstract) GRA

N74-12701# Naval Aerospace Medical Research Lab., Pensacola, Fla.
ANNOTATED BIBLIOGRAPHY OF REPORTS Supplement No. 5 Jul. 1972 - 30 Jun. 1972
Rita S. McAllister 30 Jun. 1973 30 p refs
(AD-766458) Avail: NTIS CSCL 06/19

Contents: Mechanisms underlying the behavior of the organs of equilibrium which result in motion sickness, functional reflex disturbances, and other unwanted side effects in navy personnel; Hyperbaric-hypobaric interactions as they relate to compressed air diving and aviation; Predicting motivational change and aeronautical adaptability among Navy and Marine Corps aviation trainees; Predicting fleet effectiveness of Navy and Marine Corps pilots and flight officers; Analysis of operational functions and unique characteristics of the naval flight officer; Investigation of pilot background factors in aviation accidents; Performance in non-human primates as influenced by low-frequency electromagnetic fields; Cockpit assignability codes and techniques for the presentation of anthropometric data. GRA

N74-12703 Engineering Sciences Data Unit, London (England).
AEROFOILS HAVING A SPECIFIED FORM OF UPPER-SURFACE PRESSURE DISTRIBUTIONS: DETAILS AND COMMENTS ON DESIGN
Oct. 1973 24 p refs Supersedes ESDU-67010 Sponsored by Min. of Defence and Roy. Aeron. Soc.
(ESDU-71020; ESDU-67010) Copyright. Avail: Issuing Activity

Details of a series of airfoils that have been used for parametric studies of drag-rise Mach number, of profile drag at the drag-rise Mach number, and for a limited study of profile drag at off-design conditions. A specified form of upper-surface pressure distribution at the drag-rise Mach number which is appropriate for application to swept wings at high subsonic and low supersonic speeds is presented. The influence that the principal design variables have on the geometric shape of the cambered airfoils which were derived from the pressure distribution specification is analyzed. Tables of data are included to show the aerodynamic coefficients for various airfoil shapes. Author

N74-12705*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
HYPERSONIC AERODYNAMIC CHARACTERISTICS OF A FAMILY OF POWER-LAW, WING BODY CONFIGURATIONS
James C. Townsend Washington Dec. 1973 48 p refs
(NASA-TN-D-7427; L-7176) Avail: NTIS HC $3.00 CSCL 01A

The configurations analyzed are half-axisymmetric, power-law bodies surmounted by thin, flat wings. The wing planform matches the body shock-wave shape. Analytic solutions of the hypersonic small disturbance equations form a basis for calculating the longitudinal aerodynamic characteristics. Boundary-layer displacement effects on the body and the wing upper surface are approximated. Skin friction is estimated by using compressible, laminar boundary-layer solutions. Good agreement was obtained with available experimental data for which the basic theoretical assumptions were satisfied. The method is used to estimate the

effects of power-law, fineness ratio, and Mach number variations at full-scale conditions. The computer program is included.
Author

N74-12706# Lockheed Missiles and Space Co., Palo Alto, Calif.
THE INFLUENCE OF A DEFLECTED CENTRAL SPIKE ON THE AERODYNAMIC COEFFICIENTS OF A ROTATIONALLY SYMMETRIC HYPERSONIC BODY
W. Wyborny [1973] 37 p refs Transl. into ENGLISH of West German report DLR-69-37, 1969
(DLR-FB-69-37) Avail: NTIS HC $4.00, National Translations Center, John Crerar Library, Chicago, Illinois 60616

The possibility of producing a normal component force on simple cylinders by deflecting a central spike was studied. Results of measurements are presented, and a simple analytical estimate of the aerodynamic coefficients for a central spike deflection without incidence on the main body is presented. It is shown that significant normal forces can be produced on a deflected central spike on a cylindrical model by the altered free stream around the main body. These forces are adequate for control purposes. F.O.S.

N74-12708 Texas A&M Univ., College Station.
WAKE INDUCED LOADS ON HELICOPTER ROTOR BLADES Ph.D. Thesis
Theddens Howes Sandford 1973 142 p
Avail: Univ. Microfilms Order No. 73-21699

The effects of the curved wake on the airloads of a helicopter blade in hovering flight are discussed. In most investigations of unsteady airloads, two-dimensional strip theory is used and the wake is assumed to be rectilinera. A few authors have tried to include the effects of the curved wake on a lifting line basis, but it is believed that no one has yet attempted to solve the problem on the basis of a full lifting surface theory. By using numerical technique this is accomplished, and comparisons are made between the aerodynamic coefficients calculated with and without a curved wake. It is shown that inclusion of wake curvature has an appreciable effect on the blade's life and pitching moment coefficients. Dissert. Abstr.

N74-12709 Engineering Sciences Data Unit, London (England).
APPROXIMATE METHODS FOR ESTIMATION OF CRUISE RANGE AND ENDURANCE: AIRCRAFT WITH TURBO-JET AND TURBO-FAN ENGINES
Oct. 1973 45 p Sponsored by Roy. Aeron. Soc.
(ESDU-73019) Copyright. Avail: Issuing Activity

Approximate methods are given for estimating the cruise range and endurance performance of aircraft equipped with turbojet and turbofan engines. The methods are suited to project type calculations and provide results applicable in still air. The equations have analytical solutions for cases of cruising flight in which at least one of the parameters of airspeed, Mach number, pressure height, and engine control setting is held constant. The conditions under which specific air range and specific endurance may be maximized are examined and expressions for air range and endurance are presented for each cruise case.
Author

N74-12710 Engineering Sciences Data Unit, London (England).
INTRODUCTION TO ESTIMATION OF RANGE AND ENDURANCE: AIRCRAFT WITH TURBO-JET AND TURBO-FAN ENGINES
Oct. 1973 16 p refs Sponsored by Roy. Aeron. Soc.
(ESDU-73018) Copyright. Avail: Issuing Activity

The aircraft, engine, flight path, and other factors which affect the specific range and endurance of turbojet and turbofan powered aircraft are analyzed. Mathematical models are developed to establish the relationships between these parameters. Methods of solving the equations are discussed. Author

N74-12711 Engineering Sciences Data Unit, London (England).
NON DIMENSIONAL METHODS FOR THE MEASUREMENT OF HOVER PERFORMANCE OF TURBINE ENGINED HELICOPTERS
Nov. 1973 13 p Sponsored by Roy. Aeron. Soc.
(ESDU-73027) Copyright. Avail: Issuing Activity

Test methods for helicopter hovering flight based on the measurement of engine shaft power output are presented. The methods are applied to the following cases: (1) where helicopter mass is used instead of weight, (2) where collective pitch is measured instead of power, and (3) presentation of helicopter fuel flow data. Mathematical models for a typical helicopter condition are developed. The data are presented in the form of tables and graphs. Author

N74-12712 Engineering Sciences Data Unit, London (England).
INTRODUCTION TO NONDIMENSIONAL METHODS FOR THE MEASUREMENT OF PERFORMANCE OF TURBINE-ENGINED HELICOPTERS
Nov. 1973 16 p refs Sponsored by Roy. Aeron. Soc.
(ESDU-73026) Copyright. Avail: Issuing Activity

Methods of measuring the steady state performance of turbine engined helicopters in terms of nondimensional parameters are presented. The basis of the test methods is the arrangement of the relevant dimensional qualities into several nondimensional parameters by means of dimensional analysis. The relationship between any given pair of nondimensional parameters is established for a given flight condition by flying the helicopter to maintain constant values of each of the remaining nondimensional parameters. Helicopter performance is measured in terms of power, and in some cases, the rotor collective pitch angle required to maintain steady flight under various atmospheric conditions and aerodynamic configurations. Author

N74-12713# Advisory Group for Aerospace Research and Development, Paris (France).
MARKINGS FOR PROPELLER CONSPICUITY
T. C. D. Whiteside (RAF Inst. of Aviation Med.) Sep. 1973 17 p refs
(AGARD-AR-56) Avail: NTIS HC $3.00

The general problem of marking propellers so that they may be seen is discussed. The propeller must be conspicuous to persons walking near it when the aircraft is on the ground but, on the other hand, in taxying and in flight it must not be distracting or annoying to the pilot. Other factors to be considered are the conspicuity at low and at high rpm; the conspicuity against various backgrounds since markings easily visible against a dark ground may not be visible against a light ground; the use of coloured markings which, although easily seen on a stationary propeller, become desaturated when the propeller is turning, and finally, the presence of brightness and of colour contrast with the background. In theory, to obtain maximal brightness contrast, black and white markings should be used so that the blades may be seen against either light and dark background. As black matt paint may appear grey since it scatters incident light, the markings should be in a gloss finish. Author

N74-12714*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
LOW-SPEED WIND TUNNEL INVESTIGATION OF THE LATERAL-DIRECTIONAL CHARACTERISITCS OF A LARGE-SCALE VARIABLE WING-SWEEP FIGHTER MODEL IN THE HIGH-LIFT CONFIGURATION
William T. Eckert and Ralph L. Maki Oct. 1973 35 p ref Prepared in cooperation with Army Air Mobility Res. and Develop. Lab., Moffett Field, Calif.
(NASA-TM-X-62306) Avail: NTIS HC $3.75 CSCL 01B

The low-speed characteristics of a large-scale model of the F-14A aircraft were studied in tests conducted in the Ames Research Center 40- by 80-Foot Wind Tunnel. The primary purpose of the present tests was the determination of lateral-directional stability levels and control effectiveness of the aircraft in its

high-lift configuration. Tests were conducted at wing angles of attack between minus 2 deg and 30 deg and with sideslip angles between minus 12 deg and 12 deg. Data were taken at a Reynolds number of 8.0 million based on a wing mean aerodynamic chord of 2.24 m (7.36 ft). The model configuration was changed as required to show the effects of direct lift control (spoilers) at yaw, yaw angle with speed brake deflected, and various amounts and combinations of roll control. Author

N74-12715*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
TRENDS IN TRANSPORT AIRCRAFT AVIONICS
Betty K. Berkstresser Dec. 1973 83 p refs
(NASA-TM-X-62322) Avail: NTIS HC $6.25 CSCL 01C

A survey of avionics onboard present commercial transport aircraft was conducted to identify trends in avionics systems characteristics and to determine the impact of technology advances on equipment weight, cost, reliability, and maintainability. Transport aircraft avionics systems are described under the headings of communication, navigation, flight control, and instrumentation. The equipment included in each section is described functionally. However, since more detailed descriptions of the equipment can be found in other sources, the description is limited and emphasis is put on configuration requirements. Since airborne avionics systems must interface with ground facilities, certain ground facilities are described as they relate to the airborne systems, with special emphasis on air traffic control and all-weather landing capability. Author

N74-12716# National Aviation Facilities Experimental Center, Atlantic City, N.J.
EVALUATION OF THE STRUCTURAL INTEGRITY OF AN AIRCRAFT LOADING WALKWAY UNDER SEVERE FUEL-SPILL FIRE CONDITIONS Final Report, Dec. 1972 - Oct. 1973
George B. Geyer, Lawrence M. Neri, and Charles H. Urban Oct. 1973 106 p refs Sponsored in part by Air Transport Assoc. of Am. Original contains color illustrations
(FAA-RD-73-144; FAA-NA-73-79) Avail: NTIS HC $7.50

A full-scale fire test was conducted to determine the capability of an aircraft loading walkway to provide a safe emergency egress route for passengers from an aircraft when it is exposed to severe fuel-spill fire conditions in term of structural integrity and of maintaining survivable environmental conditions within the structure. Fire exposure of the walkway indicated that the structural integrity of the walkway maintained throughtout the 10 minute fire exposure period and that the most serious problem confronting passengers passing through the tunnel would be caused by smoke and the pyrolysis of the underside of the plywood flooring adjacent to the corrugated steel shell. Small-scale laboratory tests of modified floor panels indicated that by employing thermally stable load-bearing materials the quantity of pyrolysis products and smoke can be controlled within the walkway. Author

N74-12717*# Boeing Commercial Airplane Co., Seattle, Wash.
DESIGN AND FABRICATION OF AN AEROELASTIC FLAP ELEMENT FOR A SHORT TAKEOFF AND LANDING (STOL) AIRCRAFT MODEL Final Report
G. W. Belleman and R. R. June Dec. 1973 36 p
(Contract NAS1-11767)
(NASA-CR-132339; D8-41253) Avail: NTIS HC $4.00 CSCL 01C

A flap element typifying a third element in the flap system of a short takeoff and landing aircraft was designed, fabricated, and instrumented. It was delivered to NASA for flight-simulated testing. The flap element was aluminum skin-stringer-rib construction with adhesive laminated skins. The tests conducted were as follows: (1) sonic check, (2) thermal expansion, (3) end fitting stiffness, (4) material properties, (5) maximum bending stress in the skin, and (6) effective skin width and stringer spacing. Author

N74-12718# National Aviation Facilities Experimental Center, Atlantic City, N.J.
THE MEASUREMENT OF THE DC-7 TRAILING VORTEX SYSTEM USING THE TOWER FLY-BY TECHNIQUE Final Report, Apr. - Sep. 1971
Leo J. Garodz, Nelson J. Miller, and David Lawrence Nov. 1973 375 p refs
(FAA-RD-73-141; FAA-NA-73-34) Avail: NTIS HC $20.75

The results of a series of fullscale flight tests are presented in which the wing trailing vortices of the Douglas DC-7 airplane were investigated by flying the airplane at low altitude, upwind of, and in close proximity to a 140-foot instrumented tower. Tower instrumentation consisted of hot-film anemometers located at 4-foot intervals and wind velocity and direction sensors. Vortex air flow visualization was by use of colored smoke. The data consists of tangential velocity distribution plots, peak recorded velocity as a function of time, airplane configuration and wind; vortex vertical and lateral transport velocities, and specimen time histories of the velocities recorded at individual sensors. Author

N74-12719*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE EFFECTS OF AN AUTOPILOT ON AIRPLANE RESPONSES TO TURBULENCE WITH EMPHASIS ON TAIL LOADS
Boyd Perry, III Washington Dec. 1973 53 p refs
(NASA-TN-D-7231; L-8756) Avail: NTIS HC $3.50 CSCL 01C

An analytical study has been made to assess the loads developed on the horizontal tail of an autopilot-controlled rigid airplane flying in one-dimensional atmospheric turbulence. The root-mean-square values of rigid-airframe responses and tail-load responses were calculated at five flight conditions, and the behavior of these responses was observed in two autopilot modes: pitch-attitude-hold mode and altitude-control mode. It was found that pitch attitude and altitude can be controlled by the simple autopilot with acceptable or no increases in tail loads. Author

N74-12720*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
FLIGHT EXPERIENCE WITH THE DECELERATING NOISE ABATEMENT APPROACH
Terrill W. Putman Jan. 1974 18 p refs
(NASA-TM-X-56020) Avail: NTIS HC $3.00 CSCL 20A

The noise of older aircraft can be reduced in two principal ways: retrofitting the aircraft with a quiet propulsion system, and changing the flight operational procedures used in flying the aircraft. The former approach has already proved to be expensive, time consuming, and difficult to implement even though low-noise propulsion system technology exists. The latter method seems to hold promise of being less expensive and easier to implement. One operational technique which might reduce the noise beneath the landing approach path is the decelerating approach. This technique requires intercepting the 3 deg approach path at a relatively high speed with the aircraft in the cruise configuration, then reducing the thrust to idle and allowing the aircraft to decelerate along the 3 deg approach path. As the appropriate airspeed is achieved, the landing flaps and landing gear are deployed for a normal flare and landing. Because the engines, which are the predominant noise source on landing approach, are at idle thrust, a significant reduction in the noise beneath the approach path should be realized. Author

N74-12721# Research Inst. of National Defence, Stockholm (Sweden).
IDENTIFICATION TESTS WITH OPTICAL SIGHTS AND RECONNAISSANCE AIDS IN HELICOPTERS [IDENTIFIERINGSFOERSOEK MED OPTISKA SIKTEN OCH SPANINGSHJAELPMEDEL I HKP]
Kurt Andersson and Lars-Otto Nilsson Mar. 1972 55 p refs In SWEDISH; partly in ENGLISH
(FOA-2-C-2533-D8/E1/M6) Avail: NTIS HC $4.75

A gyro stablized sight and reconnaissance aid mounted in a helicopter was studied to obtain an understanding of the basic performance of modern types of stabilized magnifying optics. The information from the trials was partly to recognize different types of vehicles, e.g. track, wheel or hovercraft and partly to identify the type of tracked vehicle. Author

N74-12722# Research Inst. of National Defence, Stockholm (Sweden).
HELICOPTER NOISE [HELIKOPTERLJUD]
Ingemar Eriksson Nov. 1971 13 p refs In SWEDISH
(FOA-3-C-3685-E4) Avail: NTIS HC $3.00

Helicopter noise does not appear to have become a matter of great significance despite the use of very much greater horsepower in recent years. In order to obtain a fundamental basis, a program of measurements was carried out which included the part played by power and noise. The sound has been analyzed on a frequency basis. Sounds have also been recorded with associated information for examining the appearance of the pulses. Pulse form and occurrence are discussed hypothetically. Author

N74-12723# Research Inst. of National Defence, Stockholm (Sweden).
REMOTE CONTROL OF AIRCRAFT AND WEAPON SYSTEM USING A NEW METHOD [FJARRSTYRNING AV FLYGPLAN OCH VAPENSYSTEM ENLIGT NY METOD]
Curt Haglund Feb. 1972 16 p In SWEDISH
(FOA-2-A-2553-E4) Avail: NTIS HC $3.00

Remote controlled aircraft can now be maneuvered in a very advanced manner by use of a system for remote sensing and data transference in real time of visual and other information from and to the aircraft. This information in combination with a system for remote operation, makes it possible for a pilot to maneuver the aircraft from a guiding station as if he was in the aircraft. In the U.S.A. this aircraft is called a remotely piloted vehicle (RPV). Development work has been going on for some years and tests with such aircraft have been made. The method can also be used for remote manning of other weapon systems. Author

N74-12725# Royal Aircraft Establishment, Farnborough (England).
THE IDENTIFICATION OF AIRCRAFT POWERPLANT DYNAMIC RESPONSE FROM FLIGHT TESTS USING POWER SPECTRAL TECHNIQUES
R. B. Lumsden Jul. 1973 46 p refs
(RAE-TR-73049; BR35900) Avail: NTIS HC $4.50

Power spectral techniques were used successfully to identify the transfer function of the Rolls Royce Avon engines in a Comet aircraft from flight results. The transfer function depends on the input to the autothrottle servo but not on the mean thrust level at typical approach settings. A second-order model output determined from spectral analysis was compared with the flight recorded acceleration output using identical input and a good match was found. The new model was incorporated in a Comet glide path autopilot and autothrottle system investigation indicating that the conventional model underestimates throttle activity. A pseudo random binary sequence application to the engine response identification has advantages which include using fairly small perturbations in the normal operating region and obtaining the total frequency response from from one run during which the flight conditions remain constant. Author (ESRO)

N74-12726# General Dynamics/Fort Worth, Tex. Convair Aerospace Div.
STUDY OF STRUCTURAL CRITERIA FOR COMPOSITE AIRFRAMES, VOLUME 3: BIBLIOGRAPHY Final Technical Report
Sherrell D. Manning, Glen H. Lemon, and Innes Bouton (Technology, Inc., Dayton, Ohio) Apr. 1973 117 p refs
(Contract F33615-72-C-1066)
(AD-767569; AFFDL-TR-73-4-Vol-3) Avail: NTIS CSCL 01/3

The current criteria and design practices for aircraft structures are examined and evaluated for applicability to composite structures. Selected probabilistic or statistical rationales are also reviewed and evaluated for possible applications. From these studies a plan was developed for acquiring understanding and data from which structural criteria and design practices applicable to composite airframes may be written. The basic characteristics of filamentary composites which are unique when compared with metallic structure are defined and explored. Special areas investigated include laminates, joints, and cutouts. Author (GRA)

N74-12727# Air Force Academy, Colo. Dept. of Aeronautics.
VORTEX SHEDDING FROM THE RAM WING VEHICLE Technical Progress Report, Jan. - Jul. 1973
Roger W. Gallington Aug. 1973 37 p refs
(AF Proj. 7905)
(AD-767234; DFAN-TR-73-6) Avail: NTIS CSCL 01/3

Extensive flow visualization of the ram wing surface effect vehicle wake reveals the predominate feature to be a strong vortex sheet shed laterally from the lower side plate edge. This sheet quickly rolls up into a concentrated vortex which continues to move outward parallel to the surface. Neutrally buoyant helium filled bubbles are used for flow visualization supplemented by common techniques. A simple flow model, applicable to low aspect ratio ram wings with side plates, corroborates the major features of observed near wake geometry and conventional force and pressure coefficient data. Minor modifications to the geometry of the side plates are shown to cause large increases in pressure on the bottoms of the side plates. Author (GRA)

N74-12728# Army Air Mobility Research and Development Lab., Fort Eustis, Va.
GENERAL DESCRIPTION OF THE ROTORCRAFT FLIGHT SIMULATION COMPUTER PROGRAM (G-81)
Edward E. Austin and William D. Vann Jun. 1973 60 p refs
(AD-767239; USAAMRDL-TN-11) Avail: NTIS CSCL 01/3

The rotorcraft flight simulation is a multidisciplinary mathematical model that may be used to simulate a wide variety of helicopter or V/STOL aircraft configurations using a digital computer. Aircraft performance, stability and control, and maneuver characteristics, as well as rotor blade loads, may be estimated using this analysis. The fuselage, main rotor, tail rotor, wing, elevator, fin/rudder, jet thrust, and weapon recoil are treated as separate aircraft components, allowing detailed representation of the aircraft for design or detailed analysis applications. Six rigid-body fuselage degrees of freedom and up to six rotor blade elastic degrees of freedom for each of two rotors are accounted for. Input for the simulation is divided into logical blocks in an easy-to-understand format. The rotor blade elastic degrees of freedom are omitted if stiffness and mass properties are not known. Output includes aircraft trim attitude, control positions, performance rotor loads, stability and control characteristics, and detailed maneuver response. (Modified author abstract) GRA

N74-12729# Army Missile Command, Redstone Arsenal, Ala. Ground Equipment and Materials Directorate.
TECHNIQUES FOR REDUCING THE VIBRATION OF ROCKET LAUNCHERS MOUNTED ON HELICOPTERS
C. D. Johnson 15 Aug. 1972 39 p refs
(DA Proj. 1M2-62303-A-214)
(AD-767237; RL-TR-72-1) Avail: NTIS CSCL 19/7

The report is concerned with various techniques that might be used to achieve high quality vibration isolation for equipment mounted on a helicopter. Of specific interest is the problem of reducing the rotor induced vibration of externally mounted rocket launchers. Three schemes for reducing rocket launcher vibrations are proposed. The first scheme is along the lines of traditional vibration isolation methods. The second scheme uses a novel device called a vibration absorber which (theoretically) can completely eliminate sinusoidal launcher vibrations - provided the vibration frequencies are constant. The third proposed scheme is somewhat newer, and more exotic, and leads to what can be called an active vibration absorber. Author (GRA)

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N74-12731# Army Aviation Systems Command, St. Louis, Mo.
MAJOR ITEM SPECIAL STUDY (MISS), AH-1G 90 DEGREE GEARBOX Interim Report, 1 Jan. 1964 - 30 Jun. 1972
Sep. 1973 32 p
(AD-767540; USAAVSCOM-TR-73-21) Avail: NTIS CSCL 01/3

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

N74-12732# Army Aviation Systems Command, St. Louis, Mo.
MAJOR ITEM SPECIAL STUDY (MISS), CH-54A MAIN ROTOR PRIMARY SERVO Interim Report, 1 Jan. 1964 - 31 Dec. 1972
Sep. 1973 30 p refs
(AD-767539; USAAVSCOM-TR-73-22) Avail: NTIS CSCL 01/3

The report describes a maintenance analysis of 2 helicopter main rotor primary servo. The report is designed to illustrate cost savings which would result from specific efforts in the areas of product improvement in quality and design, and extensions of time between overhaul of major items. For the purpose of this study the cost savings produced in the area of product improvement are based on total elimination of a certain failure mode or modes. GRA

N74-12733# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
OPTICAL FACTORS IN AIRCRAFT WINDSHIELD DESIGN AS RELATED TO PILOT VISUAL PERFORMANCE Final Technical Report
Walter F. Grether Jul. 1973 37 p refs
(AF Proj. 7184)
(AD-767203; AMRL-TR-73-57) Avail: NTIS CSCL 01/3

The slope and curvature of aircraft windshields that are optimum for high speed flight cause optical degradation of pilot vision in the forward direction. The report presents a survey of the literature bearing on the conflict between aerodynamic and visual requirements. The optical effects of windshield slope (or angle of incidence) and curvature are reviewed, in terms of displacement, deviation, distortion, binocular deviation, reflections, multiple images, haze, transmission loss, and reduced resolution. Included in the review are discussions of windshield design practices in recent military aircraft, as well as optical standards and tolerance contained in current military specifications. The review also provides a discussion and research data on pilot visual performance as affected by windshield design factors, and a small sample of pilot opinions concerning the visual problems caused by the windshield of the F-111 aircraft. The report concludes with some suggestions for further studies that would assist in making choices concerning windshield design.
Author (GRA)

N74-12734# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
UNSTEADY GAS DYNAMICS PROBLEMS AND AEROELASTIC APPLICATIONS RELATED TO FLIGHT VEHICLES Final Report, 1 Jan. 1968 - 31 Dec. 1972
Holt Ashley and J. Michael Summa Apr. 1973 25 p refs
(Contract F44620-68-C-0036)
(AD-767805; SUDAAR-456; AFOSR-73-1693TR) Avail: NTIS CSCL 01/3

The report reviews the accomplishments made during the period of five years from 1 January 1968 through 31 December 1972 at Stanford University in a program of research on unsteady aerodynamics related to flight vehicles, and on associated aeroelastic problems. Over 20 reports have been completed during the course of the research with the purpose to improve analysis and design of high-performance aircraft. The impact on the scientific and engineering community of research done under this project has been significant and is a measure of important contributions supported by AFOSR. (Modified author abstract)
GRA

N74-12735# United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft Div.
INVESTIGATION OF THE MANEUVERABILITY OF THE S-67 WINGED HELICOPTER Final Report
Robert A. Monteleone Jul. 1963 72 p refs
(Contract DAAJ02-71-C-0008; DA Proj. 1F1-63204-D-157-04)
(AD-767559; SER-67008; USAAMRDL-TR-73-51) Avail: NTIS CSCL 01/3

A flight test program and a computer simulation study have been conducted to evaluate the maneuverability and speed capability of the S-67 as a representative winged helicopter design. The flight program evaluated the effects on load factor capability of wings and of variations in gross weight, center of gravity, stabilator bias angle, and type of maneuver. The computer simulation determined the effects of stabilator linkage changes, of several control system feedbacks, and of differential speed brake application for roll control. Program results show that helicopter maneuverability can be improved by the addition of wings. Main rotor control system loads were the limiting factor on maneuver capability of the S-67. Control load buildup is minimized when rotor torque is low. Wings increased speed capability somewhat by delaying rotor stall effects. The dynamic stability of the S-67 satisfies MIL-H-8501A requirements above 100 knots. Author (GRA)

N74-12736# Naval Air Development Center, Warminster, Pa. Air Vehicle Technology Dept.
STATISTICAL REVIEW OF COUNTING ACCELEROMETER DATA FOR NAVY AND MARINE FLEET AIRCRAFT FROM 1 JANUARY 1962 TO JULY 1973 Semiannual Summary Report
Thomas A. DeFiore 1 Nov. 1973 134 p refs
(AD-767648) Avail: NTIS CSCL 01/3

The report is a specialized summary of normal acceleration data recorded by counting accelerometers. Data are separated by calendar time and mission category. Only data reported in the counting accelerometer program are included. Author (GRA)

N74-12738# Boeing Vertol Co., Philadelphia, Pa.
A MATHEMATICAL MODEL OF UNSTEADY AERODYNAMICS AND RADIAL FLOW FOR APPLICATION TO HELICOPTER ROTORS Final Report, May 1971 - Jul. 1972
Ronald E. Gormont May 1973 150 p refs
(Contract DAAJ02-71-C-0045; DA Proj. 1F1-62204-AA-41)
(AD-767240; D210-10492-1; USAAMRDL-TR-72-67) Avail: NTIS CSCL 01/3

The report documents the development of a mathematical model which represents force coefficients acting on an airfoil in an unsteady environment. In addition, the model is extended to account for the three-dimensional effects of radial flow experienced by rotor blade sections. The methods developed in this report are aimed at obtaining improved capability for predicting rotor blade section force coefficeints, particularly at or above stall conditions. The mathematical model has been incorporated into the Government's rotorcraft flight simulation program C-81 (AGAJ71 version). The mathematical model was correlated with

two-dimensional oscillating airfoil test data, and the Government's rotorcraft flight simulation program C-81 (AGAJ71 version) was correlated with full scale and model rotor test data. The results of the correlation indicate substantial improvement in rotor prediction capability at high speeds and rotor thrust coefficients above stall. Author (GRA)

N74-12739# Goodyear Aerospace Corp., Litchfield Park, Ariz.
DESIGN, TEST, AND ACCEPTANCE CRITERIA FOR ARMY HELICOPTER TRANSPARENT ENCLOSURES Final Technical Report
Herold C. James, Allen O. Ingelse, and Richard A. Huyett May 1973 142 p refs
(Contract DAAJ02-72-C-0074; DA Proj. 1F1-62205-A-119)
(AD-767242; GERA-1864; USAAMRDL-TR-73-19) Avail: NTIS CSCL 01/3

The high cost of replacement of helicopter transparencies is of serious concern to the U.S. Army. A recent study of 412 windshield replacement actions revealed that the average replacement occurred every 307 flying hours. As a result of this employed both for ballistic and ablative purposes.
Official Gazette of the U.S. Patent Office

N74-12742# Pratt and Whitney Aircraft, East Hartford, Conn.
AIR MOBILITY FUEL CELL STUDY Technical Report, 9 May 1972 - 9 Jan. 1973
Jeffrey H. Arnold Kirtland AFB, N. Mex. AFWL Jul. 1973 96 p refs
(Contract F29601-72-C-0083; AF Proj. 683M)
(AD-766757; PWA-4635; AFWL-TR-73-26) Avail: NTIS CSCL 10/2

An analytical and test program was conducted to evaluate the fuel cell power concept for the Bare Base mission which was selected as an example of an air mobility application. A life cycle cost model was developed and the life cycle costs of candidate fuel cell power systems were compared to the present Bare Base centralized power system. A study and test program was conducted to determine the feasibility of desulfurizing military JP-4 fuel and a powerplant test program was also conducted to evaluate operation on JP-4 fuel to meet typical air mobility loads. Study results verified that dispersed fuel cell power systems offer potential operational advantages in system installation, operation, and maintenance and are economically competitive with existing centralized power systems. The desulfurizer test program demonstrated the feasibility of desulfurizing JP-4 fuel. Powerplant tests demonstrated the capability to operate on JP-4 fuel and the ability to provide power compatible with air mobility loads. A comprehensive field experiment was planned as a logical next step to confirm the economic and operational conclusions of the study and provided detailed design information for an air mobility fuel cell system.
Author (GRA)

N74-12744# Pratt and Whitney Aircraft, East Hartford, Conn.
THE 1.5-kW FUEL CELL POWERPLANT Final Report, 1 Jul. 1971 - 31 Dec. 1972
Anthony J. DeCasperis and H. Leigh Ferguson 2 Apr. 1973 119 p refs
(DA Proj. 1G6-63702-DG-10; Contract DAAK02-70-C-0518)
(AD-767302; PWA-4704) Avail: NTIS CSCL 10/2

Four advanced development model 1.5kW fuel cell power plants were delivered to the Army for evaluation. The delivery configuration power plant weighs 292 lbs. and has a volume of 9.7 cubic feet. Startup and Operation are fully automatic and the power plant operates on JP-4 fuel with a specific fuel consumption of less than 2.2 lbs/kWh. Output voltage is adjustable from 26 to 34 volts at any output from 0 to 1.5kW. The power plant consists of four subsystems, a regenerative thermal cracker, which converts logistic fuel to hydrogen, an acid fuel cell power section which generates dc power from hydrogen and air, a voltage regulator and an automatic control system. A core technology program was conducted to develop the cracker voltage regulator and automatic control unit. Limited development of the power section, which is based on commercial technology fuel cells, to tailor the design to Army requirements was also conducted. The program culminated with development testing of a complete power plant and delivery of four power plants to the Army. Author (GRA)

N74-12821*# Aeronautical Research Associates of Princeton, Inc., N.J.
A PRELIMINARY SENSITIVITY ANALYSIS OF THE COUPLED DIFFUSION AND CHEMISTRY MODEL
Glenn R. Hilst and Ross M. Contiliano Oct. 1973 68 p refs
(Contract NAS1-12475)
(NASA-CR-132369; ARAP-203) Avail: NTIS HC $5.50 CSCL 07D

The sensitivity of the coupled chemistry/diffusion model's outputs to a wide range of variation of the model's independent variables has been investigated. It is shown that the efficiency with which the now catalytic cycle destroys ambient O3 is extremely sensitive to the amount of NO emitted and to the relative rates of turbulent diffusion and chemical reactions. For representative conditions in the stratosphere, a tenfold variation of either the turbulence intensity or the reaction rate constant or the source strength can vary the efficiency from 1% to 50%. If the duration of Phase 3 is a significant fraction of the total residence time of the plume, then these efficiency variations can alter O3 depletion rates by more than a factor of two. These results, therefore, point toward those variables which must be accurately defined or measured if one is to adequately predict the effect of SST operations on the ambient inventory of O3 in the lower stratosphere. Author

N74-12864# Software et Engineering des Systemes d'Informatique et d'Automatique, Paris (France).
SOFTWARE DEFINITION STUDY FOR THE AERONAUTICAL SATELLITE COMMUNICATIONS CENTER. VOLUME 1: DEFINITION SPECIFICATIONS. PART 1: GENERAL PRESENTATION OF THE AERONAUTICAL SATELLITE COMMUNICATIONS CENTER AND ITS SOFTWARE [ETUDE DE DEFINITION DU SOFTWARE POUR LE CENTRE DE COMMUNICATIONS DES SATELLITES AERONAUTIQUES. SPECIFICATIONS DE DEFINITION. TOME 1: PRESENTATION GENERALE DE L'ASCC ET DE SON SOFTWARE]
5 Jul. 1973 69 p In FRENCH
(Contract ESTEC-1777/72-SK)
(EX-5102/27-73/309; ESRO-CR(P)-307) Avail: NTIS HC $5.50

A general presentation of the ASCC/ASET to be used within the Aerosat program is given. Chapter 1 details the ASCC functions and its responsibilities for communication, surveillance, ground-air-ground links, channel allocations (dynamic and static), and role of the human operator. Chapter 2 emphasizes the necessity of real time simulation, discussing the general characteristics of the simulation and the methods to be used. Chapter 3 gives the basic concepts of real time operational systems with regard to the identified needs and technical solutions and programming language. It separates the operational computer programs (communications, surveillance, control) from the simulation programs (communication management, aerosat, mobiles, ATC, operator). Chapter 4 details the hardware configuration of the ASCC/ASET in terms of operational and simulation elements.
ESRO

N74-12865# Software et Engineering des Systemes d'Informatique et d'Automatique, Paris (France).
SOFTWARE DEFINITION STUDY FOR THE AERONAUTICAL SATELLITE COMMUNICATIONS CENTER. VOLUME 1: DEFINITION SPECIFICATIONS. PART 2: DESCRIPTION OF OPERATIONAL AND SIMULATION FUNCTIONS [ETUDE DE DEFINITION DU SOFTWARE POUR LE CENTRE DE COMMUNICATIONS DES SATELLITES AERONAUTIQUES. SPECIFICATIONS DE DEFINITION. TOME 2: DESCRIPTION DES FONCTIONS OPERATIONNELLES. DESCRIPTION DES FONCTIONS DE SIMULATION. ANNEXE]
5 Jul. 1973 219 p In FRENCH

(Contract ESTEC-1777/72-SK)
(EX-5102/27-73/305; ESRO-CR(P)-308) Avail: NTIS HC $13.00

A description of the operational and simulation functions for the ASCC/ASET of the AEROSAT program is presented. Data cover: communication function with regard to call procedures as a function of accessing methods, information transfer procedures as a function of the communication mode channel attribution and archives; surveillance with regard to mobile localization data access; control with regard to control modes, messages, management, files, data blocks, and archives; the simulation functions with regard to communication management, AEROSAT, mobiles, ATCC, operators simulation preparation, and off-line simulation analysis, and the operational system with regard to task program structure, task communication, segments, control memory management, and implementation. ESRO

N74-12866# Software et Engineering des Systemes d'Informatique et d'Automatique, Paris (France).
SOFTWARE DEFINITION STUDY FOR THE AERONAUTICAL SATELLITE COMMUNICATIONS CENTER. VOLUME 2: PROGRAMMING SPECIFICATIONS. PART 1: SOFTWARE ORGANIZATION AND GENERAL DESCRIPTION [ETUDE DE DEFINITION DU SOFTWARE POUR LE CENTRE DE COMMUNICATIONS DES SATELLITES AERONAUTIQUES. SPECIFICATIONS DE PROGRAMMATION. TOME 1: ORGANISATION ET DESCRIPTION GENERALE DU SOFTWARE]
3 Jul. 1973 85 p In FRENCH
(Contract ESTEC-1777/72-SK)
(EX-5102/27-73/296; ESRO-CR(P)-309) Avail: NTIS HC $6.25

The programming specifications for the ASCC/ASET part of the Aerosat program are presented. Discussions cover the following: (1) hardware configurations and emission/reception routines for messages; (2) general description of the application software; (3) I/O routine modules description; and (4) operational system and programming language. The I/O routine modules are detailed according to the general layout set up with regard to data management. Flow charts for every module are given. The programming languages for various subsystem data managements are specified. ESRO

N74-12867# Software et Engineering des Systemes d'Informatique et d'Automatique, Paris (France).
SOFTWARE DEFINITION STUDY FOR THE AERONAUTICAL SATELLITE COMMUNICATIONS CENTER. VOLUME 2: PROGRAMMING SPECIFICATIONS. PART 2: DESCRIPTION OF OPERATIONAL FUNCTIONS [ETUDE DE DEFINITION DU SOFTWARE POUR LE CENTRE DE COMMUNICATIONS DES SATELLITES AERONAUTIQUES. SPECIFICATIONS DE PROGRAMMATION. TOME 2: DESCRIPTION DES FONCTIONS OPERATIONNELLES]
5 Jul. 1973 224 p In FRENCH
(Contract ESTEC-1777/72-SK)
(EX-5102/27-73/308; ESRO-CR(P)-310) Avail: NTIS HC $13.25

The description of the operational functions of the ASCC/ASET for the Aerosat program, namely communication, surveillance, and control, are presented. The communication function is discussed with regard to the main modular programs, including request treatment modes and polling communication. Secondary modules are also dealt with together with special modules for access mode giving initiative to mobiles. The same structure is followed in chapter 2: surveillance with regard to mobile surveillance modular programs (main modules), channel attribution, and management programs (second modules). Data structures and archives are also detailed. Chapter 3 deals with the control function and is devoted to satellite data. ESRO

N74-12868# Software et Engineering des Systemes d'Informatique et d'Automatique, Paris (France).
SOFTWARE DEFINITION STUDY FOR THE AERONAUTICAL SATELLITE COMMUNICATIONS CENTER. VOLUME 2: PROGRAMMING SPECIFICATIONS. PART 3: DESCRIPTION OF SIMULATION FUNCTION [ETUDE DE DEFINITION DU SOFTWARE POUR LE CENTRE DE COMMUNICATIONS DES SATELLITES AERONAUTIQUES. SPECIFICATIONS DE PROGRAMMATION. TOME 3: DESCRIPTION DES FONCTIONS DESIMULATION]
4 Jul. 1973 228 p
(Contract ESTEC-1777/72-SK)
(EX-5102/27-73/299; ESRO-CR(P)-311) Avail: NTIS HC $13.50

The description of the simulation functions for the ASCC/ASET of the Aerosat program is presented. Part A, devoted to simulation program structure, contains six chapters divided as follows: (1) communication functions; tasks of interface, user communication, communication activation, and archives; (2) aerosat function; surveillance response task; satellite link state, and range calculation; (3) mobile functions; mobile position update, navigation error correction, dummy roll-call, and mobiles' method of navigation; (4) ATCC functions; process surveillance position report, process position report request, new mobiles initiation, surveillance priority change request, mobile deletion, and ATCC event activation; (5) operator functions; task of input, error display, operator implementation, EDD operator display, and SDD operator display; and (6) preparation and analysis software; software for simulation preparation and simulation analysis. Part B is devoted to the simulation data structure with the same subdivisions pertinent to sections one to five of part A. ESRO

N74-12869# Software et Engineering des Systemes d'Informatique et d'Automatique, Paris (France).
SOFTWARE DEFINITION STUDY FOR THE AERONAUTICAL SATELLITE COMMUNICATIONS CENTER. VOLUME 3: DEFINITION OF THE MEANS [ETUDE DE DEFINITION DU SOFTWARE POUR LE CENTRE DE COMMUNICATIONS DES SATELLITES AERONAUTIQUES. DEFINITION DES MOYENS]
6 Jul. 1973 85 p In FRENCH
(Contract ESTEC-1777/72-SK)
(EX-5102/27-73/311; ESRO-CR(P)-312) Avail: NTIS HC $6.25

The software evaluation for ASCC/ASET of the Aerosat program is presented with regard to computer memory requirements and program execution times. The evaluation hypotheses for programs and data volumes, the minimal core memory estimations, secondary memories occupation and central memory occupation are described as functions of test configurations. The program execution time hypotheses are considered together with estimates for central memory resident time and estimates of execution times by function and test configuration. The hardware configuration are discussed with regard to the interfaces, link ASCC-autocommutator, links ASCC-ASET and standard hardware. The reliability of the various Aerosat ground segment elements are discussed. The topics of modularity and program independence with regard to operational, simulation, and maintenance modules are reviewed. ESRO

N74-12870# Software et Engineering des Systemes d'Informatique et d'Automatique, Paris (France).
SOFTWARE DEFINITION STUDY FOR THE AERONAUTICAL SATELLITE COMMUNICATIONS CENTER. VOLUME 4: PLANNING [ETUDE DE DEFINITION DU SOFTWARE POUR LE CENTRE DE COMMUNICATIONS DES SATELLITES AERONAUTIQUES. PLANIFICATION]
6 Jul. 1973 43 p In FRENCH
(Contract ESTEC-1777/72-SK)
(EX-5102/27-73/315; ESRO-CR(P)-313) Avail: NTIS HC $4.25

The time table and cost estimate for the ASCC/ASET of the Aerosat program are presented. Data cover basic hardware (interfaces, computer, computer programs, ATCC, operators), and tasks to be performed-choice of hardware, choice of basic software, program writing and validation, integration test, tests of the various functions of communication, surveillance, control,

and definition of a convenient operational system. Cost estimates in terms of total number of instructions and required personnel are dealt with. ESRO

N74-12884# Office of Naval Research, London (England).
CONFERENCE ON SATELLITE SYSTEMS FOR MOBILE COMMUNICATIONS AND SURVEILLANCE
I. G. Kinnie and A. H. Waynick 20 Jul. 1973 38 p Conf. held at London, 13-15 Mar. 1973
(AD-767369; ONRL-C-14-73) Avail: NTIS CSCL 17/2

A fairly detailed report is presented on an international conference on the use of satellite systems for intercontinental mobile communications and surveillance. These have been termed an Aerosat system for commercial aircraft and a Marsat system for ships. Some details on the operation of the Skynet military satellite communications system are also reported upon. Author (GRA)

N74-12938# Naval Research Lab., Washington, D.C.
SURVEY OF SOLID STATE REFLECTIVE/TRANSMISSIVE DISPLAY MEDIA Final Report
D. L. Mitchell and L. A. Rauber Sep. 1973 36 p refs
(NR Proj. 215-171)
(AD-767644; NRL-MR-2657) Avail: NTIS CSCL 09/5

A survey of basic research was conducted to determine the feasible solid state media candidates for use in high contrast aircraft cockpit displays operating in a reflective or transmissive mode. A model for reflective and transmissive displays was developed in order to relate display performance to physical poperties of the media. Threshold levels were set and candidates screened against these criteria. No solid state candidates passed this screening in all respects. PLZT ceramic plates and alkali halide M-centers were found to be acceptable with reservations and warrant further consideration. Author (GRA)

N74-12969# Southwest Research Inst., San Antonio, Tex.
REQUIREMENTS FOR EXPLOSION-PROOF ELECTRICAL EQUIPMENT IN AIR FORCE HANGERS Technical Report, Jun. 1971 - Jul. 1972
Lester A. Eggleston and Michael D. Pish Aug. 1973 126 p refs
(Contract F29601-71-C-0116; AF Proj. 683M)
(AD-767600; AFWL-TR-72-135) Avail: NTIS CSCL 01/5

The objective of the research effort was to determine if current requirements for explosion-proof equipment in USAF hangars are more stringent than necessary, and thereby result in unnecessary expense in meeting such requirements. Experiments and tests conducted, both in actual USAF hangars and in the laboratory, indicated that the vapor explosibility hazard from leaks and fuel spills is lower than generally believed. The results of the study indicate that hazardous zone definitions in existing codes could be relaxed without compromising safety. (Modified author abstract) GRA

N74-12970# Utah State Univ., Logan.
MODEL STUDY OF C-5A LANDINGS ON AM2 LANDING MAT Technical Report, 9 Jun. 1971 - 1 Feb. 1973
Fred W. Kiefer, Paul T. Blotter, and Vance T. Christiansen Kirtland AFB, N. Mex. AFWL Aug. 1973 134 p refs
(Contract F29601-71-C-0129; AF Proj. 683M)
(AD-767231; AFWL-TR-72-210) Avail: NTIS CSCL 01/5

After a buckling failure in a section of AM2 landing mat runway during a test landing of a C-5A at Dyess AFB, Texas, in August 1970, a model testing program was initiated. This report presents the results of the development and testing of an analytical model and a 1/7-scale physical model AM2 mat runway subjected to C-5A loadings. The analytical model represents the landing mat as a series of discrete rigid elements interconnected and suspended by springs and dashpots subjected to external forces simulating Coulomb friction, shear, and the action of the aircraft. Results from the computer program developed included a simulation of the Dyess failure and an evaluation of various mat modifications. The 1/7-scale physical model of the C-5A landing gear produced buckling failures in the model AM2 mat runway similar to the failure that occurred at Dyess AFB. (Modified author abstract) GRA

N74-12971# Advanced Technology Labs., Inc., Westbury, N.Y.
ANALYSIS OF WALL MODIFICATION IN A TRANSONIC WIND TUNNEL
Paolo Baronti, Antonio Ferri, and Thomas Weeks Feb. 1973 55 p refs
(Contract N00014-72-C-0201; AF Proj. 9781)
(AD-767629; ATL-TR-181; AFOSR-73-1900TR) Avail: NTIS CSCL 14/2

A method for transonic wind tunnel corrections based on the concept of measuring streamline deflection and pressure in the vincinity of the tunnel walls, and of analytically determining the streamline deflection that corresponds to the measured pressure and the pressure that corresponds to the measured streamline for external uniform free stream conditions at the same Mach number of the test was experimentally investigated. The method involves the additional step of determining the required wall porosity variation or proper wind tunnel cross sectional areas variation and then making the requisite wind tunnel adjustments to obtain interference free flow. Two, two-dimensional, 6% thick circular-arc airfoils were tested at several angles of attack and at free stream Mach numbers of 0.91 and 0.95 in the AFFDL Tri-Sonic Gasdynamics Facility at Wright-Patterson AFB. Only the portion of the data related to zero angle of attack is analyzed in this report. The analysis provides a verification of the experiments themselves, gives some indication of the characteristics of the tunnel ventilated walls, indicates the sensitivity required of the measurements and defines the wall modifications which are required for interference-free conditions. Author (GRA)

N74-12986 Engineering Sciences Data Unit, London (England).
PERFORMANCE OF CONICAL DIFFUSERS IN INCOMPRESSIBLE FLOW
Oct. 1973 23 p refs Sponsored by Roy. Aeron. Soc., Inst. of Chem. Engr., Inst. of Mech. Engr., and Inst. of Structural Engr.
(ESDU-73024) Copyright. Avail: Issuing Activity

Data on static-pressure recovery, total pressure loss, and overall flow pattern for incompressible flow through straight axis conical diffusers are presented. The effects of various geometrical and flow parameters on the diffuser performance are discussed. The geometry of a typical diffuser and the associated ducting is illustrated. The three types of flow are defined as: (1) attached flow, (2) transitory separation, and (3) jet flow. Mathematical models are developed to show the relationships between the various parameters. Author

N74-12989# National Engineering Lab., East Kilbride (Scotland). Dept. of Mechanical Engineering.
EXACT SOLUTIONS FOR CONICAL MIXED FLOW ROTORS. PART 2: CAMBERED BLADES OF FINITE THICKNESS
E. H. Fisher and R. I. Lewis Sep. 1972 31 p refs
(NEL-524-Pt-2) Avail: NTIS HC $3.75

The flow characteristics of conical axisymmetric rotors with cambered blades of finite thickness and zero stagger are analyzed. The analysis is performed by transforming the conical rotor successively to a segment of a circle and a single blade. The rotor flow may be obtained by superimposing three separate flows as follows: (1) a displacement flow satisfying the blade surface velocity condition at all points, (2) a blade circulation which satisfies the Kutta condition, and (3) a flow giving the circumferentially averaged inlet conditions. A range of results are compared with the results obtained from a numerical surface singularity program. Author

N74-12995# National Aerospace Lab., Amsterdam (Netherlands).
MEASUREMENTS IN A THREE DIMENSIONAL INCOM-

48<

PRESSIBLE TURBULENT BOUNDARY LAYER IN AN ADVERSE PRESSURE GRADIENT UNDER INFINITE SWEPT WING CONDITIONS

B. VanDenBerg and A. Elsenaar 15 Aug. 1973 71 p refs (NLR-TR-72092-U) Avail: NTIS HC $5.75

On a wind tunnel model, especially designed to check calculation methods, measurements were made of a three-dimensional turbulent boundary layer under infinite swept wing conditions in an adverse pressure gradient, with a three-dimensional separation near the trailing edge. Accurate measurements of the external flow field, the mean velocity profiles and the wall shear stresses were carried out. To facilitate the comparison of the experimental data with calculation methods, the external flow field and the initial velocity profile are given in analytical form. Boundary layer profiles at ten measuring stations are given in tables together with the wall shear stress and integral parameters. A momentum balance is also presented indicating that the results are reliable. Author

N74-13129* National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

THREE-AXIS ADJUSTABLE LOADING STRUCTURE Patent

Edward J. Lynch and Darwyn T. Gray, inventors (to NASA) Issued 4 Dec. 1973 7 p Filed 16 May 1972 Supersedes N73-30416 (11-21, p 2547)

(NASA-Case-FRC-10051-1; US-Patent-3,776,028; US-Patent-Appl-SN-253725; US-Patent-Class-73-88R; US-Patent-Class-254-93R) Avail: US Patent Office CSCL 14B

A three axis adjustable loading structure for testing the movable surfaces of aircraft by applying pressure, is described. The device has three electric drives where the wall angle, horizontal position, and vertical position of the test device can be rapidly and accurately positioned.

Official Gazette of the U.S. Patent Office

N74-13136 British Library Lending Div., Boston Spa (England).

METHOD OF CALCULATING THE AIR TIGHTNESS OF THE VACUUM SYSTEM IN A TURBINE WITH A WATER - JET EJECTOR

G. E. Efimochkin 3 Sep. 1973 9 p Transl. into ENGLISH from Elektr. Sta. (USSR), v. 41, no. 8, Aug. 1970 p 24-26 (BLL-CE-Trans-5646-(9022.09)) Avail: British Library Lending Div., Boston Spa, Engl.: 1 BLL Photocopy coupon

Leakage in many 300 MW sets reduces their efficiency by up to 2%. An account is presented of a method developed for checking the air tightness of the vacuum system in such sets. It is found to be simple, accurate and reliable and has yielded very favorable results at a number of power stations. The method is based on the introduction of an additional amount of air into the system through a calibrated nozzle. Author

N74-13198# North American Systems Corp., Londonderry, N.H.

INFRARED INSPECTION OF ELECTRICAL EQUIPMENT Final Report, Phase 2, Nov. 1972 - Jul. 1973

George S. Ginsburg and Roger L. Hall Washington FAA Jul. 1973 170 p refs

(Contract DOT-FA72WA-2908) (C-208-2; FAA-RD-73-164) Avail: NTIS

Infrared temperature measurements of electrical equipment at the New York Air Route Traffic Control Center were made. These data were analyzed statistically and conclusions were drawn regarding the normal operating temperature range for these equipments. Temperatures were calculated which indicate the highest normal operating temperature and the temperature at which corrective action should be initiated. Laboratory tests were performed on various equipments which were operated above the normal temperature range to confirm predictions. A survey of infrared instruments is also included, and a handbook on the use of infrared technique for preventative maintenance of electrical equipment is provided. Author

N74-13262# Northrop Corp., Hawthorne, Calif. Aircraft Div.

DEVELOPMENT AND EVALUATION OF METHODS OF PLANE STRESS FRACTURE ANALYSIS. PART 1: REVIEW AND EVALUATION OF STRUCTURAL RESIDUAL STRENGTH PREDICTION TECHNIQUES Final Report, Jul. 1972 - Feb. 1973

Ralph M. Verette and David P. Wilhem May 1973 114 p refs

(Contract F33614-72-C-1769) (AD-767614; NOR-72-32-Pt-1; AFFDL-TR-73-42-Pt-1) Avail: NTIS CSCL 11/6

The treatment of residual strength prediction for aircraft structures having through flaws is considered in this report. A discussion of the circumstances which normally give rise to plane stress or mixed mode fracture is presented along with a summary of those elements which would constitute an ideal residual strength method. This method would be capable of prescribing the remaining strength possessed by a broad variety of flawed aircraft structures under actual service environments. Currently available prediction techniques fall considerably short of the desired goal, and the strong and weak points of existing methods, as well as comparisons with test results, are presented. A recommended technique is described for residual strength prediction which bridges the gap between the existing methods and the ideal. The recommended approach will account for slow crack growth and plasticity. It appears that the apporach will utilize the J integral in combination with a modified form of the crack growth resistance curve in making residual strength predictions.

Author (GRA)

N74-13263# Boeing Commercial Airplane Co., Seattle, Wash.

EVALUATION OF AFC 77 MARTENSITIC STAINLESS STEEL FOR AIRFRAME STRUCTURAL APPLICATIONS Final Technical Report, 1 Jun. 1971 - 31 May 1973

R. G. Caton and C. S. Carter Sep. 1973 75 p refs

(Contract F33615-71-C-1550; AF Proj. 7351) (AD-767597; D6-60225; AFML-TR-73-182) Avail: NTIS CSCL 11/6

The fabrication and properties of two high-strength stainless martensitic steel forgings are described. A high level of fracture toughness was achieved in the AFC 77 forging at a tensile strength level of 235 ksi. Stress corrosion resistance, however, was similar to that of competitive steels. The fracture toughness, stress corrosion, and fatigue properties developed in the AFC 77B forging at a tensile strength of 260 ksi were similar to those of currently used steels. Cracking problems were experienced with both forgings during heat treatment. The stress corrosion resistance of AFC 77 was no higher than that of competitive steels. The target tensile strength of 275 ksi was not achieved in the AFC 77B landing gear forging. A lower tensile strength would appear to be more appropriate for this alloy in heavy section form. The fracture toughness, stress corrosion, and notch fatigue properties were very similar to those of medium alloy steels. Although both AFC 77 and AFC 77B are stainless types of steel, it is considered that the low stress corrosion resistance would necessitate plating and painting to prevent the ingress of moisture. (Modified author abstract) GRA

N74-13266*# Parametrics, Inc., Waltham, Mass.

DEVELOPMENT OF SELF-CONTAINED PORTABLE UNIT FOR NONDESTRUCTIVE COMPOSITIONAL ANALYSIS OF AIRCRAFT AND SPACE SYSTEMS ALLOYS Final Technical Report, 1 Jul. 1971 - 31 Mar. 1973

Joris M. Brinkerhoff Jul. 1973 35 p refs

(Contract F33615-71-C-1897; AF Proj. 7360) (AD-767226; AFML-TR-73-181) Avail: NTIS CSCL 11/6

Two portable radioisotope excited X-ray fluorescence systems have been designed and delivered, one a high resolution type using a cryogenically cooled solid state detector and the other a gas filled proportional counter operated in conjunction with balanced X-ray filters. The measurement probes were designed for sample areas that may be of small size or that may occur in recessed locations. Measurement techniques were formulated and studied that use pure elemental standards in conjunction

with just a single alloy reference for a given unknown. Computational programs were written to implement these techniques. A set of twenty-seven analyzed reference alloys was also provided. This report summarizes the design aspects of the two systems and the course of evaluation of the measurement techniques.
Author (GRA)

N74-13286# Frankford Arsenal, Philadelphia, Pa.
FUNGUS RESISTANCE OF POLYVINYL ACETATE LATEX DUST CONTROL MATERIAL
Leonard Teitell and Sidney H. Ross Jun. 1973 18 p refs
(DA Proj. 1T0-62105-A-329)
(AD-767256; FA-M73-19-1) Avail: NTIS CSCL 11/9

A polyvinyl acetate latex material, intended for use as a dust control material for helicopter landing pads, was evaluated for fungus susceptibility. Laboratory tests included incubation of dried films on inorganic salts-agar and burial of specimens in biologically active soil. The dried films show a marked loss in flexibility, probably due to use of plasticizer by soil microorganisms. The dried films can be protected against fungus attack by the addition of a biocide such as 2, 3, 5, 6-tetrachloro-4 (methylsulfonyl) pyridine to the latex material prior to casting the films. Examination of drums of liquid dust control material stored in the tropical climate of the Canal Zone showed evidence of microbiological contamination of the liquid latex.
Author (GRA)

N74-13318# Kanner (Leo) Associates, Redwood City, Calif.
AIR POLLUTION FROM AIRPORTS
H. A. Meester-Broertjes Jul. 1973 30 p Transl. into ENGLISH from Procesteckniek (Netherlands), v. 27, no. 21, 10 Oct. 1972 p 683-693 Sponsored by EPA
(TR-595-73; APTIC-47405) Avail: NTIS HC $3.50

Air pollution by aircraft engine emission at Schiphol Airport was studied. The composition and concentration of the exhaust fumes are reported. It was found that the highest concentration of carbon monoxide, hydrocarbons, and aldehydes appear during the stationary phase, while nitrogen oxides, soot, and sulfur dioxide appear during the start. The air pollution at Schiphol due to air traffic amounts to 6700 tons per year.
F.O.S.

N74-13402# Royal Aircraft Establishment, Farnborough (England). Structures Dept.
ON THE NATURE OF LARGE CLEAR AIR GUSTS NEAR STORM TOPS
Anne Burns London Aeron. Res. Council 1973 48 p refs Supersedes RAE-TR-72036; ARC-33976
(ARC-CP-1248; RAE-TR-72036; ARC-33976) Avail: NTIS HC $4.50; HMSO 70p; PHI $2.95

Detailed analysis of a small patch of severe clear air turbulence recorded in a Canberra aircraft flying in the vicinity of storm tops, in Oklahoma, 1965, reveals the existence of a pattern in the variation of horizontal and vertical gust velocities. This pattern appears to arise from the presence of a complex system of equally-spaced vortex rolls, some with horizontal and some with tilted axes, embedded in turbulence of a more random nature. The largest gusts are found near the centers of the vortex rolls and are characterized by the sharpness of their gradients. The implications with respect to aircraft design loads of large gusts arising from such organized air motions is discussed, with particular reference to the power spectral approach.
Author (ESRO)

N74-13420* National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
TERMINAL GUIDANCE SYSTEM Patent
Shu W. Gee, inventor (to NASA) Issued 4 Dec. 1973 15 p Filed 6 Mar. 1972 Supersedes N72-21632 (10 - 12, p 1638)
(NASA-Case-FRC-10049-1; US-Patent-3,776,455; US-Patent-Appl-SN-232021; US-Patent-Class-235-150.22; US-Patent-Class-235-150.26; US-Patent-Class-235-150.27; US-Patent-Class-244-77A; US-Patent-Class-244-77B; US-Patent-Class-343-108R) Avail: US Patent Office CSCL 17G

A terminal guidance system is described including a heading command subsystem and a glide-slope command subsystem which develop command signals for use in guiding an aircraft or other vehicle into a preselected heading and/or altitude at a terminal point. The heading command subsystem is responsive to certain input data and continuously develops command signals for use in directing the aircraft from a remote location to a terminal point so that upon arrival it has a preselected terminal heading. The glide-slope command subsystem is responsive to certain other input data and continuously develops command signals for use in controlling the rate of descent of the aircraft so that it will have a preselected altitude and glide-slope upon arrival at the terminal.
Official Gazette of the U.S. Patent Office

N74-13421# Airborne Instruments Lab., Deer Park, N.Y.
MICROWAVE LANDING SYSTEM (MLS) DEVELOPMENT PLAN AS PROPOSED BY AIL DURING THE TECHNIQUE ANALYSIS AND CONTRACT DEFINITION PHASE OF THE NATIONAL MLS DEVELOPMENT PROGRAM. PART 3.0, VOLUME 3.2: APPENDIX A: SYSTEM TECHNIQUE SUMMARY. APPENDIX B: FUNCTIONAL REQUIREMENTS SUMMARY. APPENDIX C: DETAILED FEASIBILITY HARDWARE SPECIFICATIONS
27 Sep. 1972 96 p
(Contract DOT-FA72WA-2800; FAA Proj. 075-325-013)
(FAA-RD-73-166-Vol-3.2) Avail: NTIS HC $7.00

The development and characteristics of a microwave landing system for air traffic control are discussed. The subjects presented are: (1) functional requirements specification for the prototype system, (2) functional requirements specifications for the feasibility demonstration equipment, (3) detailed feasibility hardware specifications, (4) accuracies for angular guidance, and (5) distance measuring equipment specifications.
Author

N74-13422*# National Aeronautics and Space Administration. Wallops Station, Wallops Island, Va.
GENERAL AVIATION AIR TRAFFIC PATTERN SAFETY ANALYSIS
Loyd C. Parker 17 Jul. 1973 22 p refs Presented at the System Safety Soc. Symp., 17 Jul. 1973
(NASA-TM-X-69455; Paper-A-24) Avail: NTIS HC $3.25 CSCL 17G

A concept is described for evaluating the general aviation mid-air collision hazard in uncontrolled terminal airspace. Three-dimensional traffic pattern measurements were conducted at uncontrolled and controlled airports. Computer programs for data reduction, storage retrieval and statistical analysis have been developed. Initial general aviation air traffic pattern characteristics are presented. These preliminary results indicate that patterns are highly divergent from the expected standard pattern, and that pattern procedures observed can affect the ability of pilots to see and avoid each other.
Author

N74-13423# Research Inst. of National Defence, Stockholm (Sweden).
PROPOSAL FOR A VISUAL SYSTEM OF SIMULATING A LANDING [FOERSLAG TILL VISUELLT SYSTEM FOER LANDNINGSSIMULERING]
Brian Hoegman, Ake Persson, and Goeran Oernberg Dec. 1971 27 p In SWEDISH
(FOA-2-C-2509-E4) Avail: NTIS HC $3.50

In order to increase the degree of simulation when simulating different flying situations, a proposal has been made for simulation of information from the external visual environment concerned with the landing of an aircraft. The solution presented gives a limited possibility for a dynamic simulation of the external visual environment. It is mainly intended for studying the performance of the pilot during landing and in this respect, it gives a relatively high degree of simulation. The proposal has been designed for use with a TV system and terrain models where the TV picture is modified depending on the position of the aircraft, and the pilots control reactions.
Author

N74-13424# Elektronik fuer Luftfahrzeuge G.m.b.H., Stuttgart (West Germany).
A NEW TYPE OF ELECTRONIC LANDING SYSTEM FOR REGIONAL AIRPORTS [EIN NEUARTIGES ELEKTRONIK-LANDE-SYSTEM FUER REGIONALFLUGPLAETZE]
Roland Kissling 1973 8 p In GERMAN Presented at the DGLR-DGON Symp. on Neue Anflug- und Landeverfahren, Duesseldorf, 2-4 May 1973
(DGLR-Paper-73-020) Avail: NTIS HC $3.00

An electronic landing system for regional airports is proposed, based on instrument flight rules (IFR). The unsolved problem consists of ensuring a certain landing approach under IFR conditions for the most frequent types of weather. The existing GCA and ILS form too high an investment to be applied under these conditions. The system proposed is based on the concept of a simulated GCA or ILS using simple electronic means. The onboard equipment involved is equivalent to the minimum requirements for flight safety. Several ground equipment configurations are discussed. Small antennas are used for a 1 GHz receive frequency, and a transponder is proposed working at 4 GHz. ESRO

N74-13427# Meta Systems, Inc., Santa Clara, Calif.
POTENTIAL CONFLICT PREDICTION AND ASSOCIATED FUNCTIONS FOR OCEANIC AIR TRAFFIC CONTROL AUTOMATION Final Report, Mar. 1972 - May 1973
Frank V. Giallanza, Charles P. Giallanza, and James C. Brown May 1973 59 p
(Contract DOT-FA72WA-2851)
(AD-767453; FAA-RD-73-73) Avail: NTIS CSCL 17/7

Algorithms to determine potential conflicts over an ocean airspace based on given vertical, lateral, and longitudinal separation criteria were developed. Additional algorithms to handle special cases have yet to be developed. Associated functions used by air traffic controllers to resolve conflict situations are also described. Author (GRA)

N74-13450# Army Electronics Command, Fort Monmouth, N.J.
THE EFFECT OF HELICOPTER NOISE ON COMMUNICATION AND HEARING
Thomas A. Giordano and Gerard C. Keane Aug. 1973 151 p refs
(DA Proj. 1T0-61101-A-91A; DA Proj. 1F2-63207-DB-97)
(AD-767222; ECOM-4140) Avail: NTIS CSCL 20/1

The effects of CH-47 (CHINOOK) helicopter noise on the aviator's hearing and on communication system intelligibility are serious ones. The effort described by this report is aimed at reducing the sound pressure levels at the aviator's ears while maintaining high intelligibility and quality in the communication system. The overall problem is first defined. The noise levels inside all areas of the CH-47 were found to exceed the hearing damage risk criteria set forth by the Surgeon General. Even with hearing protectors, the aviator is limited to the time he may fly without undue risk to his hearing. The electrical characteristics of the communication system were determined. Non-linear frequency responses of the microphone and earcup were detected. These resonances cause emphasis of those frequencies in which the ear is most sensitive. The poor noise cancelling ability of the M-87 microphone at high frequencies cause low signal to noise ratios in the communication system. An intelligibility vs. in-ear dBA level study was run to evaluate the potential success of an ideal perfect noise cancelling microphone and other microphone modifications. GRA

N74-13501# Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.
JP-4 THERMAL STABILITY SURVEY Final Report, Jun. 1971 - Aug. 1972
Jerry C. Ford, Royce P. Bradley, and Leonard C. Angello Jun. 1973 35 p refs
(AF Proj. 3048)
(AD-767591; AFAPL-TR-73-27) Avail: NTIS CSCL 21/4

A survey was conducted to determine the thermal stabilities of JP-4 fuels produced by refineries in the United States. The effect on fuel availability of increasing the test conditions of the JP-4 specification from 300/400F to 325/425F was determined to be minimal provided a precise method of measuring thermal stability is available. Physical properties on the 19 JP-4 fuels are documented. (Modified author abstract) GRA

N74-13510# Cincinnati Univ., Ohio. Dept. of Aerospace Engineering.
A NUMERICAL SOLUTION FOR THE HEAT TRANSFER BETWEEN AN AXI-SYMMETRIC AIR JET AND A HEATED PLATE
R. Ravuri and W. Tabakoff Sep. 1973 36 p refs
(Contract DAHC04-69-C-0016)
(AD-767268; AROD-T-4-57-E; Rept-73-38) Avail: NTIS CSCL 21/5

Due to their characteristic high rate of heat transfer, impinging air jets are being used extensively in industry. A numerical scheme is devised to predict the heat transfer between an axi-symmetric air jet and a heated plate, neglecting the effect of curvature, compressibility, and turbulence. The momentum and continuity equations are transformed to vorticity and stream function equations and are then solved by iterative successive substitution techniques to determine the flow field and subsequently the temperature distribution in the fluid. An attempt is made to predict the average heat transfer coefficient of a row of axi-symmetric air jets impinging on a heated plate by assuming that each jet cools a fraction of the plate without any interference from the neighboring jets. Author (GRA)

N74-13511# Naval Postgraduate School, Monterey, Calif.
EXPERIMENTAL INVESTIGATION OF THE EFFECTS OF TIP CLEARANCE AND END LOSSES ON AXIAL COMPRESSOR PERFORMANCE M.S. Thesis
John Kirtland Welch Jun. 1973 136 p refs
(AD-767656) Avail: NTIS CSCL 21/5

The objective of the study was to determine by experimental means the rotor efficiencies at different radii between hub and tip of a single stage axial compressor at its design point, to show the influence of tip clearance and end losses. Procedures for calibration and application of pressure probes to survey the flow in the compressor were established and programs were written to analyze the measured data. Recommendations are made for improvements of the data reduction method, which should precede experiments involving controlled changes in the blade tip clearances. Author (GRA)

N74-13513# Cincinnati Univ., Ohio. Dept. of Aerospace Engineering.
OFF-DESIGN BEHAVIOR FOR AXIAL FLOW COMPRESSOR STAGES WITH INVARIABLE AND VARIABLE GEOMETRY BLADES
K. Grahl and W. Tabakoff Sep. 1973 68 p refs
(Grant DA-ARO(D)-31-124-G154)
(AD-767265; AROD-10223-6-E) Avail: NTIS CSCL 21/5

An application of a computer program is described for studying the off-design performance for single and multistage axial flow compressors. The calculation method allows one to determine the stage characteristics as a function of revolutions. This can be accomplished in a very short time with only a few geometrical and aerodynamical input data. The flow is described by the well-known streamline curvature method. The necessity of a good loss model is shown. Limitations of this method are described. Some computation examples for the first and fifth stages of a ten-stage NASA axial flow compressor are presented. The stage and overall characteristics for different compressors are considered for invariable and variable blade geometry. The off-design analytical results are compared with existing experimental results. Author (GRA)

N74-13514# United Aircraft Corp., East Hartford, Conn.
DEVELOPMENT OF OPTIMAL CONTROL MODES FOR ADVANCED TECHNOLOGY PROPULSION SYSTEMS

Interim Technical Report, 1 Feb. - 30 Jun. 1973
Gerald J. Michael and Florence A. Farrar Aug. 1973 37 p refs
(Contract N00014-73-C-0281; NR Proj. 215-219)
(AD-767425; UARL-M911620-1) Avail: NTIS CSCL 21/5

A nonlinear multivariable feedback controller was developed for the V/STOL hover application (80 to 100 percent thrust range) of the Pratt and Whitney Aircraft F401 variable cycle turbofan engine. The analytical design involved (1) linearizing the F401 engine dynamics about two closely-spaced, steady-state operating points and applying linear optimization methods at each point, and (2) combining two optimal linear controllers into a single nonlinear controller having feedback gains that vary with system state. Variable fan, compressor, and exhaust geometries and changes in main burner fuel flow rate are coordinated by the controller to achieve improved engine dynamic response. Responses with the optimal controller were computed using a nonlinear digital simulation of the engine. The engine response evaluated was for a commanded thrust change from the V/STOL hover setting (80 percent) to military rated thrust (100 percent). These responses were compared with those obtained using a state-of-the-art conventional controller designed to provide rapid thrust response (the P and WA) fast accel controller). (Modified author abstract) GRA

N74-13633# National Aerospace Lab., Amsterdam (Netherlands).
FATIGUE CRACK GROWTH IN ALUMINUM ALLOY SHEET MATERIAL UNDER FLIGHT-SIMULATION LOADING. EFFECTS OF DESIGN STRESS LEVEL AND LOADING FREQUENCY
J. Schijve, F. A. Jacobs, and P. J. Tromp Feb. 1972 26 p refs
(NLR-TR-72018-U) Avail: NTIS HC $3.25

Specimens of 2024-T3 and 7075-T6 were tested at 10, 1 and 0.1 cps. Values of mean stress in flight were 10.0, 8.5, 7.0, 5.5 and 4.0 kg/sq mm. The analysis of the results considers the frequency effect and its significance for inspection periods in service, and the effect of stress level. A comparison between the two alloys, the prediction of crack rates in flight-simulation tests, and the meaning of the stress intensity factor for the latter purpose are included. Author

N74-13674 National Aeronautical Establishment, Ottawa (Ontario). High Speed Aerodynamics Lab.
REYNOLDS NUMBER EFFECTS AT LOW SPEEDS ON THE MAXIMUM LIFT OF TWO-DIMENSIONAL AEROFOIL SECTIONS EQUIPPED WITH MECHANICAL HIGH LIFT DEVICES
J. A. Thain *In* Natl. Res. Council of Can. Quart. Bull. of the Div. of Mech. Eng. and the Natl. Aeron. Estab. 30 Sep. 1973 p 1-24 refs

Published experimental data are reviewed from various sources on the variation of maximum lift coefficient with Reynolds number (RN) of two-dimensional aerofoil sections equipped with mechanical high lift devices. The importance of Mach number is also discussed. The study indicates that the stalling characteristics of single aerofoils is fairly well understood and the effect of the RN is predictable for most commonly used sections. The optimum position for a single slotted flap relative to the main wing was found to vary with RN. Predicting the maximum lift coefficient of a particular multielement section at a RN other than that tested was found to be a difficult problem. K.M.M.

N74-13675 National Research Council of Canada, Ottawa (Ontario). Engine Lab.
ENERGY IN TRANSPORTATION
E. P. Cockshutt *In its* Quart. Bull. of the Div. of Mech. Eng. and the Natl. Aeron. Estab. 30 Sep. 1973 p 25-32 refs

The energy requirements of a variety of transportation systems are reviewed in the context of the current concern over diminishing reserves of hydrocarbon fuels. The energy costs of current passenger and cargo transportation systems are presented. The energy cost components - thermo-propulsive efficiency, frictional resistance, and structural efficiency-are assembled as a ratio for low energy cost. Charts and graphs are included. K.M.M.

N74-13682# Federal Aviation Administration, Washington, D.C. Systems Research and Development Service.
SRDS TECHNICAL PROGRAM DOCUMENT, FISCAL YEAR 1974. ENGINEERING AND DEVELOPMENT PROGRAMS
Jul. 1973 179 p
Avail: NTIS HC $11.00

The technical program document for the fiscal year 1974 engineering and development programs of the Department of Transportation of the Federal Aviation Administration is presented. The program resumes identify the technical objective, approach, milestones scheduled for accomplishment, and requirements. The overall program is discussed under twenty-two categories which include: (1) aircraft safety, (2) air traffic control, (3) airports, and (4) weather services. Author

N74-13690# Research Inst. of National Defence, Stockholm (Sweden).
VISIT REPORT ON THE FLYING AND SPACE EQUIPMENT EXHIBITION IN PARIS 1971 [RESERAPPORT FRAN DEN 29. FLYG OCH RYMDUTSTALLNINGEN I PARIS 1971]
Curt Haglund Oct. 1971 52 p In SWEDISH
(FOA-2-C-2494-M6) Avail: NTIS HC $4.75

Some impressions from the 29th Flying and Space Exhibition in Paris May/June 1971 are reported. The exhibition was visited during the first four days. Author

N74-13696# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
DIFFERENTIAL GAME BARRIERS AND THEIR APPLICATION IN AIR-TO-AIR COMBAT Ph.D. Thesis
Urban H. D. Lynch Mar. 1973 252 p refs
(AD-766890; DS/MC/73-1) Avail: NTIS CSCL 15/7

The mathematical theory of perfect information, zero-sum, differential games is used as an analytical tool to learn as much as possible about the one-on-one, air-to-air combat problem and the problem parameters which have major effect on its outcome. The primary emphasis is on differential game Barrier theory and the application of the Barrier as an analytical tool for air-to-air combat analysis. A series of progressively more complex air-to-air combat models is developed and solved in such a way that the solution results of a given model have direct input to the more complex model that follows and learning from one model to the next is accumulative. The importance of the Barrier, its shape and its sensitivity to aircraft design parameters is discussed and demonstrated. (Modified author abstract) GRA

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SUBJECT INDEX

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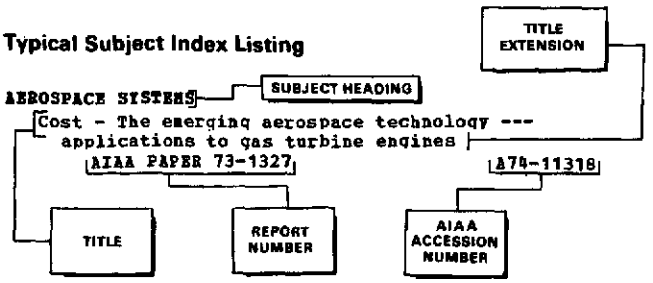

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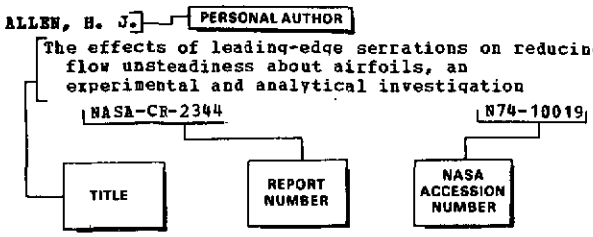

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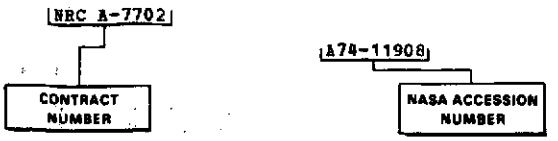

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