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AERONAUTICAL ENGINEERING

A Special Bibliography

Supplement 33

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 June 1973 in

- *Scientific and Technical Aerospace Reports (STAR)*
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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 419 reports, journal articles, and other documents originally announced in June 1973 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*.

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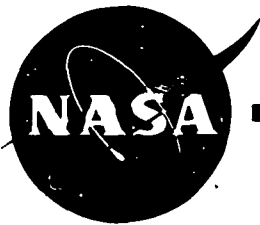
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AERONAUTICAL ENGINEERING

A Special Bibliography (Suppl. 33)

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IAA ENTRIES

A73-24979 Noise radiated from a turbulent boundary layer. E. A. Vecchio and C. A. Wiley (North American Rockwell Corp., Autonetics Div., Anaheim, Calif.). *Acoustical Society of America, Journal*, vol. 53, Feb. 1973, p. 596-601. 12 refs. Research sponsored by Johns Hopkins University.

The theory for the fluid-dynamic generation of sound, recently developed by Lotsch for boundary-layer turbulence, is extended by making use of correlations. Its application to the experimental configurations used by Haddle and Skudrzyk showed good agreement between theory and experiment for the radiation-field pressures produced by an aluminum and a wooden buoyant vehicle (Author)

A73-24980 * # Sound directivity pattern radiated from small airfoils. A. S. Hersh (Bolt Beranek and Newman, Inc., Canoga Park, Calif.) and W. C. Meecham (California, University, Los Angeles, Calif.). *Acoustical Society of America, Journal*, vol. 53, Feb. 1973, p. 602-606. 6 refs. NASA-sponsored research.

Verification of Curle's (1955) point dipole sound theory as a means for predicting the level and directivity of sound radiated from rigid surfaces in flow. A presented comparison between theory and experiment is shown to provide evidence that airfoils in flow, whose dimensions are small in relation to the wavelength of the radiated sound, radiate like point dipoles in apparent support of Curle's theory. M.V.E.

A73-24981 Synthesis of helicopter rotor tips for less noise. R. H. Lyon (MIT, Cambridge, Mass.), W. D. Mark, and R. W. Pyle, Jr. (Bolt Beranek and Newman, Inc., Cambridge, Mass.). *Acoustical Society of America, Journal*, vol. 53, Feb. 1973, p. 607-618. 6 refs.

Theoretical and computational studies of rotor-tip sound radiation have been conducted for the purpose of designing rotor tips that radiate less sound in specified frequency bands. Consideration is given to radiation due to lift and thickness effects. Effects of unsteady vortex shedding on lift radiation are examined. It is shown that lift radiation is generally negligible in comparison with thickness radiation. A computational algorithm is developed for the synthesis of tip shapes that cause minimum thickness radiation in specified frequency bands. Numerical results are obtained for tip shapes that minimize high-frequency radiation, and a substantial reduction of radiation in comparison with existing shapes is shown. The uncertainty principle is used to establish a fundamental relationship between the tip section chord length and the minimum possible cutoff frequency for effective suppression of high-frequency sound. Factors that affect tradeoffs between choices on airfoil section and platform are discussed. (Author)

A73-25000 A single number rating for effective noise reduction. C. K. Barton (Newport News Shipbuilding and Dry Dock Co., Newport News, Va.). *Sound and Vibration*, vol. 7, Feb. 1973, p. 23-25.

A73-25046 # Nonstationary flow downwash behind a delta wing during supersonic motion (Nestatsionarnyi skos potoka za treugol'nym krylom pri sverkhzvukovom dvizhenii). R. Sh. Solomonian (Nauchno-Issledovatel'skii Institut Avtomatizatsii Proizvodstvennykh Protseessov Khimicheskoi i Tsvetnoi Metallurgicheskoi Promyshlennosti, Kirovakan, Armenian SSR). *Akademiia Nauk Armianskoi SSR, Izvestiia, Mekhanika*, vol. 25, no. 5, 1972, p. 45-64. 6 refs. In Russian.

Expressions are derived to determine the unsteady downwash caused by a delta wing having supersonic leading edges. It is assumed that the wing moves in an ideally compressible fluid at a small angle of attack with a certain angle of slip, that the principal motion of the wing is a rectilinear forward motion at a constant supersonic speed, and that the wing also develops small oscillations. The downwash is found through the coefficients of rotational derivatives given by Mezhlumian (1970) and Kisliagin (1961). Formulas given by Mezhlumian are used to determine the coefficients. V.Z.

A73-25103 Varying-temperature test installation for the interior design of the Concorde (Wechseltemperatur-Prüfanlage für die 'Concorde'-Innenanlage). N. P. Wynn (Gebrüder Sulzer AG, Winterthur, Switzerland). *Technische Rundschau Sulzer*, vol. 54, no. 2, 1972, p. 114-124. In German.

During the actual flight, the external wall of the aircraft is heated by friction effects for about two hours to a temperature of about 100 C. During this time a great part of the interior of the aircraft structure is heated by the mechanism of heat conduction. Approaches for simulating these conditions in a test temperature cycle are discussed. Attention is given to the replacement of the fuel in the tanks during the tests by a suitable liquid. Other problems are related to the design of suitable air circulation conditions for the tests, including the generation of excess pressure in the cabin and the required cooling or air and fuel. G.R.

A73-25128 * Structural integrity in aircraft. H. F. Hardrath (NASA, Langley Research Center, Materials Div., Hampton, Va.). (*American Society for Testing and Materials, Annual Meeting, 75th, Los Angeles, Calif., June 26, 1972.*) *Journal of Testing and Evaluation*, vol. 1, Jan. 1973, p. 3-12. 15 refs.

The paper reviews briefly the current design philosophies for achieving long, efficient, and reliable service in aircraft structures. The strengths and weaknesses of these design philosophies and their demonstrated records of success are discussed. The state of the art has not been developed to the point where designing can be done without major test inspection and maintenance programs. A broad program of research is proposed through which a viable computerized design scheme will be provided during the next decade. The program will organize and correlate existing knowledge on

fatigue and fracture behavior, identify gaps in this knowledge, and guide specific research to upgrade design capabilities. (Author)

A73-25180 Design of control and display panels using computer algorithms. M. W. Bartlett (USAF, Washington, D.C.) and L. A. Smith (Auburn University, Auburn, Ala.). *Human Factors*, vol. 15, Feb. 1973, p. 1-7. 8 refs.

The feasibility of using facilities-allocation algorithms in the design of control and display panels was illustrated by applying the CRAFT (Computerized Relative Allocation of Facilities Technique) facilities-allocation algorithm to the design of a hypothetical aircraft main instrument panel. The results indicate that facilities-allocation algorithms are feasible tools for designing control and display panels and suggest that development of an algorithm specifically for the panel design problem is warranted. (Author)

A73-25206 Düsseldorf airport. H. Trautwein (Flughafen Düsseldorf GmbH, Düsseldorf, West Germany). *Airport Forum*, Mar. 1973, p. 9, 11, 14, (10 ff.). In English and German.

Following a brief historical survey Düsseldorf airport, the concept behind the new passenger terminal, which will have the capacity to handle about 9,000,000 passengers per year when finally completed, is discussed. To keep far-reaching reorganization risks down to a minimum, planning at Düsseldorf was based on the principle of 'simple and flexible.' The execution of the project in three phases ensures that the facilities can keep reasonable pace with actual traffic development, since the capacity of the terminal building is to be adapted to requirements at intervals of two or three years. In this way, it will also be possible to meet new technical requirements, such as those involved in the introduction of the wide-bodied jets. F.R.L.

A73-25207 Malmo-Sturup, Sweden's colourful airport. C. Akerstedt (Malmo-Sturup Airport, Malmo, Sweden) and M. Lippold. *Airport Forum*, Mar. 1973, p. 43-45, 47, 49, 50. In English and German.

Malmo-Sturup is an extremely modern airport, and can be used at any time as a relief airport for Copenhagen-Kastrup. The airport is distinguished by its simplicity and unpretentiousness. Baggage is transported without lengthy delays from the arriving aircraft to the waiting passenger, and a special point has been made of locating the baggage claim area close to the exit from the terminal. There is also a cargo terminal, and an ATC school is to be established to train both civil and military air traffic controllers. The airport is oriented entirely to the coming decades. F.R.L.

A73-25208 Airports promote Ireland. J. M. Rieck. *Airport Forum*, Mar. 1973, p. 61, 63-66, (7 ff.). In English and German.

In the 1971/1972 fiscal year Ireland's three commercial airports, Dublin, Shannon, and Cork handled over 3,300,000 passengers. The airports are managed by Aer Rianta, a State-sponsored company. Plans are in hand to construct in 11,000-ft runway for Dublin airport to make possible departures by long-range aircraft with a full fuel load. The Dublin terminal building and its operational procedures are described. Although Shannon airport has ceased to be merely a refuelling stop, half of its million passengers are in transit. Cork airport is used almost exclusively by medium-range and general aviation aircraft. F.R.L.

A73-25209 Aquaplaning can be prevented. W. Symmang (Possehl Chemie und Isolierstoffe GmbH, Wiesbaden, West Germany). *Airport Forum*, Mar. 1973, p. 84, 85, 87-89, (ff. 5). 12 refs. In English and German.

Aquaplaning is defined as complete or partial loss of friction between the aircraft tires and the runways surface under the influence of water. The onset of an aquaplaning situation is influenced by speed of the aircraft, tire pressure, tire profile and composition of the rubber, the braking and lateral forces which come into play during the landing of an aircraft, the thickness of the film of water

on the runway, and the condition of the runway surface. Runway surfaces must be well drained and grip well. Methods of measuring roughness are described. Different ways of improving or restoring skid resistance may be divided into overlay and cutting processes. Surface treatment using anti-skid overlays has been found increasingly satisfactory. The qualities of runway surfaces may be improved by cutting grooves at right angles to the runway at intervals of between 25 and 50 mm. Tire wear and rubber deposits are considered. F.R.L.

A73-25210 Computerised departure control. D. McIlwain. *Airport Forum*, Mar. 1973, p. 115-118, 120-122. In English and German.

A control system is described which has been designed from first principles, both hardware and software, for stand-alone application in airports throughout the world. The system is known as LOPAC (Load Optimization and Passenger Acceptance Control). As a system it offers a versatile range of hardware and software options covering 150 different airport and airline transactions, and virtually all permutations and combinations of departure control routines. The emphasis can vary from one country to another: visas, vaccination, interflight transit, security, etc. LOPAC is considered to be the definitive departure control system for airports checking in up to 2000 passengers an hour over the coming decades, and at a very moderate price. F.R.L.

A73-25288 # Composite inorganic material for aircraft radomes (Matériau inorganique composite pour radomes d'avions). J. Meneret and B. Spite (Desmarquest, S.A., Sèvres, Hauts-de-Seine, France). In: International Conference on Electromagnetic Windows, 2nd, Paris, France, September 8-10, 1971, Proceedings, Volume 2. Paris, Direction Technique des Constructions Navales, 1972, p. 333-340. In French.

An attempt has been made to develop a new type of material which is less brittle than oxides, silicates, cordierite, or vitro-crystalline products. This material consists essentially of an inorganic matrix very strongly reinforced by refractory fibers. The fabrication characteristics and the final properties of the products obtained are outlined, and their limitations are discussed. Glass and silica fibers are evaluated. Silica fibers have the property of maintaining mechanical strength at high temperature, and hence are preferable to glass fibers. The composite material described makes it possible to produce light, nonbrittle radomes which can be used up to 400 or 500 C. F.R.L.

A73-25291 # Materials for Mach 3 aircraft radomes (Matériaux pour radomes d'avions Mach 3). M. Gastinel (Société Nationale Industrielle Aérospatiale, Courbevoie, Hauts-de-Seine, France). In: International Conference on Electromagnetic Windows, 2nd, Paris, France, September 8-10, 1971, Proceedings, Volume 2. Paris, Direction Technique des Constructions Navales, 1972, p. 371-385. In French.

It is shown that there are two classes of materials capable of withstanding the thermal conditions imposed on a Mach 3 aircraft radome. These are the polybenzimidazoles, and the polyimides and the polyamides-imides. The polyamides-imides are compatible with usual fabrication methods if average mechanical characteristics are acceptable. Several rules have been formulated in an attempt to aid in the choice of optimum cycles. With the help of some simple examples, chosen from tests carried out, the sensitivity of these materials to technological parameters is shown. F.R.L.

A73-25296 # The test rails - Methods of simulation of rain erosion (Les rails d'essais - Moyens de simulation de l'érosion à la pluie). M. Moutier (Direction des Recherches et Moyens d'Essais; Service des Equipements de Champs de Tir, Arcueil; Val-de-Marne, France). In: International Conference on Electromagnetic Windows, 2nd, Paris, France, September 8-10, 1971, Proceedings, Volume 2. Paris, Direction Technique des Constructions Navales, 1972, p. 455-461. In French.

The possibilities offered by test rails for the study of rain erosion phenomena on aircraft or missile structures are discussed. The simulation rail makes use of the sliding of a vehicle on one or several linear rails crossing the rain zone obtained from a row of sprinklers. With the rail testing arrangement it is possible to carry out studies at velocities which cannot be attained by other methods, and to exceed the scope of the laboratory when testing actual components. Another advantage is that the test object can be recovered.

F.R.L.

A73-25297 # Environmental problems for airliner radomes (Problemes d'environnement pour radomes d'avions de ligne). G. Jubé (Société Nationale Industrielle Aérospatiale, Courbevoie, Hauts-de-Seine, France). In: International Conference on Electromagnetic Windows, 2nd, Paris, France, September 8-10, 1971, Proceedings, Volume 2. Paris, Direction Technique des Constructions Navales, 1972, p. 463-469. In French.

The meteorological radome, which now equips all airliners, has inherited, thanks to speed increases, all the difficulties reserved up to now for military aircraft. Structural radome types include the honeycomb core, or a core material constructed by juxtaposition of laminated rectangular section tubes, or the one-piece radome. Erosion by atmospheric precipitation, water penetration, icing, bird and stone impact, and lightning are discussed. A certain amount of improvement can be effected by better materials, but the need for a means of protection remains.

F.R.L.

A73-25300 # The radome situation in Sweden - State of technology. B. Thylen (Trelleborgplast A.B., Ljungby, Sweden). In: International Conference on Electromagnetic Windows, 2nd, Paris, France, September 8-10, 1971, Proceedings, Volume 2. Paris, Direction Technique des Constructions Navales, 1972, p. 505-510.

The most important radomes are the nose type used for military aircraft. All were of solid half-wavelength design except one which was a sandwich radome. The Viggen radome has a shape which is a good compromise electrically and aerodynamically. The only radome material used in Sweden so far is glass fiber reinforced plastics. The hand lay-up method for radome manufacturing is in general use and has been improved. For optimizing radomes the combined powers of man and computer are used. Measuring techniques are described and evaluated.

F.R.L.

A73-25301 # Radome technology in France (La technologie des radomes en France). C. Bonami (Direction des Constructions et Armes Navales, Cuers, Var, France). In: International Conference on Electromagnetic Windows, 2nd, Paris, France, September 8-10, 1971, Proceedings, Volume 2. Paris, Direction Technique des Constructions Navales, 1972, p. 511-521. In French.

Theoretical and experimental studies have been carried out on dielectric materials with periodic metallic inclusions. Calculations of the radiation diagram of a radome-antenna assembly were made, as well as calculations making it possible to determine the law of true illumination of an antenna when its radiation diagram is known. Computer programming of the calculation of the transmission and the angular aberrations of a radome was carried out. Aircraft and missile radomes are discussed, and tests on radomes involving mechanical and thermal factors, deicing, and erosion in rain and in wind tunnels are reviewed.

F.R.L.

A73-25348 Calculation of the potential flow past axisymmetric annular profiles (Berechnung der Potentialströmung um rotationssymmetrische Ringprofile). W. Geissler (Aerodynamische Versuchsanstalt, Göttingen, West Germany). *Zeitschrift für Flugwissenschaften*, vol. 21, Jan. 1973, p. 16-21. 9 refs. In German.

Methods for calculating the potential flow around axisymmetric annular profiles by means of the singularity method are presented. In contrast to linearized methods operating with singularity distributions on a cylindrical substitute body, the source and vortex

distributions are attached to the curved profile surface. The first as well as the second main problems of the airfoil theory for annular profile camber lines and thick annular profiles are solved. The solution of the second main problem for thick annular profiles (axially parallel free stream) is compared with measurement results.

(Author)

A73-25349 The effect of servomechanical control and stability systems on the flutter behavior of aircraft (Einfluss servomechanischer Steuerungs- und Stabilitätssysteme auf das Flatterverhalten von Flugzeugen). H. Försching (Aerodynamische Versuchsanstalt, Göttingen, West Germany). *Zeitschrift für Flugwissenschaften*, vol. 21, Jan. 1973, p. 22-31. 8 refs. In German.

A73-25383 # Test and evaluation of a quiet helicopter configuration HH-43B. M. A. Bowes (Kaman Aerospace Corp., Bloomfield, Conn.). *Acoustical Society of America, Fall Meeting, 84th, Miami Beach, Fla., Nov. 28-Dec. 1, 1972, Paper. 44 p. 9 refs.* Grant No. DAAJ02-70-C-0004. ARPA Order 1322.

A series of noise control modifications was made to the HH-43B helicopter. The objective of these modifications was attainment of a 50% reduction in forward flight (flyover), octave band sound pressure level signature. Additionally, the effect of each modification was to be evaluated through direct comparison of the acoustic signatures of modified and unmodified configurations. Modifications were made to the aircraft engine, drive and rotor systems, resulting in substantial reductions in the helicopter noise signature. 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.

(Author)

A73-25385 # A comparative study of augmentor wing, ejector nozzle and power jet flap low noise STOL concepts. J. V. O'Keefe; T. B. Nickson, and H. C. True (Boeing Co., Seattle, Wash.). *Acoustical Society of America, Fall Meeting, 84th, Miami Beach, Fla., Nov. 28-Dec. 1, 1972, Paper. 19 p.*

A noise and performance comparison of these STOL airplane configurations is summarized. Aircraft were sized for a 2000-ft take-off field length, 150 passengers, and a STOL range of 500 miles. A discussion of thrust augmentation ratios, airplane thumbprint sizing, thrust requirements, thrust lapse rates, static test configurations, 500-ft S.L. noise comparisons, and noise footprints are presented for each concept.

(Author)

A73-25386 # Reduction of noise generated by flow of fluid over plate. B. Pinkel and T. D. Scharton (Bolt Beranek and Newman, Inc., Canoga Park, Calif.). *Acoustical Society of America, Fall Meeting, 84th, Miami Beach, Fla., Nov. 28-Dec. 1, 1972, Paper. 9 p.*

Description of a method for reducing the noise generated by a fluid flowing at subsonic velocity over a plate. The noise reduction is accomplished through interposition of a secondary fluid layer at the trailing edge of the plate between the primary flow and the plate. This concept may prove useful for reducing the noise of STOL aircraft.

M.V.E.

A73-25387 # Optimal and preferred listening levels for speech in aircraft acoustical environments. R. M. Robertson and C. E. Williams (U.S. Naval Aerospace Medical Research Laboratory, Pensacola, Fla.). *Acoustical Society of America, Fall Meeting, 84th, Miami Beach, Fla., Nov. 28-Dec. 1, 1972, Paper. 6 p.*

A73-25417 # Design and manufacture of structure components made of fiber-reinforced materials (Konstruktion und Herstellung von Bauteilen aus faserverstärkten Werkstoffen). H. Leis (Messerschmitt-Bölkow-Blöhm GmbH, Ottobrunn, West Germany). In: Composite materials; Meeting, 2nd, Konstanz, West Germany, March 15, 16, 1972, Technical Reports. Oberursel, West Germany, Deutsche Gesellschaft für Metalikunde, 1972, p. 320-337. In German.

Description of a filament-reinforcement optimized design and fabrication of horizontal tail surface airframe components using a boron-filament reinforced aluminum composite material. The cost-conscious design and fabrication development method is shown to result in a risk minimization for the composite-material based manufacture of large structural components. Filament reinforcement is applied only to areas where high concentrations of lines of force occur under service loads. M.V.E.

A73-25434 Higher order numerical solution of the integral equation for the two-dimensional Neumann problem. J. L. Hess (Douglas Aircraft Co., Long Beach, Calif.). *Computer Methods in Applied Mechanics and Engineering*, vol. 2, Feb. 1973, p. 1-15, 10 refs. Research supported by the Douglas Independent Research and Development Program.

Interest in the problem of two-dimensional potential flow in arbitrary multiply-connected domains has been stimulated by the need to calculate flow about multiple airfoil configurations consisting of slats and flaps detached from the main airfoil. General methods of solution are based on the use of a singularity distribution over the boundary. The distribution is obtained as the solution of an integral equation over the boundary. This paper systematically investigates the effectiveness of higher order approximations of the integral equation, including use of curved surface elements and parabolically-varying singularity. It is found that the approach using flat elements with constant singularity is mathematically consistent as is the next higher-order approach with parabolic elements and linearly varying singularity. The popular approach based on flat elements with linearly varying singularity is shown to be mathematically inconsistent, and examples are presented for which the effect of element curvature is greater than that of the singularity derivative. (Author)

A73-25440 Display for aircraft landing at a steep angle (Display für Steilländer). R. Beyer (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Flugführung, Braunschweig, West Germany). *DFVLR-Nachrichten*, Mar. 1973, p. 382; 383. In German.

A device for providing the information needed for the supervision of an automatically controlled aircraft with significantly reduced take-off and landing space requirements has been developed. The qualifications of a number of display designs were evaluated with the aid of a computer-controlled display simulator. The device developed consists of three parts, including the profile display, the attitude indicator, and the horizontal situation indicator. G.R.

A73-25478 * # Design oriented structural analysis. O. O. Storaasli and J. Sobieszcanski (NASA, Langley Research Center, Hampton, Va.). *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 14th, Williamsburg, Va., Mar. 20-22, 1973, AIAA Paper 73-338*. 9 p. 8 refs. Members, \$1.50; nonmembers, \$2.00.

Recent developments in computer-aided structural design indicate a need for computerized structural analysis techniques which are efficient for the repetitive analysis of large complex structures undergoing design modifications. This paper describes such a technique based on a Taylor series approach. Results are presented for an idealized aircraft fuselage midsection to demonstrate the efficiency and accuracy of the technique. The results show that satisfactory analyses of modified structures may be obtained with the proposed technique, even for large changes in member sizes, for only a small fraction of the computational cost of a full reanalysis. (Author)

A73-25490 * # Application of computer-aided aircraft design in a multidisciplinary environment. R. E. Fulton, J. Sobieszcanski, O. Storaasli, E. J. Landrum (NASA, Langley Research Center, Hampton, Va.), and D. Loendorf (U.S. Army, Air Mobility Research

and Development Laboratory, Hampton, Va.). *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 14th, Williamsburg, Va., Mar. 20-22, 1973, AIAA Paper 73-353*. 10 p. 15 refs. Members, \$1.50; nonmembers, \$2.00.

Applications of a multidisciplinary system of computer programs to selected analytical and optimization problems encountered in an aircraft design are described. The depth of the analyses, and optimizations permits such detailed output as individual stringer sizes and pressure distributions. Data flow from one program to another is performed in a hands-off manner in the modular and open-ended system. Numerical examples show how this automation permits multidisciplinary trade-off studies, typical of a preliminary design process to be based on such a level of detail in each discipline that normally would not be available at this stage of the process. (Author)

A73-25493 # Reliability and quality control of production engineering computer programs. S. D. Hansen and Q. D. McHarg (Boeing Commercial Airplane Co., Seattle, Wash.). *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 14th, Williamsburg, Va., Mar. 20-22, 1973, AIAA Paper 73-356*. 10 p. Members, \$1.50, nonmembers, \$2.00

Action taken by an aircraft engineering organization to improve the quality and reliability of its technical software is described. Before and after comparisons are given to illustrate that the quality and reliability were improved to where engineers no longer considered them to be a major factor in task planning and the expenditure of programming time for 'fire drills' during production use was reduced to a negligible amount. The action taken was administrative rather than technical. It was, however based upon general procedures for control and communication that can be adapted by other engineering organizations for the same purpose. (Author)

A73-25506 # Preliminary design of aircraft structures to meet structural integrity requirements. J. C. Ekvall, T. R. Brussat, A. F. Liu (Lockheed-California Co., Burbank, Calif.), and M. Creager. *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 14th, Williamsburg, Va., Mar. 20-22, 1973, AIAA Paper 73-374*. 10 p. 6 refs. Members, \$1.50; nonmembers, \$2.00. Contract No. F33615-71-1324.

A sample preliminary design analysis is presented illustrating the systematic use of fracture mechanics analysis procedures for sizing aircraft structure to be durable and damage tolerant. A set of damage tolerance design criteria are stipulated, which augment the traditional static and fatigue requirements, to minimize the occurrence of major structural failures in service due to the growth of undetected flaws or cracks. These structural integrity requirements are imposed in a preliminary design analysis for the lower wing surface of a typical fighter/attack aircraft, and the impact of the damage tolerance criteria on design stress and weight is evaluated. (Author)

A73-25514 # X2048, a high strength, high toughness alloy for aircraft applications. S. A. Levy, R. E. Zinkham, and G. E. Spangler (Reynolds Metals Co., Richmond, Va.). *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 14th, Williamsburg, Va., Mar. 20-22, 1973, AIAA Paper 73-385*. 7 p. Members, \$1.50; nonmembers, \$2.00.

X2048 is an alloy which retains all of the desirable properties of 2024 or 2124-T851, but exhibits fracture toughness equal to or greater than 2219-T851. Testing of three inch thick plant-produced plate has shown that the strength corrosion resistance, fatigue resistance, and elevated temperature stability of 2X24-T851 are maintained. Through control of chemistry and processing, the level of brittle second phase particles is substantially reduced for the new alloy. Short transverse elongations as high as 8% have been obtained for X2048. (Author)

A73-25518 # Structural optimization for aeroelastic requirements. S. Pines (Analytical Mechanics Associates, Inc., Jericho, N.Y.) and M. Newman (Israel Aircraft Industries, Ltd., Lydda Airport,

Israel). *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 14th, Williamsburg, Va., Mar. 20-22, 1973, AIAA Paper 73-389.* 12 p. 15 refs. Members, \$1.50; nonmembers, \$2.00.

In carrying out aeroelastic structural optimization analyses, the use of fixed vibration mode shapes proves inconvenient since variations in weight and speed result in changing modes. A method is presented for determining the aeroelastic structural modal shapes as a function of mass distribution, structural stiffness, and aerodynamic forces. The optimality condition is the minimum weight distribution, which satisfies given structural strength constraints and precludes the onset of flutter over the airplane speed-altitude domain. Modern finite element and displacement methods are used to describe the aeroelastic equations of motion in matrix form. Aerodynamic forces are given in lift distribution versus displacement matrix form and modal shapes are the solution of a matrix eigenvalue problem. The onset of flutter is that point at which diagonalization proves unattainable. (Author)

A73-25519 # Gradient optimization of structural weight for specified flutter speed. E. E. Simodynes (General Dynamics Corp., Convair Aerospace Div., Fort Worth, Tex.). *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 14th, Williamsburg, Va., Mar. 20-22, 1973, AIAA Paper 73-390.* 7 p. 10 refs. Members, \$1.50; nonmembers, \$2.00.

A method for optimizing structures to satisfy flutter requirements is presented. The specific algorithm employs a gradient of total weight with respect to variable structural parameters as the specified flutter speed remains constant. Equations are presented for direct calculation of the gradient. In applications thus far, the method has been efficient in reducing structural weight while retaining flutter speed without frequent recalculation of normal modes of vibration. An all-movable horizontal tail application is cited in which the skin alone and then the entire structure is resized. Applications using 2 and 6 modes of vibration are also compared. (Author)

A73-25520 # A general method for flutter optimization. L. B. Gwin (Stanford University, Stanford, Calif.) and R. F. Taylor (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 14th, Williamsburg, Va., Mar. 20-22, 1973, AIAA Paper 73-391.* 7 p. 9 refs. Members, \$1.50; nonmembers, \$2.00. Contracts No. F33615-70-C-1282; No. F33615-72-C-1275.

A numerical procedure is presented for determination of optimal member sizes of aircraft structural components such that weight is minimized subject to a specified lower bound on flutter speed. The method has been devised to utilize the most general and accurate of current analytical flutter prediction methods so that substructures of arbitrary aerodynamic and structural complexity can be efficiently synthesized with substantial numbers of design parameters. Expressions for first order flutter derivatives are developed for driving a gradient based mathematical program. Application to a sample problem of just two design variables is used to illustrate the method and the optimization of a larger problem is included to indicate favorable operational efficiency. (Author)

A73-25521 # Incremented flutter analysis. R. F. O'Connell (Lockheed-California Co., Burbank, Calif.). *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 14th, Williamsburg, Va., Mar. 20-22, 1973, AIAA Paper 73-392.* 7 p. 5 refs. Members, \$1.50; nonmembers, \$2.00.

A method is presented to determine the magnitude of any particular increment (mass, stiffness, damping, etc.) necessary to satisfy prescribed flutter constraints. A reduced-order eigenvalue problem is formulated from the basic flutter equations, and the required increment is determined to the degree of accuracy inherent in the basic flutter equations. Application of the procedure to the evaluation of flutter with external stores is presented, as well as a simplified stiffness optimization procedure. Use of the method in an interactive (computer graphics) mode is described. (Author)

A73-25522 * # An automated procedure for computing flutter eigenvalues. R. N. Desmarais and R. M. Bennett (NASA, Langley Research Center, Loads Div., Hampton, Va.). *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 14th, Williamsburg, Va., Mar. 20-22, 1973, AIAA Paper 73-393.* 8 p. Members, \$1.50; nonmembers, \$2.00.

A new, fast and economical automated procedure for implementing the traditional V-g method of flutter solution is described. The procedure requires as input the generalized aerodynamic forces for a range of reduced frequencies obtained from an aerodynamic program. These aerodynamic forces are interpolated with respect to reduced frequency using a newly developed, partially tabulated cubic spline that is both fast in execution and economical in storage. The flutter solution is then obtained using an eigenvalue routine that has been developed to take advantage of the parametric nature of the V-g type of solution. Furthermore, the routine takes care of the fundamental and troublesome problem of properly sorting the output eigenvalues. By solving the root-sorting problem, the interpolation for flutter crossings and automatic plotting are accomplished efficiently. The computational techniques used in this new program are described and some sample results are given. (Author)

A73-25523 * # Parametric studies of the wing flutter behavior of a STOL transport. A. C. Kyser and C. M. Willis (NASA, Langley Research Center, Hampton, Va.). *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 14th, Williamsburg, Va., Mar. 20-22, 1973, AIAA Paper 73-394.* 10 p. Members, \$1.50; nonmembers, \$2.00.

A computer study was conducted to evaluate the effects of variations in the principal structural parameters on the wing flutter behavior of a four-engine STOL transport configuration having relatively low inplane wing stiffness and heavy engines. The wing structure was represented by a finite-element model which included the coupling between inplane and out-of-plane motion of the wing induced by the offset engine masses. The parameters which were varied were engine mass, pylon stiffness, and the inplane stiffness of the wing. It was found that the value of inplane stiffness for best flutter performance lies substantially below the range encountered in conventional designs. For engine weights in the medium-to-heavy range, the best inplane stiffness provided a dramatic improvement in flutter performance over that for infinite inplane stiffness, while for the lightest engines the improvement was moderate. (Author)

A73-25526 # Static aeroelasticity and the flying wing. T. A. Weisshaar (Maryland, University, College Park, Md.) and H. Ashley. *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 14th, Williamsburg, Va., Mar. 20-22, 1973, AIAA Paper 73-397.* 11 p. 14 refs. Members, \$1.50; nonmembers, \$2.00. Contract No. F44620-68-C-0036.

This paper demonstrates, by means of elementary examples, certain features of flying wing static aeroelasticity. Prominent among these are the influence of trimming control surfaces on wing divergence. Models are formulated using elementary beam-rod differential equations and aerodynamic strip theory. Divergence of an unswept wing, rolling freely about a pinned shaft, is discussed. The resulting torsional divergence speed is over eight times that of a nonrolling wing of half the span, clamped at the root. If the rolling velocity of the full wing is trimmed by elevons, antisymmetrical divergence may occur at a speed lower than the classical torsional divergence speed. The case of a wing trimmed in roll by 30% Fowler flaps is presented. A similar elementary analysis of an oblique or yawed wing free to roll about a pinned shaft parallel to an airstream and trimmed in roll is also presented. (Author)

A73-25532 * # Analysis of stall flutter of a helicopter rotor blade. P. Crimi (Avco Corp., Avco Systems Div., Wilmington, Mass.). *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 14th, Williamsburg, Va., Mar. 20-22, 1973, AIAA Paper 73-403.* 12 p. 14 refs. Members, \$1.50; nonmembers, \$2.00. Army-sponsored research; Contract No. NAS1-11378.

A study of rotor blade aeroelastic stability was carried out, using an analytic model of a two-dimensional airfoil undergoing dynamic stall and on elastomechanical representation including flapping, flapwise bending and torsional degrees of freedom. Results for a hovering rotor demonstrated that the models used are capable of reproducing both classical and stall flutter. The minimum rotor speed for the occurrence of stall flutter in hover was found to be determined from coupling between torsion and flapping. Instabilities analogous to both classical and stall flutter were found to occur in forward flight. However, the large stall-related torsional oscillations which commonly limit aircraft forward speed appear to be the response to rapid changes in aerodynamic moment which accompany stall and unstall, rather than the result of an aeroelastic instability

(Author)

A73-25533 * # Sensitivity of rotor blade vibration characteristics to torsional oscillations. T. Bratanow and A. Ecer (Wisconsin, University, Milwaukee, Wis.). *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 14th, Williamsburg, Va., Mar. 20-22, 1973, AIAA Paper 73-404*. 13 p. Members, \$1.50; nonmembers, \$2.00 Grant No. NGR-50-007-001.

A theoretical investigation of dynamic response characteristics of helicopter rotor blades in forward flight was carried out with special emphasis on the torsional degrees-of-freedom. The finite element method was applied in the formulation of the coupled equations of motion for flapwise bending and torsion for blades with non-collinear elastic, mass and aerodynamic axes. The sensitivity of blade vibration characteristics with respect to structural, geometric and aerodynamic properties as well as flight conditions was evaluated. Numerical results for sample blades were plotted to show the variation of the coupling between bending and torsional components of the response.

(Author)

A73-25534 # Stability of elastic bending and torsion of uniform cantilevered rotor blades in hover. D. H. Hodges and R. A. Ormiston (U.S. Army, Air Mobility Research and Development Laboratory, Moffett Field, Calif.). *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 14th, Williamsburg, Va., Mar. 20-22, 1973, AIAA Paper 73-405*. 18 p. 22 refs. Members, \$1.50; nonmembers, \$2.00

Nonlinear partial differential equations for elastic flap bending, lead-lag bending, and torsion of cantilevered helicopter rotor blades are presented, and used for linearized stability analyses in hover. Untwisted rotor blades with uniform properties exhibit significant instabilities for positive pre-cone or low torsional stiffness. Torsional deflections were found to be stabilizing for configurations without pre-cone. For moderate torsional frequencies, torsional dynamics are negligible compared to the structural bending-torsion coupling, and the problem can be reduced to a modified flap-lag system. Flap-lag elastic coupling is stabilizing for uniform blades and stability is sensitive to the number of elastic modes retained in the analyses

(Author)

A73-25535 # The spatial correlation method and a time-varying flexible structure. F. Y. M. Wan (MIT, Cambridge, Mass.) and C. Lakshminathan (U.S. Army, Army Materials and Mechanics Research Center, Watertown, Mass.). *AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 14th, Williamsburg, Va., Mar. 20-22, 1973, AIAA Paper 73-406*. 8 p. 15 refs. Members, \$1.50; nonmembers, \$2.00.

The determination of statistics of the dynamic response of flexible lifting rotors to random excitation is complicated by the fact that the structural properties of the rotor blade vary with time. For this and other complex deformable structures, available methods of analysis are either inapplicable or impractical. A new method was developed recently to obtain the second order statistics of the response of such structures. The present paper applies this new spatial correlation method to study the transverse flexural motion of a flexible rotor blade under random excitations. The results of this study allow us to assess the adequacy of available rigid blade solutions for random loading uniform along the blade span, and the effect of a spatial variation of the random excitation.

(Author)

A73-25539 * # Dynamic effects of shock-induced flow separation. L. E. Ericsson (Lockheed Missiles and Space Co., Inc., Sunnyvale, Calif.). *American Institute of Aeronautics and Astronautics, Dynamics Specialists Conference, Williamsburg, Va., Mar. 19, 20, 1973, Paper 73-308*. 12 p. 37 refs. Members, \$1.50; nonmembers, \$2.00. Contracts No. NAS8-11238, No. NAS8-20354; No. NAS9-11445; No. NAS1-6450; No. NAS1-7999, No. NAS1-9987.

Shock-induced flow separation is the flow mechanism usually responsible for what the structural dynamicist terms 'buffet.' The shock-induced flow separation affects the aeroelastic response via two different mechanisms: (1) the flow separation generates fluctuating pressures, i.e., a forcing function that is independent of the motion of the aerodynamic surface, e.g., an aircraft wing, and (2) the flow separation affects the motion-dependent forces and can in some cases generate negative aerodynamic damping. A simple analysis is presented which, using static experimental data as an input, can predict these two buffet-components for a wing in high Mach number subsonic flow.

(Author)

A73-25540 # An exploratory investigation of the unsteady aerodynamic response of a two-dimensional airfoil at high reduced frequency. G. L. Commerford and F. O. Carta (United Aircraft Research Laboratories, East Hartford, Conn.). *American Institute of Aeronautics and Astronautics, Dynamics Specialists Conference, Williamsburg, Va., Mar. 19, 20, 1973, Paper 73-309*. 13 p. 19 refs. Members, \$1.50; nonmembers, \$2.00.

A73-25542 # Buffeting pressures on a swept wing in transonic flight - Comparison of model and full scale measurements. C. E. Lemley and R. E. Mullans (McDonnell Aircraft Co., St. Louis, Mo.). *American Institute of Aeronautics and Astronautics, Dynamics Specialists Conference, Williamsburg, Va., Mar. 19, 20, 1973, Paper 73-311*. 6 p. 9 refs. Members, \$1.50; nonmembers, \$2.00. Contract No. F33615-70-C-1272.

A73-25544 * # Unsteady subsonic compressible flow around finite thickness wings. L. Morino and C.-C. Kuo (Boston University, Boston, Mass.). *American Institute of Aeronautics and Astronautics, Dynamics Specialists Conference, Williamsburg, Va., Mar. 19, 20, 1973, Paper 73-313*. 8 p. 19 refs. Members, \$1.50; nonmembers, \$2.00. Grant No. NGR-22-004-030.

A general formulation for the unsteady subsonic compressible potential flow around aircraft having arbitrary configurations is presented. An integral representation of the velocity potential is obtained. From this a linear integral equation relating the perturbation potential and its normal derivative (which is known from the boundary conditions) is derived. For the numerical solution of the integral equation, the surface of the aircraft is divided into small elements and the potential is assumed to be constant within each element. Numerical results are obtained for an oscillating finite-thickness wing and indicate good convergence and excellent agreement with existing lifting surface solutions.

(Author)

A73-25545 * # Flutter of pairs of aerodynamically interfering delta wings. R. R. Chipman, F. J. Rauch (Grumman Aerospace Corp., Bethpage, N.Y.), and R. W. Hess (NASA, Langley Research Center, Hampton, Va.). *American Institute of Aeronautics and Astronautics, Dynamics Specialists Conference, Williamsburg, Va., Mar. 19, 20, 1973, Paper 73-314*. 7 p. 5 refs. Members, \$1.50; nonmembers, \$2.00. Contract No. NAS1-10635-7.

To examine the effect on flutter of the aerodynamic interference between pairs of closely spaced delta wings, several structurally uncoupled 1/80th-scale models were studied by experiment and analysis. Flutter test boundaries obtained in NASA Langley's 26-in. transonic blowdown wind tunnel were compared with subsonic analytical results generated using the doublet lattice method. Trends for several combinations of vertical and longitudinal wing separation were determined, showing flutter speed significantly affected in the closely spaced configurations. A new flutter

mechanism coupling one wing's first bending mode with the other wing's first torsion mode was predicted and observed. (Author)

A73-25547 * # Calculation of unsteady transonic aerodynamics for oscillating wings with thickness. S. Y. Ruo, J. G. Theisen (Lockheed-Georgia Co., Advanced Flight Sciences Dept., Marietta, Ga.), and E. C. Yates, Jr. (NASA, Langley Research Center, Structures Div., Hampton, Va.). *American Institute of Aeronautics and Astronautics, Dynamics Specialists Conference, Williamsburg, Va., Mar. 19, 20, 1973, Paper 73-316.* 12 p 18 refs. Members, \$1.50; nonmembers, \$2.00. Contract No. NAS1-11156.

An analytical approach is presented to account for some of the nonlinear characteristics of the transonic flow equation for finite thickness wings undergoing harmonic oscillation at sonic flight speed in an inviscid, shock-free fluid. The thickness effect is accounted for in the analysis through use of the steady local Mach number distribution over the wing at its mean position by employing the local linearization concept and a coordinate transformation. Computed results are compared with that of the linearized theory and experiments. Application to a flutter problem is shown. (Author)

A73-25548 * # Development and applications of supersonic unsteady consistent aerodynamics for interfering parallel wings. K. Appa and G. C. C. Smith (Bell Aerospace Co., Buffalo, N.Y.). *American Institute of Aeronautics and Astronautics, Dynamics Specialists Conference, Williamsburg, Va., Mar. 19, 20, 1973, Paper 73-317.* 15 p. 25 refs. Members, \$1.50; nonmembers, \$2.00. Contract No. NAS1-10880.

A73-25549 # An investigation of unsteady aerodynamics on an oscillating airfoil. S. M. Batill (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio) and C. W. Ingram (Notre Dame, University, Notre Dame, Ind.). *American Institute of Aeronautics and Astronautics, Dynamics Specialists Conference, Williamsburg, Va., Mar. 19, 20, 1973, Paper 73-318.* 10 p. 14 refs. Members, \$1.50; nonmembers, \$2.00. USAF-supported research.

A technique is developed to experimentally determine the unsteady aerodynamic coefficients, based on classical derivative theory, for a rigid airfoil section. The method is an iterative numerical technique which fits numerically integrated solutions of the airfoil section's coupled differential equations of motion to position versus time free response data. Results are presented for computer simulated response data, and subsonic experimental data in the subcritical and flutter regimes. A subsonic smoke flow visualization study is presented for the subcritical and flutter phenomena. Results indicate it is possible to evaluate the unsteady aerodynamic force system through an indirect measurement technique. (Author)

A73-25552 # Active flutter suppression - B-52 controls configured vehicle. G. E. Hodges (Boeing Co., Wichita, Kan.). *American Institute of Aeronautics and Astronautics, Dynamics Specialists Conference, Williamsburg, Va., Mar. 19, 20, 1973, Paper 73-322.* 6 p. Members, \$1.50; nonmembers, \$2.00. Contract No. F33615-71-C-1926.

Review of the system synthesis and airplane implementation approach to B-52 Flutter Mode Control (FMC), based on recent mathematical modeling and flight-control technology advances that make possible flutter suppression at significantly lesser weight and performance penalties than in the past. The FMC system utilizes dual flaperon and aileron control surfaces to suppress a 2.4 Hz symmetric wing flutter problem. The conducted analysis, synthesis, and hardware implementation studies are summarized. The FMC system will be implemented and flight tested during 1973. M.V.E.

A73-25553 * # Design and evaluation of miniature control surface actuation systems for aeroelastic models. G. E. Bergmann and F. D. Severt (Boeing Co., Wichita, Kan.). *American Institute of*

Aeronautics and Astronautics, Dynamics Specialists Conference, Williamsburg, Va., Mar. 19, 20, 1973, Paper 73-323. 7 p. Members, \$1.50; nonmembers, \$2.00. Research sponsored by the Boeing Co. and NASA.

A73-25554 # Phenomenological approach to low-cycle fatigue fracture of a typical aircraft full scale component static test. P. M. Toor (Lockheed-Georgia Co., Marietta, Ga.). *American Institute of Aeronautics and Astronautics, Dynamics Specialists Conference, Williamsburg, Va., Mar. 19, 20, 1973, Paper 73-324.* 8 p. 18 refs. Members, \$1.50; nonmembers, \$2.00.

A73-25557 * # Vibration and local edge buckling of thermally stressed, wedge airfoil cantilever wings. C. D. Bailey (Ohio State University, Columbus, Ohio). *American Institute of Aeronautics and Astronautics, Dynamics Specialists Conference, Williamsburg, Va., Mar. 19, 20, 1973, Paper 73-327.* 8 p. Members, \$1.50; nonmembers, \$2.00. Grant No. NGL-36-008-109.

The local edge buckling phenomena that can occur along the heated thin edge of a wedge shape airfoil is calculated. Qualitative comparison (qualitative only because the experimental temperature distribution was not measured) is made to the experimentally observed phenomena. The consequences of the assumption of identical vibration and buckling modes is shown by a comparison of results with and without the assumption of mode identity. Computer plots of the elastic surface as local buckling develops with increasing temperature are shown. The calculated, fully developed local edge buckling is compared to a photograph of a fully developed buckling as observed in the laboratory. (Author)

A73-25558 # The theoretical and experimental methods used in France for flutter prediction. R. Dat (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *American Institute of Aeronautics and Astronautics, Dynamics Specialists Conference, Williamsburg, Va., Mar. 19, 20, 1973, Paper 73-329.* 14 p 29 refs. Members, \$1.50, nonmembers, \$2.00.

A73-25559 # Flutter technology in the United Kingdom - A survey. J. C. A. Baldock and C W Skingle (Royal Aircraft Establishment, Farnborough, Hants., England). *American Institute of Aeronautics and Astronautics, Dynamics Specialists Conference, Williamsburg, Va., Mar. 19, 20, 1973, Paper 73-330.* 12 p. 29 refs. Members, \$1.50; nonmembers, \$2.00.

The status of analytical and experimental tools deployed in flutter investigation is described. The sources of structural and aerodynamic data are discussed. Flutter models are used mainly indirectly to check the validity of aerodynamic theories in the high subsonic, transonic and supersonic regions. Multipoint excitation in shake testing is usual, but the results are sometimes disappointing. In flight flutter testing, digital analysis methods are being developed, and these show promise of reducing scatter of results and reducing analysis time. Several features are highlighted. (Author)

A73-25560 # The state of the art in aeroelasticity of aerospace vehicles in Japan. S. Kobayashi (Tokyo, University, Tokyo, Japan). *American Institute of Aeronautics and Astronautics, Dynamics Specialists Conference, Williamsburg, Va., Mar. 19, 20, 1973, Paper 73-331.* 11 p. 72 refs. Members, \$1.50, nonmembers, \$2.00.

The present survey paper deals with research, published in the past decade, on aeroelastic problems related to mainly airplanes and sounding rockets developed in Japan. Topics selected are as follows; T-tail flutter, effect of pylon stiffness on flutter speed of wings, transonic flutter of swept-back wings, propeller-nacelle whirl flutter, aeroelastic divergence of sounding rockets, flutter of plate wings subjected to aerodynamic heating, aeroelastic instability of two dimensional panels in subsonic and transonic flow, supersonic panel

flutter of circular cylindrical shells, supersonic flutter of curved panels, supersonic flutter of stiffened panels, and flutter of helicopter rotor blades. (Author)

A73-25561 # European contribution to structural response to noise. B. L. Clarkson (Southampton, University, Southampton, England). *American Institute of Aeronautics and Astronautics, Dynamics Specialists Conference, Williamsburg, Va., Mar. 19, 20, 1973, Paper 73-332.* 11 p. 33 refs. Members, \$1.50; nonmembers, \$2.00.

The normal mode theory formulated by Powell has formed the framework for extensive theoretical and experimental studies of the important parameters in the response of structures to noise. The excitation forces have been defined by their cross spectral density and the predominant mode shapes in typical structures have been identified. Reduction in the response levels has been achieved by the addition of damping. An estimation method has been evolved for use in design and comparisons made with a range of experimental results. Recent developments of the wave propagation method offer the possibility of a better understanding of structural response to travelling pressure fields. (Author)

A73-25570 # International air traffic conventions: Air piracy - Concept, facts, protective measures (Internationale Luftfahrtabkommen: Luftpiraterie - Begriff, Tatbestände, Bekämpfung). A. Meyer (Köln, Universität, Cologne, West Germany). Cologne, Carl Heymanns Verlag KG (Institut für Luftrecht und Weltraumrechtsfragen, Schriftenreihe. Volume 6), 1972. 262 p. 54 refs. In German. \$11.82.

The concepts 'air piracy' and 'hijacking' are discussed together with some examples involving the seizure of aircraft by hijackers. Protective measures against the illegal seizure of aircraft, acts of sabotage, and armed attacks include actions on board of the aircraft, such as, for instance, the locking of the door to the cockpit and the presence of armed guards. Protective measures on the ground are connected with the search of passengers and their luggage for weapons and explosives. Strikes and boycotts are considered as economic measures for enforcing cooperation in the fight against air piracy. Steps concerning legal action against air piracy on an international and a national basis are discussed. G.R.

A73-25738 # Noise intensity in the field of subsonic turbulent jets (Intensivnost' shuma v pole dozvukovykh turbulentsnykh strui). L. M. Viaz'menskaia (Leningradskii Gosudarstvennyi Universitet, Leningrad, USSR). *Inzhenerno-Fizicheskii Zhurnal*, vol. 24, Feb. 1973, p. 282-289. 13 refs. In Russian.

The author's method (1971) is used in the calculation of the acoustic characteristics of subsonic turbulent jets on a digital computer in a study of noise levels in the turbulence field of such jets. Expressions are given for determining vortex regions, turbulence time scales, turbulent velocity pulsations, and acoustic levels in such jets and in their sections. The calculations cover Mach numbers below unity. Satisfactory agreement is obtained between calculated and experimental results at distances from jet boundaries exceeding 2 to 4 gauges. V.Z.

A73-25782 * # Performance characteristics of a model VTOL lift fan in crossflow. S. Lieblein, J. A. Yuska, and J. H. Diedrich (NASA, Lewis Research Center, Cleveland, Ohio). *Journal of Aircraft*, vol. 10, Mar. 1973, p. 131-136. 16 refs.

This paper presents a summary of principal results obtained from crossflow tests of a model 15-in.-diam lift fan installed in a wing in the NASA Lewis Research Center, 9 by 15 ft V/STOL Propulsion Wind Tunnel. Tests were run with and without exit louvers over a range of tunnel air speeds, fan speeds, and wing angle of attack. Fan thrust in crossflow was influenced by two principal factors: the effects of inflow distortion on blade-row performance, and changes in fan stage operating point brought about by changes in back pressure ratio. In this particular fan, flow separation on the

inlet bellmouth did not appear to be a serious problem for crossflow operation. (Author)

A73-25783 * # Some effects of bias errors in redundant flight control systems. R. F. Stengel (MIT, Cambridge, Mass.). *Journal of Aircraft*, vol. 10, Mar. 1973, p. 150-156. Contract No. NAS9-10268.

The controllability and steady-state response of parallel-redundant flight control systems are examined. It is found that state components which appear in the parallel signal paths, e.g., individual actuator-commands, are not controllable, although the sum of the command signals is well behaved. If the response modes associated with these components are not stable, bias errors can cause the components to diverge, leading to the possibility of nuisance trips in failure detection/isolation logic and eventual control system lockup (at saturation). Combining the inputs to the control computers assures that sensor bias will not cause divergence, while cross-strapping control strings bounds divergent response to all bias error inputs. (Author)

A73-25784 # Reduction of ILS errors caused by building reflections. R. N. Ghose (American Nucleonics Corp., Woodland Hills, Calif.). *Journal of Aircraft*, vol. 10, Mar. 1973, p. 167-171. FAA-sponsored research.

An analysis of a concept for reducing beam distortion effects of an Instrument Landing System caused by reflections from buildings and other structures and a scale-model experimental verification of the concept on the localizer part of ILS are discussed. The concept, however, is not restricted to the ILS localizer error correction only and can be extended to correct glide-slope error with a similar but additional correction arrangement. A high degree of correlation between the predicted and measured data on the nature of reduction of derogation effects of structures has been achieved. Practical means to obtain corrections for beam distortions which do not require any modification of the landing system transmitter or receiver and which do not introduce any additional beam distortion problems are discussed in this paper. (Author)

A73-25785 * # Mountain waves and CAT encountered by the XB-70 in the stratosphere. J. R. Scoggins (Texas A & M University, College Station, Tex.) and T. P. Incrocci (USAF, Washington, D.C.; Global Weather Central, Omaha, Neb.). *Journal of Aircraft*, vol. 10, Mar. 1973, p. 172-180. 20 refs. Grant No. NGR-44-001-081.

The data from 36 XB-70 flights conducted over the mountainous regions of the western United States together with rawinsonde data were used to investigate relationships between conditions favorable for mountain waves and clear air turbulence. Profiles for the Scorer parameter and the gradient Richardson number were evaluated from the rawinsonde data. The Scorer parameter and the gradient Richardson number profiles were computed on those days when the XB-70 flew, and these results compared to model profiles and related to the reported turbulence. Ascent rate profiles of rawinsonde balloons were analyzed from which the presence of mountain or lee waves was inferred. (Author)

A73-25786 # An optimal control approach to terminal area air traffic control. D. K. Schmidt and R. L. Swaim (Purdue University, West Lafayette, Ind.). *Journal of Aircraft*, vol. 10, Mar. 1973, p. 181-188. 17 refs.

In this investigation, the problem addressed is the specification of the curved approach paths and landing sequence for a group of aircraft desiring to land in a terminal area such that the terminal-area system performance is maximized. The multiple-aircraft problem includes the aspect of competition or cooperation between the vehicles by formulating the problem as a set of disconnected optimal trajectories. The flight paths are governed by kinematic equations of motion while in-flight and terminal-time separation inequality constraints between trajectories are imposed. The performance criterion for the system is the sum of the flight durations plus the

integrated weighted accelerations of the aircraft. The solution approach employs penalty functions for the treatment of the inequality constraints and is based on the steepest descent algorithm. A number of examples are presented which involve interactions between two and three aircraft. (Author)

A73-25787 # Wind shear payload support system. P. O. Jarvinen (Sanders Associates, Inc., Electro-Optics Div., Nashua, N.H.). *Journal of Aircraft*, vol. 10, Mar. 1973, p. 189, 190. 8 refs. Contract No. F33657-70-C-1052.

A technique is investigated for the support of small payloads in the atmosphere for long periods without internal sources of power by utilizing the extraneous energy source of wind shear. It is implemented by a system that employs two connected aerodynamic bodies which operate at different altitudes and extract energy from windshear to maintain the system in flight. Payloads of 50% or more of the total system weight are possible. M.V.E.

A73-25788 # Vibrations of an Euler beam with a system of discrete masses, springs, and dashpots. K. S. Raghavan and V. Sundararajan (Indian Institute of Technology, Kanpur, India). *Journal of Aircraft*, vol. 10, Mar. 1973, p. 190-192. 6 refs.

A73-25790 The Lynx's rotor system. W. E. Goff. *Flight International*, vol. 103, Mar. 15, 1973, p. 397-399.

Description of the design and materials features of the main rotor head, main rotor blade, and conformal main rotor drive system of the twin-engined Anglo-French Lynx helicopter. The rotor head is of semi-rigid design in which flexible elements, or arms, replace the flap and lag articulations of the conventional type of rotor. The principal elements are made of titanium forgings. The blade consists of a spar/leading edge, comprising preformed nested stainless-steel sections bonded together, with a trailing edge section of sandwich construction using fiberglass skins and a nylon honeycomb filler. Conformal gearing was used in the main rotor drive train to obtain greater load carrying capacity under requirements of low overall height of the helicopter. T.M.

A73-25795 # Horizontal stabilizer of the Iliushin-62 aircraft (Statecznik poziomy samolotu Il-62). S. Musiatowicz. *Technika Lotnicza i Astronautyczna*, vol. 28, Feb. 1973, p. 9-11. In Polish.

Description of the structural design and control mechanisms of the regulated horizontal stabilizer employed in the Iliushin-62 aircraft. Attention is given to special safety measures employed in the design of both the mounting hardware and the electrically driven servo mechanism. The indicators used to display angular deflection of the stabilizer are discussed. T.M.

A73-25796 # Analysis of the aerodynamic characteristics of wing-lift augmentation devices. II (Analiza charakterystyk aerodynamicznych urzadzen zwiekszajacych sile nosna skrzydla. II). R. Garncarek. *Technika Lotnicza i Astronautyczna*, vol. 28, Feb. 1973, p. 12-16, 41. In Polish.

A73-25797 # Utilization of the Doppler effect to measure the drift angle and the ground speed of an aircraft (Wykorzystanie zjawiska Dopplera do pomiaru kata znoszenia i predkosci podroznej samolotu). K. Kucharski and A. Feder. *Technika Lotnicza i Astronautyczna*, vol. 28, Feb. 1973, p. 23-29, 41. In Polish.

A73-25798 # Problems involving the shape of a supersonic aircraft (Problemy ksztaltu samolotu naddzwiekowego). A. Gryga and W. Kania. *Technika Lotnicza i Astronautyczna*, vol. 28, Feb. 1973, p. 30-33. 6 refs. In Polish.

A73-25803 Corrosion fatigue in the aerospace industry. B. Cohen (USAF, Wright-Patterson AFB, Ohio). In: Corrosion fatigue: Chemistry, mechanics and microstructure; Proceedings of the International Conference, Storrs, Conn., June 14-18, 1971.

Houston, Tex., National Association of Corrosion Engineers, 1972, p. 65-82; Discussion, p. 78, 82, 83.

Demonstration of typical corrosion fatigue induced failures which have occurred in various aerospace components. Corrosion fatigue is considered in various aluminum components, including a wing attachment spar, a helicopter rotor blade, an entrance door frame, a wing attachment forging, a landing gear outer cylinder, and a lower front wing spar, a propeller hub, and a compressor rotor, and in various steel components, including a compressor inducer, engine bearings, an engine shaft, and cables. A B.K.

A73-25826 Crack propagation of aluminum alloys in corrosive environments. W. E. Krupp, D. W. Hoepfner, and E. K. Walker (Lockheed-California Co., Burbank, Calif.). In: Corrosion fatigue: Chemistry, mechanics and microstructure; Proceedings of the International Conference, Storrs, Conn., June 14-18, 1971.

Houston, Tex., National Association of Corrosion Engineers, 1972, p. 468-483; Discussion, p. 482, 483. 40 refs. Research sponsored by the Lockheed-California Co.

Summary of crack propagation data developed in a continuing research program designed to quantify the response of aircraft structural alloys to cyclic loading. Experimental results are presented for 2024-T3, 7075-T6, and T76 aluminum alloys in dry air, wet air, and 3.5% NaCl. The relations of crack growth rate to cracking mode, stress ratio, cyclic frequency, and severity of environment are discussed together with fracture surface details. A model describing fatigue crack propagation is developed on the basis of these observations. T.M.

A73-25827 Stress corrosion fatigue of aluminum pressure cylinders. G. E. Nordmark, M. S. Hunter, and B. W. Lifka (Alcoa Research Laboratories, New Kensington, Pa.). In: Corrosion fatigue: Chemistry, mechanics and microstructure; Proceedings of the International Conference, Storrs, Conn., June 14-18, 1971.

Houston, Tex., National Association of Corrosion Engineers, 1972, p. 484-497; Discussion, p. 497, 498. 5 refs. Contract No. F33615-67-C-1922. AF Project 7381.

Description of an investigation undertaken to study the combined effects of stress corrosion and corrosion fatigue for cylinders under loading rates and exposure conditions appropriate for aircraft components. The results of fatigue tests of hydraulic cylinders of several high-strength aluminum alloys under internal pressure, in which alloy, temper, method of fabrication, stress, external environment, and frequency were variables, are cited. The tests performed include C-ring stress corrosion tests, static stress corrosion tests of cylinders, fatigue tests of cylinders in air, and stress corrosion fatigue tests of cylinders in simulated seacoast environment. It is found that stress corrosion cracking may occur under cyclic loading, especially at low frequencies, and that stress corrosion and fatigue can interact under certain conditions to produce failures in shorter times and fewer cycles than for either phenomenon alone. A.B.K.

A73-25837 Fretting fatigue in titanium helicopter components. M. J. Salkind and J. J. Lucas (United Aircraft Corp., Sikorsky Aircraft Div., Stratford, Conn.). In: Corrosion fatigue: Chemistry, mechanics and microstructure; Proceedings of the International Conference, Storrs, Conn., June 14-18, 1971.

Houston, Tex., National Association of Corrosion Engineers, 1972, p. 627-630; Discussion, p. 630. 11 refs.

A73-25838 Fretting resistant coatings for titanium alloys. D. W. Lum (McDonnell Aircraft Co., St. Louis, Mo.) and J. J. Crosby (USAF, Materials Laboratory, Wright-Patterson AFB, Ohio). In: Corrosion fatigue: Chemistry, mechanics and microstructure; Proceedings of the International Conference, Storrs, Conn., June 14-18, 1971.

Houston, Tex., National Association of Corrosion Engineers, 1972, p. 631-634; Discussion, p. 634. 11 refs.

tion of Corrosion Engineers, 1972, p. 631-641.

Review of a program of investigation of surface treatments and coatings for titanium to alleviate fretting fatigue. The program was divided into three tasks. Task 1 included an airframe joint survey to select those parameters which influence fretting damage, the definition of a test plan using these parameters, and fatigue tests on uncoated titanium (Ti-6Al-2Sn) to establish fretting conditions. Task 2 consisted of a survey of existing knowledge of titanium coatings, screening and mechanical-properties tests on candidate coatings, and the final selection of three coating systems for subsequent fretting-fatigue tests. Task 3 had the objective of evaluating the three coatings selected in Task 2, using the fretting specimen and parameters developed in Task 1. The ability of the coatings to prolong fatigue life by eliminating fretting damage was judged in comparison with Task 1 data.

A.B.K.

A73-25853 # A linearized potential flow theory for airfoils with spoilers. G. P. Brown and G. V. Parkinson (British Columbia, University, Vancouver, Canada). *Journal of Fluid Mechanics*, vol. 57, Mar. 6, 1973, p. 695-719. 15 refs. Defence Research Board of Canada Grant No. 9551-13.

Linearized two-dimensional potential flow theory is applied to an airfoil with an upper surface spoiler. The spoiler wake is modeled as a cavity of empirically given constant pressure, and a sequence of conformal transformations maps the linearized physical plane, with a slit on the real axis representing the airfoil plus cavity, onto the upper half of the plane exterior to the unit circle. The complex acceleration potential is used, and its real part is specified on the real axis, representing the cavity boundary, while its imaginary part is specified on the unit semicircle, representing the wetted surface of the airfoil and spoiler. Solutions are found for both the steady-state lift and the transient lift after spoiler actuation for airfoils of arbitrary camber, thickness and incidence, with and without a simple flap, and with spoilers of arbitrary position, height and angle.

(Author)

A73-25864 # Correction for change in fluid flow curvature about a lift-generating airfoil in a two-dimensional test section with perforated walls (Les corrections de changement de courbure des filets fluides autour d'une maquette de portance dans la veine bidimensionnelle à parois perforées). J. Benetka (Vyzkumny a Zkusebni Letecky Ustav, Prague, Czechoslovakia). *Zprava VZLU*, no. Z-18, 1972. 11 p. 6 refs. In French.

Derivations of angle-of-attack and aerodynamic-coefficient corrections are presented that provide the means for making due allowance for the effects of curvature changes in the fluid flow about a lift-generating airfoil induced by perforations in the walls of a two-dimensional, transonic wind tunnel. The magnitude of these corrections is of the same order as that of the correction allowing for the effects of downwash behind an airfoil. Experimental results corroborating the theoretical derivations are also presented.

M.V.E.

A73-26125 # Regional airport systems study: Final Plan. W. E. Gillfillan, C. Bastian, N. Jerrick, P. Spiegel, and R. Turner. Research supported by the U.S. Department of Housing and Urban Development. Berkeley, Calif., Association of Bay Area Governments, 1972. 264 p. 27 refs.

The plan for a regional airport system is presented and analyzed. The alternatives considered, the contributions from citizens and organizations, the policies and goals, and the decision criteria used in making the decision are reviewed. Key data, which include the modifications of the original work, and which can be used as a technical summary and reference, are examined.

V.P.

A73-26204 # First order effects of terrain on the radiation pattern of a non-directional LF beacon. R. H. Ott and J. R. Wait (NOAA, Institute for Telecommunication Sciences, Boulder, Colo.). *Archiv für Elektronik und Übertragungstechnik*, vol. 27, Mar. 1973, p. 106-110. 8 refs. FAA-supported research.

A73-26256 # Design and stability of airplanes and helicopters (Konstruktsiia i prochnost' samoletov i vertoletov). M. S. Voskoboinik, G. S. Lagosiuik, Iu. D. Milen'kii, K. D. Mirtov, D. P. Osokin, M. L. Skripka, V. S. Ushakov, and Zh. S. Chernenko. Moscow, Izdatel'stvo Transport, 1972. 440 p. 14 refs. In Russian.

The textbook outlines the step-by-step procedure of designing airplanes and helicopters for expected operational loads. Much attention is given to the selection of the proper wing (or rotor) configuration and the proper power plant, and to the solution of problems associated with the design and construction of aircraft and helicopter subsystems. Means of improving vibration stability, strength, reliability, lifetime, efficiency, and aeroelasticity are examined.

V.P.

A73-26257 # The protection of the air frontier in peace (Der Schutz der Luftgrenzen im Frieden). K. Hailbronner (Max-Planck-Institut für ausländisches öffentliches Recht und Völkerrecht, Heidelberg, West Germany). Cologne, Carl Heymanns Verlag KG (Beiträge zum ausländischen öffentlichen Recht und Völkerrecht, No. 58), 1972. 128 p. 575 refs. In German. \$8.60.

The protective measures of a state against the intrusion of foreign aircraft in the airspace of the state are discussed, giving attention to typical claims made by the states, the rights of the states according to international law and conventions, and the evolution of international regulations. Various incidents in which aircraft, airships, or balloons were found over the territory of a foreign nation are discussed together with protective measures planned against military aircraft with hostile intentions and steps taken against aircraft intruding into a foreign airspace as a result of an emergency. Attention is also given to the rights of states in the contiguous airspace above the seas, taking into account the establishment of air defense zones and the right of pursuit in the case of intruding foreign aircraft.

G.R.

A73-26269 # A description of the NAE T-33 turbulence research aircraft, instrumentation and data analysis. J. I. MacPherson (National Aeronautical Establishment, Ottawa, Canada). *Canada, National Research Council, Division of Mechanical Engineering and National Aeronautical Establishment, Quarterly Bulletin*, no. 4, 1972, p. 1-15, 17-31. 20 refs.

The instrumentation now being flown in the National Aeronautical Establishment T-33 turbulence research aircraft is described along with the complete data handling process, from its in-flight recording to the final plotted and tabulated results. The system is capable of measuring the three orthogonal components of true gust velocity, pilot control inputs, and the wind, temperature, and humidity fields through which the aircraft is flown. Estimates of the accuracy of the computed results are included.

(Author)

A73-26271 # Hydraulics for V/STOL aircraft. K. F. Beckér and L. H. Mathis (Sperry Rand Corp., Vickers Div., Detroit, Mich.). *Sperry Rand Corp., Aerospace Fluid Power Conference, 22nd, Troy, Mich., Oct. 30, 31, 1972, Paper*, 16 p.

Programs to develop integrated actuator packages (IAPs) for flight control in V/STOL aircraft have resulted in the development of a line of packages with many significant advantages. The IAP is defined as a class of flight control actuator wherein the complete hydraulic power supplies are integrated directly into the actuator. A 'Simplex' IAP is one wherein only the single prime mover and pumping element is applied to the control of a single piston ram configuration. It has been shown that IAPs can be successfully applied to the flight control system of transport aircraft, and that they offer a unique approach to the reduction of system weight, mechanical complexity, and power loss.

F.R.L.

A73-26272 # Advanced flight control systems - Power-by-wire and fly-by-wire. V. R. Schmitt and J. K. Ramage (USAF, Flight

Dynamics Laboratory, Wright-Patterson AFB, Ohio). *Sperry Rand Corp., Aerospace Fluid Power Conference, 22nd, Troy, Mich., Oct. 30, 31, 1972, Paper. 18 p.*

Power-by-wire (PBW) is the transmission of power from the aircraft engine to the control surface actuator by electrical rather than hydraulic means. Fly-by-wire (FBW) is an electrical closed-loop feedback control system which makes aircraft motion, rather than surface position, the controlled variable. FBW offers improved flight safety and decreased vulnerability, weight and volume savings through use of small flexible electric wires that do not move, pivot, or bind, and an increase in reliability through use of a two-fail/operate approach. Significant benefits can result by extending redundancy principles to the aerodynamic loops through the use of split-surface integrated actuator packages in conjunction with a FBW primary flight control system, and therefore represent two of the most promising flight control advancements for future aircraft.

F.R.L.

A73-26292 # Seismic vibrations induced by Concorde sonic booms. J. Bradley and R. W. B. Stephens (Imperial College of Science and Technology, London, England). *Acustica*, vol. 28, Mar. 1973, p. 191, 192. 5 refs. Research supported by the Ministry of the Environment.

Discussion of seismic measurement data recorded at a Cornish cottage near St. Day during Concorde sonic boom flights. Two sets of three-directional moving-coil geophones positioned 31 m apart in wet clay along the flight path were used for the recording. Diagrams of precursor waveforms and a HF vertical component tail are given.

V.Z.

A73-26298 # Optimisation of aircraft structures with multiple stiffness requirements. I. C. Taig and R. I. Kerr (British Aircraft Corp., Ltd., Military Aircraft Div., Preston, Lancs., England). *NATO, AGARD, Symposium on Structural Optimization, 2nd, Milan, Italy, Apr. 2-4, 1973, Preprint. 14 p. 7 refs.*

A general optimality theorem is presented for structures whose members have stiffnesses proportional to their masses and which are designed by generalized stiffness requirements. The theorem is used to derive an iterative procedure for optimum structure design. Modifications to the basic theorem enable practical constraints such as minimum material gauges and strength or stability requirements to be introduced. The method can be used where stiffness requirements are directly specified for given loading conditions or where vibration frequency or aeroelastic efficiency requirements are stipulated. A useful feature of the method, when used in conjunction with B.A.C. automated design procedures, is that the optimization can operate with real structure variables and constraints so that there is no subsequent design operation required to convert idealized structure dimensions to feasible detail sizes.

(Author)

A73-26299 # Non-destructive testing of adhesive bonding. W. F. Bennett (Ciba-Geigy, Ltd., Duxford, Cambridge, England). *Non-Destructive Testing Society of Great Britain, Annual Conference and Exhibition, 9th, Loughborough University of Technology, Loughborough, England, Sept. 12-15, 1972, Paper. 15 p. 14 refs.*

The efficiency of nondestructive testing in applications to adhesive bonding is evaluated in a review of available theoretical and experimental studies. Adhesion and cohesion are discussed as the variables fundamentally influencing the suitability of particular nondestructive tests. Tests for adhesion, cohesion strength, metal-metal and metal-honeycomb bonding, and pretreatment tests are considered. An extensive listing of specific individual nondestructive tests is included.

V.Z.

A73-26338 # Researches on the two-dimensional retarded cascade. III - Cascade performances at high inlet angles. T. Ikui, M. Inoue, and M. Kuromaru (Kyushu University, Fukuoka, Japan). *JSME, Bulletin*, vol. 16, Feb. 1973, p. 252-260; Discussion, p. 260; Authors' Closure, p. 261. 19 refs.

Two-dimensional cascade data at inlet angles higher than 65 deg have been presented which are required often for the designs of axial blowers. Cascade tests of NACA 65-series compressor blades were performed by the testing technique which had been established by the authors in the foregoing paper. Reliable data have been obtained in the ranges of inlet angle from 65 to 80 deg, solidity from 0.5 to 1.33, and camber from 0 to 2. Characteristics of cascade performance at high inlet angles are found. In the case of high inlet angles, it is necessary to take care in selecting a design angle of attack, because the range of angles of attack for an effective operating region is very narrow.

(Author)

A73-26339 # Researches on the two-dimensional retarded cascade. IV - Determination of blade elements at retarded blade row. T. Ikui, M. Inoue, and M. Kuromaru (Kyushu University, Fukuoka, Japan). *JSME, Bulletin*, vol. 16, Feb. 1973, p. 262-271. 9 refs.

It is well known that the experimental, two-dimensional cascade data are far more available than the theoretical calculations to work out a reliable design of blade rows of the axial flow compressor. In this paper, three kinds of design diagrams for the NACA 65 series compressor blade section have been presented, based on the available experimental cascade data. First, the improved carpet plotting diagrams have been prepared corresponding to the optimum design angle of attack which is obtained semi-theoretically. Next, introducing the angle-of-attack selecting factor, another type of design diagrams has been prepared, by which one may select the suitable angle of attack in the effective operating range.

(Author)

A73-26340 # Theory on blades of axial, mixed, and radial turbomachines by inverse method. Y. Kashiwabara (Hitachi, Ltd., Kokubunji, Japan). *JSME, Bulletin*, vol. 16, Feb. 1973, p. 272-280; Discussion, p. 280, 281; Author's Closure, p. 281. 12 refs.

In this paper, a theory on blades of axial, mixed, and radial turbomachines is presented, in which the shapes of blades are obtained with the prescribed velocity distribution along the blade surfaces. The singularity method is used in this theory; vortices, sources and sinks are arranged along the camber line of blade sections on the mean stream surface of revolution. The effect of three-dimensional flow due to the arbitrary shapes of the mean stream surfaces through blades is also taken into account.

(Author)

A73-26347 # On the estimation of the directional spectrum of surface gravity waves from a programmed aircraft altimeter. R. L. Snyder (Nova University, Dania, Fla.). *Journal of Geophysical Research*, vol. 78, Mar. 20, 1973, p. 1475-1478. Contract No. N00014-67-A-0386-0001.

A method of determining the directional spectrum from the record of an aircraft-mounted (laser) altimeter is proposed. The method involves synchronous programming of the angle that the altimeter beam makes with the vertical and acquisition of the data. Subsequent analysis is similar to the directional spectrum analysis of the signals of a fixed array of wave recorders.

(Author)

A73-26349 # Regularization of the legal status of international air charter services. R. M. Lichtman (Chicago, University, Chicago, Ill.). *Journal of Air Law and Commerce*, vol. 38, Autumn 1972, p. 441-471. 74 refs.

Following a review of the development of charter traffic and charter airlines, the governmental regulation of international charter air services is discussed. For the most part such services remain subject to a heterogeneous mixture of unilaterally imposed and widely differing governmental regulations and restrictions. Procedural issues in regularizing the status of international charter services are discussed, and provisions for a bilateral charter agreement are recommended. Particulars of the U.S.-Belgium memorandum of understanding, signed Oct. 17, 1972, are outlined.

F.R.L.

A73-26350 # Airport noise control; Can communities live without it - Can airlines live with it. J. F. Vittek, Jr. (MIT, Cambridge, Mass.). *Journal of Air Law and Commerce*, vol. 38,

Autumn 1972, p. 473-518. 136 refs.

The problem of how the concerns and interests of the community and the air industry are to be balanced with reference to noise control is studied. It is suggested that airport noise can be kept to a minimum by the application of technology and legal-political approaches that are both effective and economical. Legislation is needed both to accelerate the technology and to allow area and regional planning. A number of cases involving airport noise which have reached the courts are reviewed. As quieter aircraft replace older equipment, the trend in noise will be downward. F.R.L.

A73-26370 A reappraisal of design methods for inward flow radial gas turbines. F. S. Bhinder (Hatfield Polytechnic, Hatfield, Herts., England). (*Technion - Israel Institute of Technology, Israel Conference on Mechanical Engineering, 6th, Haifa, Israel, June 26, 27, 1972.*) *Israel Journal of Technology*, vol. 10, no. 6, 1972, p. 443-450. 10 refs.

Interest in the inward flow radial gas turbine has grown rapidly in recent years; consequently, several papers have been published which deal with its performance under steady as well as unsteady flow conditions. In contrast, the design has not received adequate coverage. A few references on the subject of design which can be cited in the open literature deal either with the investigation of the interactions between the main design parameters and performance, or a detailed study of the flow in the rotor. The aim of this paper is to discuss these papers briefly and to present a systematic approach to the overall design problem. (Author)

A73-26371 Gas-turbine processes with interrupted expansion and interrupted compression (Gasturbinenprozesse mit gebrochener Entspannung und gebrochener Verdichtung). N. Gasparovic and P. A. F. Spek. *Forschung im Ingenieurwesen*, vol. 39, no. 2, 1973, p. 37-44. 13 refs. In German.

The three possibilities considered include an expansion process interrupted by a stage in which the fluid is cooled, a compression process interrupted by a stage in which the fluid is heated, and a process consisting of an interrupted expansion combined with an interrupted compression. The characteristics of the gas turbine process with interrupted expansion for a high-pressure turbine entrance temperature of 1200 K are considered, giving attention to thermal efficiency, pressure ratio, and conditions regarding the high-pressure turbine and the low-pressure turbine. Details concerning the gas-turbine process with interrupted compression are also presented. G.R.

A73-26385 # Aerodynamics of wake vortices. C. E. Brown (Hydronautics, Inc., Laurel, Md.). *AIAA Journal*, vol. 11, Apr. 1973, p. 531-536. 16 refs. Contract No. F44620-71-C-0080.

The effect of wing span loading on the development of fully rolled-up wing trailing vortices is discussed. It is shown that parabolic wing loadings produce potential flow maximum core rotary speeds which are finite and less than 50% greater than the downwash speeds at the plane of symmetry. The development of turbulent cores is analyzed and core growth is predicted to occur as the two-thirds power of time, whereas the peak velocities fall off as the inverse one-third power. Axial flow effects of the wing profile drag and lifting system are shown to lead to axial jets on the vortex axis which may either follow the aircraft or exceed the freestream velocity, depending on the ratio of profile drag to induced drag. (Author)

A73-26405 # Turbulent heat transfer to a fin leading edge - Flight test results. E. C. Lemmon and H. W. Coleman (Sandia Laboratories, Livermore, Calif.). *AIAA Journal*, vol. 11, Apr. 1973, p. 571-573. 6 refs. Contract No. AT(29-1)-789.

Predictions of turbulent heat transfer to a leading edge, in the region near the intersection of a swept leading edge and a body, based on a technique proposed by Coleman and Lemmon (1972), are

compared with turbulent heat transfer data obtained from the flight test of a cone on which four fins were mounted. The agreement found between the predictions and experimental data seems to validate the prediction-underlying heat transfer calculation technique. The results obtained also confirmed that there is no significant difference in the measured heat transfer on slender fins with flat or cylindrical faces otherwise geometrically identical. M.V.E.

A73-26419 # Recent developments in commercial fire resistant fibrous materials. J. H. Ross (USAF, Materials Laboratory, Wright-Patterson AFB, Ohio). *SAFE Engineering*, Winter 1972-1973, p. 16-21. 9 refs.

A73-26424 * # Effects of prevaporized fuel on exhaust emissions of an experimental gas turbine combustor. C. T. Norgren and R. D. Ingebo (NASA, Lewis Research Center, Cleveland, Ohio). *Combustion Institute, Spring Meeting, Urbana, Ill., Mar. 27, 28, 1973, Paper*. 24 p. 9 refs.

Effect of fuel vaporization on the exhaust emission levels of oxides of nitrogen (NO_x), carbon monoxide, total hydrocarbons and smoke number were obtained in an experimental turbojet combustor segment. Two fuel injector types were used in which liquid ASTM A-1 jet fuel and vapor propane fuel were independently controlled to simulate varying degrees of vaporization. Tests were conducted over a range of inlet-air temperatures from 478 to 700 K, pressures from 4 to 20 atmospheres, and combustor reference velocities from 15.3 to 27.4 m/sec. Converting from liquid to complete vapor fuel resulted in NO_x reductions as much as 22% and smoke number reductions up to 51%. (Author)

A73-26439 # Supersonic gas flow past the leeward side of a conical wing (Obtekanie podvetrennoi storony konicheskogo kryla sverkhzvukovym potokom gaza). V. I. Lapygin and N. A. Ostapenko. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza*, Jan.-Feb. 1973, p. 112-121. 11 refs. In Russian.

Analysis of a supersonic gas flow incident at an angle of attack on the leeward side of a delta wing with supersonic leading edges. Expansions are given to describe the transformation of a compressed flow into a rarefied Prandtl-Mayer flow during a flow-wing interaction at various angles of attack. A method described by Babenko and Kozlov (1971) is applied to determine the flow parameters on the wing surface. A system of equations of motion, linearized at infinity, is given to study this transformation within the framework of a linear theory with the angle of attack represented by a small parameter. V.Z.

A73-26496 A note on the scattering of sound in jets and the wind. M. J. Rudd (Bolt Beranek and Newman, Inc., Cambridge, Mass.). *Journal of Sound and Vibration*, vol. 26, Feb. 22, 1973, p. 551-560. 14 refs.

The theory of the scattering of sound by turbulence, as developed by Tatarski and modified by Monin, is used to calculate the scattering cross sections of two turbulent flows, jets and the wind. The results indicate that strong scattering can occur under quite normal conditions. The strength of the scattering increases quite rapidly with the frequency of the sound and the length scale of the turbulence. The importance of acoustic scattering is then discussed in connection with methods of jet noise reduction and sound 'attenuation' by the wind. (Author)

A73-26503 A 32-cm airborne infrared observatory. P. Léna, N. Coron, C. Darpentigny, K. Hammal, and G. Vanhabost (Paris, Université; Meudon, Observatoire; CNRS, Meudon, Hauts-de-Seine, France). In: *Infrared detection techniques for space research; Proceedings of the Fifth ESLAB-ESRIN Symposium, Noordwijk, Netherlands, June 8-11, 1971.* Dordrecht, D. Reidel Publishing Co., 1972, p. 32-40.

Aspects of atmospheric transmission are discussed, giving attention to the vertical distribution of water in the atmosphere and the theoretical transmission spectrum of water. Four guiding methods can be used to overcome effects of aircraft instability including manual guiding, photoelectric guiding, IR guiding, and inertial guiding. The telescope system has been installed in a Caravelle aircraft which has an operational ceiling altitude of 35000 ft. The aircraft position provides the main alignment of the telescope with the object. Two gyros supply the error signals for the torque motors. G.R.

A73-26589 General guideline for the design of manned aerospace vehicles (*Pilotage et conception des avions*). J.-C. Wanner (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *L'Aéronautique et l'Astronautique*, Mar.-Apr. 1973, p. 10-18. In French.

The Franco-British airworthiness authorities have been brought to review the set of technical specifications they intended to require for Concorde in order to insure the safety of the missions of this new transport aircraft. Most of the old rules of thumb generally used for the conventional aircraft appeared as obsolete or unapplicable to a supersonic transport. In order to guide the definition of these new regulations, a theoretical method was developed for evaluating the reliability of the missions of manned aerospace vehicles. This method is based on an investigation of the way of occurrence of accidents. It has been seen that an accident is due to a set of incidents which can be classified into only three different types. The study of each type of incident, the probability of occurrence of which has to be reduced in order to increase the safety, is very useful in helping the designer of a new project to choose between possible solutions, taking into account the reliability of the systems, the possible human errors, and the flight conditions. (Author)

A73-26591 Advanced maintenance programs for transport aircraft (*Programmes d'entretien modernes pour avions de transport*). T. D. Matteson (United Air Lines, Inc., Chicago, Ill.). *L'Aéronautique et l'Astronautique*, Mar.-Apr. 1973, p. 24-29. In French.

There has been a startling metamorphosis in maintenance programs for transport airplanes in the past 12 years. Formerly these programs were based on an unproven, but universally accepted intuitive model which ascribed great value to scheduled overhauls as a means for ensuring the highest level of operating safety. Knowledge obtained from careful analysis suggested the application of a decision tree technique for determining preventive maintenance requirements. This technique has proved its effectiveness on the 747 and DC-10, the first new airplanes to which it was applied. (Author)

A73-26592 Variations in the sound field of a STOL aircraft as a function of wing-flap deflection (*Variations du champ sonore d'un avion de type A.D.A.C. en fonction du braquage des volets hypersustentateurs*). L. Rizo and M. Jannot (Société Nationale Industrielle Aérospatiale, Paris, France). (*Association Française des Ingénieurs et Techniciens de l'Aéronautique et de l'Espace and Groupement des Acousticiens de Langue Française, Colloque d'Acoustique Aéronautique, 3rd, Toulouse, France, Mar. 6, 7, 1972.*) *L'Aéronautique et l'Astronautique*, Mar.-Apr. 1973, p. 43-54. 5 refs. In French.

A73-26593 In-flight flutter testing methods and techniques (*Méthodes et techniques de l'essai aéroélastique en vol*). G. Piazzoli (ONERA, Direction des Structures, Châtillon-sous-Bagneux, Hauts-de-Seine, France). (*NATO, AGARD, Réunion, Lyngby, Denmark, Apr. 9-14, 1972.*) *L'Aéronautique et l'Astronautique*, Mar.-Apr. 1973, p. 55-66. In French.

After showing the role played by flight vibration tests in the prevention of the flutter instability of aircraft prototypes, the methods used for the experimental determination of the natural frequencies and damping ratios of the structure in the presence of airflow are examined. The methods presented in the paper are based on three types of excitation used or investigated in France: the harmonic excitation with electrodynamic exciters; the impulse

excitation with explosive charges; and the random excitation provided either by the atmospheric turbulence or by exciters fed with a pre-recorded signal. The analog and digital procedures used to process the data are also described. (Author)

A73-26594 International programs for stratospheric studies (*Les programmes internationaux d'études de la stratosphère*). R. Joatton (Société Nationale Industrielle Aérospatiale, Paris, France). *L'Aéronautique et l'Astronautique*, Mar.-Apr. 1973, p. 67-76. In French.

The increase of stratospheric transport makes it necessary to increase stratospheric knowledge. Hence important programs of stratospheric studies are available in several countries (U.S.A., U.K., France) and are roughly summarized in this paper. The report of the Australian Academy of Sciences on stratospheric flights is enclosed. (Author)

A73-26595 Basic aerodynamic parameters of flame stabilizers (*Caractéristiques aérodynamiques fondamentales des stabilisateurs de flammes*). G. Matton and J.-P. Spies (Ecole Nationale Polytechnique, Algiers, Algeria; Centre de Documentation de l'Armement, Paris, France). *L'Aéronautique et l'Astronautique*, Mar.-Apr. 1973, p. 93-107. 6 refs. In French.

The reheat devices for jet engines make use of flame stabilizers, and these are generally torus shaped. The theory of the notched hodograph extended to compressible closed jet flows provides the means of evaluating the basic characteristics of the torus shaped cascades involved in the flame stabilization process. This method, developed some years ago at the ONERA, has been computerized. The numerical processing presented here deals with three values of the apex angle. The analysis shows the advantage of profiles with small angle width. (Author)

A73-26596 Reliability of helicopter transmission components (*Fiabilité des transmissions d'hélicoptères*). J.-P. Libeer (Société Nationale Industrielle Aérospatiale, Paris, France). (*Association Française pour le Contrôle Industriel de Qualité, Association Française des Ingénieurs et Techniciens de l'Aéronautique et de l'Espace, Association Technique, Maritime et Aéronautique, Groupement pour l'Avancement de la Mécanique Industrielle, and Société des Ingénieurs de l'Automobile, Journées d'Etudes sur la Fiabilité des Moteurs, Paris, France, Mar. 20-22, 1972.*) *L'Aéronautique et l'Astronautique*, Mar.-Apr. 1973, p. 108-116. In French.

Helicopter transmission components and, in particular, reduction gearboxes are the object of reliability studies. Experience (recorded reliability) has made it possible to devise a method of calculating expected reliability based on the service life of bearings. The problems set by gears (fatigue and surface wear) are eliminated by correct proportioning and have a negligible effect upon total reliability. The increase in reliability obtained is neither very costly nor implies a great increase in weight; it allows general overhaul life to be extended and overhaul 'according to condition' to be aimed at, provided that safety can be ensured by flight and ground monitoring media. (Author)

A73-26633 The application of holography to sonic boom investigations. P. Smigielski, A. Hirth, and C. Thery (Institut Franco-Allemand de Recherches, Saint-Louis, Haut-Rhin, France). *IEEE Transactions on Aerospace and Electronic Systems*, vol. AES-8, Nov. 1972, p. 751-756. 10 refs.

A Q-switch single-mode ruby laser is used for holographic recording of simulated sonic booms. The gaseous objects are visualized by means of the following techniques: (1) Differential interferometry in polarized light, as well as the Schlieren method with defocused phase plate. Both techniques are applied to the holographically recorded wave (directional lighting). (2) Interferometry by double exposure with directional lighting. (Author)

A73-26722 # The electrostatic charge of the aircraft (Elektrostatische Aufladung des Flugzeuges). V. Aleksandrov and A. Fedchenko (Gosudarstvennyi Nauchno-Issledovatel'skii Institut Grazhdanskoi Aviatsii, Moscow, USSR). (*Grazhdanskaia Aviatsiia*, no. 7, 1972, p. 12, 13.) *Technisch-ökonomische Informationen der zivilen Luftfahrt*, vol. 9, no. 1, 1973, p. 18-21. In German. (Translation).

Electric charges are induced on an aircraft when it passes through an electrically charged atmosphere. The effects of friction between the aircraft surface and dust particles or gases can produce an electrostatic charge on the aircraft. Electrostatic charges of the aircraft can enhance or reduce the probability that the aircraft will be damaged by lightning. Approaches for the protection of the aircraft against such damage are discussed, giving attention also to a shielding of the fuel container against lightning effects and the removal of the electrostatic charge on the aircraft by various methods. G.R.

A73-26723 # Determination of the turn start point coordinates for modern commercial aircraft (Ermittlung der Koordinaten für den Beginn des Kurvenfluges moderner Verkehrsflugzeuge). D. Oehme (Gesellschaft für Internationalen Flugverkehr mbH, Berlin, East Germany). *Technisch-ökonomische Informationen der zivilen Luftfahrt*, vol. 9, no. 1, 1973, p. 22-25. In German.

A73-26725 # Flight-mechanics analysis of various flight conditions of conventional aircraft. VII - Mechanical foundations: Dynamic equations of motion of the translational motion of a rigid body (Flugmechanische Analyse verschiedener Flugzustände konventioneller Flugzeuge. VII - Mechanische Grundlagen: Dynamische Bewegungsgleichungen der Translationsbewegung eines starren Körpers). F. Seidler (Dresden, Hochschule für Verkehrswesen, Dresden, East Germany). *Technisch-ökonomische Informationen der zivilen Luftfahrt*, vol. 9, no. 1, 1973, p. 50-58. In German.

The equations for the translational motion of a rigid body are derived as an extension of the dynamic equations of motion for a point mass. Effects of linear motion relative to the aircraft of objects within the aircraft upon the translational motion of the aircraft are investigated. An indirect effect is connected with changes in the distribution of the mass within the aircraft. The second effect is related to the principle of the conservation of the momentum. G.R.

A73-26769 # Problems in constructing aerodynamically active elements - Converters of input and output signals in automatic control systems (Problemy postroyeniia elementov aerodinamicheskogo deistviia - Preobrazovatelei vkhodnykh i vykhodnykh signalov v sistemakh avtomaticheskogo upravleniia). L. A. Zalmanzon. In: Engineering means in automatic control. (A73-26751 12-10) Moscow, Izdatel'stvo Nauka, 1971, p. 255-263. 15 refs. In Russian.

A73-26785 # Investigation of new elements and equipment configurations in stable-frequency, alternating-current, electrical power supply systems employing primary power plants consisting of engines with varying rotational speed (Issledovanie novykh elementov i kompleksov apparatury v sistemakh elektrosnabzheniia peremennogo toka stabil'noi chastoty s pervichnymi dvigateliami peremennoi skorosti vrashcheniia). S. V. Strakhov, V. T. Trubachev, V. I. Urdin, and V. A. Velikovskii. In: Engineering means in automatic control. Moscow, Izdatel'stvo Nauka, 1971, p. 565-573. 8 refs. In Russian.

A73-26823 # Technical problems encountered with the flying laboratory LALA-1 (Problemy techniczne latajacego laboratorium LALA-1). J. Swidzinski. *Technika Lotnicza i Astronautyczna*, vol. 28, Jan. 1973, p. 8-14. In Polish.

Description of structural design changes necessitated by the conversion of the An-2R agricultural support aircraft into a flying test bed (experimental LALA-1) to be used in feasibility studies

evaluating jet engines in agricultural support aircraft. The entire rear of the fuselage was radically modified to permit mounting of the AI-25 jet engine directly behind the trailing edge of the upper wing. The standard piston engine was retained to permit comparisons between the two types of power plants in typical agricultural support operations. T.M.

A73-26824 # Analysis of the aerodynamic characteristics of wing lift augmentation devices (Analiza charakterystyk aerodynamicznych urzadzen zwiakszajacych sile nosna skrydla). R. Garncarek. *Technika Lotnicza i Astronautyczna*, vol. 28, Jan. 1973, p. 24-27, 41. In Polish.

Description of the aerodynamic characteristics of the following types of wing lift augmentation devices used with light aircraft: plain flaps, split flaps, slotted and double-slotted flaps, and leading-edge slots. Graphs illustrate the effects of profile shape and thickness, Reynolds number, and flap structural parameters on the aerodynamic characteristics of wing-flap combinations. Ground effects are also considered. T.M.

A73-26825 # Illumination of aircraft cockpit instrument indicators (Oswietlenie wskaznikow lotniczych przyrzadow pokladowych). E. Babiasz. *Technika Lotnicza i Astronautyczna*, vol. 28, Jan. 1973, p. 28-32, 40. 13 refs. In Polish.

Visibility and reliability requirements posed for cockpit instrument display systems are explained together with the design and materials features of different methods for illuminating mechanical indicator devices. Transillumination, edge lighting, wedge prism lighting, and electroluminescent illumination are described in terms of operation; power requirements, cost, and relative merits and drawbacks from a human engineering viewpoint. T.M.

A73-26881 # Use of reinforced plastics in a composite propeller blade. J. G. Russell (Dowty Rotol, Ltd., Gloucester, England). *Plastics Institute, Conference on Designing to Avoid Mechanical Failure, Cranfield Institute of Technology, Cranfield, Beds., England, Jan. 8-10, 1973, Paper. 16 p.*

A method of blade construction employing carbon-fiber reinforced plastic in a basic load carrying spar, with a glass-fiber reinforced plastic outer shell of aerofoil form, has been developed. Full scale blade specimens have been fatigue tested in various modes. Other tests, such as bird impact trials, have also been carried out. Complete propellers have been run on hovercraft and the blades were strain gauged; comparisons are made between the measured vibratory strains and the fatigue test results. (Author)

A73-27036 Temperature sensitivity of cfrp honey-comb structures under holographic ndt. M. Marchant (Royal Aircraft Establishment, Farnborough, Hants., England). *Non-Destructive Testing*, vol. 6, Feb. 1973, p. 14, 15.

The experimental panels used in the investigation consisted of two skins of cross-ply carbon-fiber reinforced plastics, bonded with film adhesive to a honeycomb core. When a little heat was applied to the panel, debonded areas, and to some extent the honeycomb structure itself, were readily observed with the aid of standard live-fringe holographic interferometry. The results obtained in the studies indicate that the panels are surprisingly sensitive to ambient temperature changes. G.R.

A73-27043 Properties of the submerged low silhouette blade antenna (Eigenschaften der versenkten Low-Silhouette-Blade-Antenne). P. J. Muenzer (Standard Elektrik Lorenz AG, Stuttgart, West Germany). *Frequenz*, vol. 27, Mar. 1973, p. 74-77. In German.

A flush-mountable version of the elliptically polarized Low Silhouette Blade (LSB) is obtained by placing the latter in an open metal box with flat bottom and conical sidewalls. This antenna, which can quickly and easily be made in-house, is also a practical means to beat the long delivery times of circularly polarized spiral

antennas. This paper describes the electrical properties of the LSB in general, and those of the 'submerged' LSB in particular. (Author)

A73-27054 # Basic science for aerospace vehicles /4th edition/. J. L. McKinley and R. D. Bent (Northrop Institute of Technology, Inglewood, Calif.). New York, McGraw-Hill Book Co., 1972. 427 p \$12.95.

Science fundamentals are discussed together with elements of aerodynamics, airfoils, and aircraft in flight. Other subjects considered include blueprint reading, fundamentals of drafting, standards, materials, hardware, structures for aerospace vehicles, hydraulics and pneumatics, plumbing for aerospace vehicles, aircraft fuels and fuel systems, questions of weight and balance, pressure instruments, mechanical instruments, and gyro instruments. Problems of aircraft handling, servicing, and inspections are also examined, giving attention to taxiing and towing, the starting of various types of engines, aspects of control by lights, tying down aircraft, cleaning aircraft, fueling, and federal aviation regulations of interest. G.R.

A73-27063 # A new method for the study of the phenomenon of dynamic instability of thin-walled bars used in the construction of aeroplanes, ships and bridges. N. D. Popescu (Petroseni, Institutul de Mine, Petrosani, Rumania). *Istituto Internazionale delle Comunicazioni, Convegno Internazionale delle Comunicazioni, 20th, Genoa, Italy, Oct. 8-13, 1972, Paper. 26 p. 10 refs.*

A73-27066 # Air cargo transport: When and how much (Aerotrasporto merci - Quando e quanto conviene). R. Vannutelli. *Istituto Internazionale delle Comunicazioni, Convegno Internazionale delle Comunicazioni, 20th, Genoa, Italy, Oct. 8-13, 1972, Paper. 22 p. In Italian.*

After a brief survey of cargo air transport development, individual advantages are discussed. These include not only those resulting from rapidity but also other ones (such as shorter routes, less packing, fewer transfers; lower insurance costs, etc.) all of which, if properly evaluated, often counterbalance the high rate disadvantage. When a decision has to be taken between the air and another kind of transport, an estimate should be made taking into account all pros and cons duly worked out in figures. For this purpose, a procedure is indicated and a ready comparison form is provided, which summarizes and facilitates the above estimate. Methods for the economic evaluation of the time savings are also suggested. For a generic assessment of cases, a simplified calculation is outlined, in which few elements are needed to roughly know when and how much air transportation is worthwhile. (Author)

A73-27069 # Analysis of the operational parameters of a bypass turbojet (Analisi dei parametri di funzionamento di un turbogetto a diluizione a flussi associati). U. Ghezzi and C. Ortolani (Milano, Politecnico, Milan, Italy). *Istituto Internazionale delle Comunicazioni, Convegno Internazionale delle Comunicazioni, 20th, Genoa, Italy, Oct. 8-13, 1972, Paper. 38 p. 7 refs. In Italian.*

Determination of the characteristic performances of a bypass turbojet, and of the most favorable operational conditions once certain basic data have been established. Parameters are introduced which are capable of taking into account both the characteristics connected with the overall performance and those more specifically related to the dimensioning and space requirements of the engine components. A.B.K.

A73-27070 # Methodologies for the analysis of transport requirements with particular regard to the aeronautic case (Metodologie per l'analisi della domanda di trasporto con particolare riguardo al caso aeronautico). V. Correnti (Palermo, Università, Palermo, Italy). *Istituto Internazionale delle Comunicazioni, Convegno Inter-*

nazionale delle Comunicazioni, 20th, Genoa, Italy, Oct. 8-13, 1972, Paper. 43 p. In Italian.

A73-27077 # Prediction for a park of helicopters of the same type (Prognozirovanie parka odnotipnykh vertoletov). V. S. Moiseev. *Aviatsionnaia Tekhnika*, vol. 15, no. 4, 1972, p. 9-13. 8 refs. In Russian.

The planning of helicopter operation, involving the prediction of the number of serviceable units over a certain period of time is examined. A law governing the supply of new helicopters to the helicopter park is derived for a given volume of work required to be carried out over a given period of time. The problem is solved by mathematical simulation of the operation of the park. V.P.

A73-27084 # Contribution to the theory of the finite element method applied to the overall stress analysis of a fuselage (K teorii rascheta fiuzeliazha na obshchuiu prochnost' metodom konechnykh elementov). Z. I. Burman. *Aviatsionnaia Tekhnika*, vol. 15, no. 4, 1972, p. 49-55. 5 refs. In Russian.

The theory of designing a fuselage as a thin-walled reinforced shell with allowance for such structural complications as multicell cross sections, internal longitudinal elements, and multiply connected frames is discussed. A rational principle of constructing the basic system matrices is outlined, which is based on a representation of the loading in terms of a special lambda-matrix. The mathematical formulations and algorithms are developed for the case where fuselage analysis is based on the finite element method. V.P.

A73-27085 # Deformation equations of a propeller blade and the orthogonality characteristics of its normal mode shapes of vibration (Uravneniia deformatsii lopasti vozdušnogo vinta i svoistva ortogonal'nosti form ee sobstvennykh kolebani). A. Iu. Liss. *Aviatsionnaia Tekhnika*, vol. 15, no. 4, 1972, p. 56-66. 7 refs. In Russian.

Integrodifferential equations describing the deformation of a blade in a centrifugal force field are derived with allowance for torsion and for deflection in two planes. The simplifying assumptions are minimized, terms usually neglected are retained, and other refinements are introduced. The equations are used as a basis for deriving orthogonality conditions that are satisfied by the normal mode shapes of blade vibrations for various blade mounting methods. V.P.

A73-27086 # Creep analysis of a thin-walled wing on the basis of the plate analogy (Raschet na polzuchest' tonkostennogo kryla na osnove plastinnoi analogii). V. G. Shataev. *Aviatsionnaia Tekhnika*, vol. 15, no. 4, 1972, p. 67-72. 7 refs. In Russian.

The stress-strain state of the framework and skin of an airfoil under conditions of unsteady creep is determined, using a rigid cantilever plate as the design diagram. The solution is reduced to the numerical computation of a linearly elastic wing for a given load and a fictitious system of forces which defines the creep flow. V.P.

A73-27090 # Increasing the gas temperature in front of the turbine as a major trend in the development of gas-turbine engines (Povyshenie temperatury gaza pered turbinoi - glavnyi put' razvitiia sovremennykh GTD). V. I. Lokai. *Aviatsionnaia Tekhnika*, vol. 15, no. 4, 1972, p. 89-101. 14 refs. In Russian.

Problems associated with the use of high gas temperatures are examined, and the effectiveness of solving them by cooling the turbine components exposed to the highest thermal loads is assessed. The degree to which the energy losses due to cooling decrease the gain obtained by increasing the gas temperature is examined. Particular attention is given to the effectiveness and rational use of various blade cooling methods. V.P.

A73-27091 # Influence of the turbine air cooling system on the characteristics of a turbojet engine during regulation of the latter (Vliianie sistemy vozdušnogo okhlazhdeniia turbiny na kharakteristiki turboreaktivnogo dvigatel'ia pri ego regulirovanii). E. N. Bogomolov. *Aviatsionnaia Tekhnika*, vol. 15, no. 4, 1972, p. 102-111. In Russian.

A73-27094 # Some causes for the appearance of the 'extraneous noise' defect in transfer pumps of aircraft fuel systems (O nekotorykh prichinakh poivleniia defekta 'postoronni shum' u perekachivaiushchikh nasovov toplivnykh sistem samoletov). N. K. Gladchenko. *Aviatsionnaia Tekhnika*, vol. 15, no. 4, 1972, p. 123-126. In Russian.

The dynamics of the operation of a system composed of the aircraft power plant, the fuel supply mains, the transfer pumps, and the electric motors of the pumps is analyzed. It is shown that the appearance of extraneous noise may be attributed to the imperfection of the automatic control system of the transfer pumps, due to which the pumps are made to operate in a cyclic mode that includes a period of zero capacity. V.P.

A73-27095 # Optimization of aircraft parameters (K zadache optimizatsii parametrov samoleta). V. P. Gogolin and A. I. Nikitin. *Aviatsionnaia Tekhnika*, vol. 15, no. 4, 1972, p. 126-129. In Russian.

Ilichev's (1969) method is applied to the determination of the optimal design parameters of an aircraft. The method is based on the use of a criterion function which represents the overall deviation of the design characteristics from the specifications. As an example, the method is applied to the calculation of the principal parameters of a subsonic passenger aircraft. V.P.

A73-27098 # Supersonic flow around a delta wing, taking into account flow separation at the leading edges (Scurgereea supersonica in jurul aripilor delta considerind separatia curentului la bordurile de atac). S. Staicu (Bucuresti, Institutul Politehnic Gheorghe Gheorghiu-Dej, Bucharest, Rumania). *Bucuresti, Institutul Politehnic Gheorghe Gheorghiu-Dej, Buletinul*, vol. 34, Nov.-Dec. 1972, p. 83-99. 8 refs. In Rumanian.

Solution of the problem of supersonic flow around a thin delta wing, with allowance for flow separation at the subsonic leading edges, by employing a method of hydrodynamic analogy previously used in the study of wings in conical flows. After first considering the perturbations introduced by the angle of attack of a plane delta wing in the absence of vortices, a study is made of a fictitious delta lifting wing which has a symmetrical thickness with respect to the frame or which can have the same aerodynamic effect on the wing as the vortices. To study the flow, the fictitious wing is decomposed into a thin wing with its angle of attack varying in such a way that the mean value of this angle is zero, on the one hand, and the phenomenon of pressure modification on the wing surface is ensured, on the other, and a wing of symmetrical thickness with its slope varying in such a way that the mean slope of each surface of the wing is zero. A.B.K.

A73-27134 Turbulence in the free atmosphere. N. K. Vinnichenko, N. Z. Pinus, S. M. Shmeter, and G. N. Shur (Tsentral'naia Aerologicheskaiia Observatoriia, Dolgo-Prudnaya, USSR). (Translation of *Turbulentnost' v svobodnoi atmosfere*, Leningrad, Gidrometeorologicheskoe Izdatel'stvo, 1968.) New York, Consultants Bureau, 1973. 267 p. 421 refs. \$37.50

A73-27154 * Evaluation of glide paths for landing a VTOL airplane using linear regulator theory. G. F. Reid (Virginia Military Institute, Lexington, Va.), R. C. Montgomery (NASA, Langley

Research Center, Hampton, Va.), and L. Hasdorff (Virginia Polytechnic Institute and State University, Blacksburg, Va.). In: *Asilomar Conference on Circuits and Systems*, 6th, Pacific Grove, Calif., November 15-17, 1972, Conference Record. North Hollywood, Calif., Western Periodicals Co., 1973, p. 46-50. 10 refs.

A method of evaluating certain characteristics of approach paths for VTOL airplanes is presented which is based on the solution of the matrix Riccati equation to obtain an optimal state variable feedback controller. The longitudinal equations of motion of the airplane are linearized about a preselected path and the resulting system of equations is treated as a linear, time-varying regulator. The controller which minimizes a quadratic cost function is applied to the linearized system to determine the airplane's ability to return to the prescribed path given a specified initial error in altitude. The procedure is applied to the XC-142A, tilt-wing, V/STOL airplane, under decelerating approach conditions with a glide path consisting of two segments, the first having a smaller angle of descent than the second. (Author)

A73-27158 On the improvement in survivability for avionics equipment. K. A. Pullen, Jr. (U.S. Army, Ballistics Research Laboratories, Aberdeen Proving Ground, Md.). In: *Asilomar Conference on Circuits and Systems*, 6th, Pacific Grove, Calif., November 15-17, 1972, Conference Record. North Hollywood, Calif., Western Periodicals Co., 1973, p. 154-161. 6 refs.

Because of the nature of electronic units, the impact of a projectile or fragments on it will usually either produce an immediate (less than one second) K-kill for the unit, or it will survive. As a practical matter, improvement of survivability is conveniently achieved by use of parallel processing paths, thereby making the target many times more vulnerable. Attention is given to the series redundancy problem and ground-loop control. It is shown that some relatively simple changes may lead to substantial improvements of survivability in electronic equipment for use on aircraft, and also that with properly designed protective equipment, the arrangements for providing the redundancy need not introduce significant failure problems of their own. F.R.L.

A73-27162 A new approach to Doppler-inertial navigation /Doppler Beam Sampling/. D. R. VanderStoep, R. W. Call (Boeing Co., Seattle, Wash.), and R. R. Warzynski (USAF, Avionics Laboratory, Wright-Patterson AFB, Ohio). In: *Asilomar Conference on Circuits and Systems*, 6th, Pacific Grove, Calif., November 15-17, 1972, Conference Record. North Hollywood, Calif., Western Periodicals Co., 1973, p. 267-275. Contract No F33615-71-C-1654.

Most current Doppler radar systems employ four symmetrically oriented beams, each of which provides a return signal proportional to the closing rate between the aircraft and the point of incidence of the beam on the ground. With the Doppler Beam Sampling (DBS) concept the four raw Doppler beam closing rates are sent to the navigation computer, which removes the calculable Doppler beam errors before the velocity vector is synthesized. In addition to greatly improving the Doppler accuracy, this approach removes undesirable spectral characteristics from the Doppler errors, thereby easing the problem of Doppler modeling in the Kalman filter. F.R.L.

A73-27165 Signal processing in the Air Traffic Control Radar Beacon System. B. Rubinger and G. G. Haroulès (U.S. Department of Transportation, Transportation Systems Center, Cambridge, Mass.). In: *Asilomar Conference on Circuits and Systems*, 6th, Pacific Grove, Calif., November 15-17, 1972, Conference Record. North Hollywood, Calif., Western Periodicals Co., 1973, p. 290-295. 11 refs.

The radar beacon system provides the air traffic controller with his primary source of data. The operation of this system is explained and its evolution discussed. Attention is then focussed on the signal processing required for target azimuth determination. The present

systems employ a sliding window detector which requires numerous aircraft replies. A monopulse measurement technique is discussed which would allow accurate determination of angular position from a small number of target hits. In this scheme it is assumed that the monopulse information is derived from a standard interrogator antenna which is modified by the addition of a hybrid network to provide both sum and difference information. The on-boresight accuracy achievable with this approach is investigated. (Author)

A73-27166 **Practical quadratic optimal control for systems with large parameter variations.** A. J. VanDierendonck (Honeywell, Inc., Minneapolis, Minn.). In: Asilomar Conference on Circuits and Systems, 6th, Pacific Grove, Calif., November 15-17, 1972, Conference Record. North Hollywood, Calif., Western Periodicals Co., 1973, p. 391-396. 8 refs. Contract No. F33615-71-C-1058

A practical controller design procedure for the control of systems with large parameter variations has been developed. The procedure is based on quadratic optimal control theory with limited measurement feedback. The feedback gains are fixed, although some may be allowed to vary with known parameter variations. The system is represented linearly at discrete points in the parameter space. A performance index is defined as a weighted sum of quadratic performance indices at these points. The index is minimized with a gradient scheme - the Incremental Gradient - that ensures fast convergence to a global minimum. It is applied to examples. (Author)

A73-27168 * **Microprogrammed digital filters for strapdown guidance application.** K. Kapadia and W. R. Dunn (Santa Clara University, Santa Clara, Calif.). In: Asilomar Conference on Circuits and Systems, 6th, Pacific Grove, Calif., November 15-17, 1972, Conference Record. North Hollywood, Calif., Western Periodicals Co., 1973, p. 419-423. 11 refs. Grant No. NGR-05-017-031.

Discussion of an approach for implementing digital filters using microprogrammed control logic with read only memory (ROM) for strapdown guidance applications, and description of a second-order multiplexed system using multiprogrammed control instruction. The microprogramming technique for control using ROM is shown to enhance higher order digital filter realization. The high speed of digital circuits reduces propagation time and facilitates multiplexing. Programmed ROM's can be altered easily for different algorithms. M.V.E.

A73-27171 # **A note on the lift coefficient of a thin jet-flapped airfoil.** T. Kida and Y. Miyai (Osaka Prefecture University, Sakai, Osaka, Japan). *Japan Society for Aeronautical and Space Sciences, Transactions*, vol. 15, no. 30, 1973, p. 163-177. 8 refs.

An equivalent approach to the small jet momentum coefficient expansion on a thin jet-flapped airfoil is described, the expansion discussed by Spence (1961) being equivalent to the inner expansion in this paper. In order to avoid the nonuniformity of the expansion an outer solution is introduced, and the inner and outer solutions are matched with each other by the limit matching method. When the composite solution is considered the uniformity of the solution is restored and the lift derivatives are calculated more correctly. The greatest advantage of this method lies in solving analytically the singular integro-differential equation on a thin jet-flapped airfoil, the solution being valid even far downstream. F.R.L.

A73-27175 # **Prediction of height-velocity boundaries for rotorcraft by application of optimization techniques.** M. Komoda (National Aerospace Laboratory, Tokyo, Japan). *Japan Society for Aeronautical and Space Sciences, Transactions*, vol. 15, no. 30, 1973, p. 208-228. 12 refs.

An analytical method utilizing optimization techniques to estimate an ideal height-velocity (HV) diagram and a critical decision point (CDP) of rotorcraft is proposed. The aim is to obtain reasonable expressions of a control program for the model equations which describe rotorcraft dynamics after a critical engine has failed. It is shown that such control inputs, which otherwise must be assumed purely empirically, are obtained as the solution of an adequately stated optimization problem in which the height loss is maximized or minimized, or equivalently, the final rotor rpm is maximized. (Author)

A73-27360 **Radio Technical Commission for Aeronautics, Annual Assembly Meeting, Washington, D.C., November 9, 10, 1972, Proceedings.** Washington, D.C., Radio Technical Commission for Aeronautics, 1972. 198 p. \$6.00.

Subjective descriptions are given by airspace users of the services expected from the National Aviation System, with emphasis on coordination of diverse interests. The status of funded improvements to the system, and planned improvements not yet funded are discussed, as well as improvements in the use of human resources for system maintenance, and improvement in the use of resources for system performance assurance. The cost effectiveness of planned improvements is analyzed, and today's conceptual attitudes are assessed. The need to coordinate cost effective avionics installation for the airspace user with ground facility implementation is studied. F.R.L.

A73-27361 # **General aviation and the National Aviation System.** V. J. Kayne (Aircraft Owners and Pilots Association, Washington, D.C.). In: Radio Technical Commission for Aeronautics, Annual Assembly Meeting, Washington, D.C., November 9, 10, 1972, Proceedings. Washington, D.C., Radio Technical Commission for Aeronautics, 1972. 9 p.

General aviation's needs vary from the sophisticated requirements of the business jet to the crop duster that requires only a small grass strip. The basic services required are airports, weather, briefing (including NOTAMS), navigation aids, air/ground communications, traffic advisories, airport information, separation, and flight plan service. Although many facilities and services within the National Aviation System are provided by the federal government, many are provided by private individuals and companies at no cost to the government. An element of government activity that is needed by general aviation is research and development. F.R.L.

A73-27362 # **How to think more clearly about future air traffic systems or a handful of rules-of-thumb.** D. R. Israel (FAA, Washington, D.C.). In: Radio Technical Commission for Aeronautics, Annual Assembly Meeting, Washington, D.C., November 9, 10, 1972, Proceedings. Washington, D.C., Radio Technical Commission for Aeronautics, 1972. 16 p.

The data acquisition process for planning and engineering of an improved air traffic system is first considered, since the design of this process is fundamental to the successful achievement of the operational system. Several of the more important design aspects are examined, and comments are provided on the system design itself. It is considered that an improved air traffic system will be a long and costly endeavor, without any foreseeable shortcuts. Since piecemeal evolution is inevitable, preparation should be made for this effort, adopting a frame of mind and acquisition process which recognizes these facts. F.R.L.

A73-27363 # **Status of funded improvements to the National Aviation System and planned improvements not yet funded.** R. W. Pulling (FAA, Washington, D.C.). In: Radio Technical Commission for Aeronautics, Annual Assembly Meeting, Washington, D.C., November 9, 10, 1972, Proceedings.

Washington, D.C., Radio Technical Commission for Aeronautics, 1972. 17 p.

A73-27364 # Improvements in the use of FAA resources for system performance assurance. D. F. Babcock (Stanford Research Institute, Menlo Park, Calif.). In: Radio Technical Commission for Aeronautics, Annual Assembly Meeting, Washington, D.C., November 9, 10, 1972, Proceedings. Washington, D.C., Radio Technical Commission for Aeronautics, 1972. 12 p.

Methods are needed for assessing system performance and for estimating system costs. What is sought is a means for giving adequate visibility to the salient features of the system that require attention either from a performance or cost viewpoint. In general, it is feasible to prepare a definition and description of the National Airspace System (NAS) and to create performance measures and set goals for NAS performance. It is recommended that life cycle models for all major system elements should be established and maintained, that system criticality be analyzed, and that a plan should be formulated to allocate resources. F.R.L.

A73-27365 # Assessing the cost effectiveness of planned improvements. S. B. Poritzky (Air Transport Association of America, Washington, D.C.). In: Radio Technical Commission for Aeronautics, Annual Assembly Meeting, Washington, D.C., November 9, 10, 1972, Proceedings. Washington, D.C., Radio Technical Commission for Aeronautics, 1972. 18 p.

The cost-effectiveness of planned improvements in the aviation system can be judged by whether the improvements serve the masses of people who fly and ship on airlines and permit the carriers to provide ever-improving services for profit. The FAA is embarked on a nearly \$3 billion 10-year facilities and equipment improvement program. The requirements for ATC automation and for terminal aids are discussed, and attention is given to the noise problem. The FAA has plans for a significant program to replace obsolescent equipment. The problem of finding out how much value a given level of automation or a new system of facilities can offer requires not only technical expertise but also good judgment. F.R.L.

A73-27366 # An appraisal of the funding provisions of the Airport and Airways Development Act of 1970 to implement system improvements. J. J. O'Donnell (Air Line Pilots Association, Washington, D.C.). In: Radio Technical Commission for Aeronautics, Annual Assembly Meeting, Washington, D.C., November 9, 10, 1972, Proceedings. Washington, D.C., Radio Technical Commission for Aeronautics, 1972. 10 p.

The Air Line Pilots Association (ALPA) has strongly demanded that funds which are being accumulated and not spent must be programmed to obtain the minimum airport facilities which ALPA has recommended be installed by Oct., 1973. It is increasingly important that installation priorities be established that will be acceptable to the aviation community. Attention is given to the airport and related facilities, the ALL Instrument Landing System (ILS) components, including lighting, and the air traffic control system. F.R.L.

A73-27367 # An appraisal of the funding provisions of the Airport and Airway Development Act of 1970 in relation to implementing system improvements. T. S. Miles (National Air Transportation Conference, Inc., Washington, D.C.). In: Radio Technical Commission for Aeronautics, Annual Assembly Meeting, Washington, D.C., November 9, 10, 1972, Proceedings. Washington, D.C., Radio Technical Commission for

Aeronautics, 1972. 11 p.

The Trust Fund created by the Airport and Airway Development Act of 1970 is building up an 'uncommitted surplus' which is the difference between user tax revenues and appropriations. Expenditures from the Trust Fund can only be made as appropriated by the Congress. It is suggested that the aviation community should

have a more effective voice on a continuing consultative basis with respect to user tax fund expenditures in advance of FAA programming. Another important action needed to expedite improvements is to provide some sort of incentive plan for the airspace users. F.R.L.

A73-27383 # Developments of the SV-20 program (Sviluppi del programma SV-20). E. Bianchi (SIAI Marchetti S.p.A., Rome, Italy). In: Italian contributions to present aerospace activities; Conference, 2nd, Turin, Italy, June 9, 10, 1972, Proceedings. Turin, Italy, Società Ingegneri ed Architetti di Torino, 1972, p. 47-52. In Italian.

Review of a program of development of a medium-range helicopter of new design in a winged version. The proposed helicopter is designed to transport a pilot and 13 passengers at a cruising speed of 175 knots over distances up to 500 km. After reviewing some organizational and financial changes which have occurred in the program during the last two years, the basic characteristics of the helicopter are cited, noting, in particular, the adoption of a wing to reduce the use of the main rotor. The design of the main rotor, the tail rotor, the wing-fuselage structure, the propulsion and power transmission systems, and the combustion, electrical, and hydraulic plants is described in detail. A.B.K.

A73-27384 # Systems analysis in aerospace projects (La 'systems analysis' nei progetti aerospaziali). G. Chiara (Fiat S.p.A., Divisione Aviazione, Turin, Italy). In: Italian contributions to present aerospace activities; Conference, 2nd, Turin, Italy, June 9, 10, 1972, Proceedings. Turin, Italy, Società Ingegneri ed Architetti di Torino, 1972, p. 53-55. In Italian.

Review of the fundamental parameters and purposes of systems analysis in the evaluation and optimization of aerospace systems. The main parameters defining the performance of a system are discussed, including capability, dependability, and availability, and a multistage procedure for carrying out a complete and accurate analysis of a system is outlined. Various applications of systems analysis are cited. A.B.K.

A73-27385 # A modern mechanical laboratory for the support of aircraft engine design (Un moderno laboratorio meccanico a supporto della progettazione di motori aeronautici). G. Feo (Fiat S.p.A., Divisione Aviazione, Turin, Italy). In: Italian contributions to present aerospace activities; Conference, 2nd, Turin, Italy, June 9, 10, 1972, Proceedings. Turin, Italy, Società Ingegneri ed Architetti di Torino, 1972, p. 59-61. In Italian.

A73-27387 # Graphic-interactive analysis of the velocity field around blade cascades for turbomachines (Analisi grafico-interattiva del campo di velocità intorno a profili di schiere per turbomacchine). A. Geranzani and A. Perardi (Fiat S.p.A., Turin, Italy). In: Italian contributions to present aerospace activities; Conference, 2nd, Turin, Italy, June 9, 10, 1972, Proceedings. Turin, Italy, Società Ingegneri ed Architetti di Torino, 1972, p. 67, 68. In Italian.

A73-27388 # Propulsion nozzles - Experimental analysis on models (Ugelli propulsori - Analisi sperimentale su modelli). B. Cockshutt and G. Vallini (Fiat S.p.A., Divisione Aviazione, Turin, Italy). In: Italian contributions to present aerospace activities; Conference, 2nd, Turin, Italy, June 9, 10, 1972, Proceedings. Turin, Italy, Società Ingegneri ed Architetti di Torino, 1972, p. 69, 70. In Italian.

Results of experimental tests on scale models of a conical variable-geometry propulsion nozzle with short petals for a multi-purpose fighter aircraft. The results of a series of tests on linear scale models with a 1:6.88 ratio are presented and discussed in order to evaluate the aerodynamic performance of this nozzle. In general, the lift coefficients obtained were found to be higher and the thrust coefficients lower than those predicted. A.B.K.

A73-27389 # Condition monitoring - A new technology for aircraft engine maintenance (Condition monitoring - Una nuova tecnologia per la manutenzione dei motori aeronautici). S. Brignone (Fiat S.p.A., Divisione Aviazione, Turin, Italy). In: Italian contributions to present aerospace activities; Conference, 2nd, Turin, Italy, June 9, 10, 1972, Proceedings. Turin, Italy, Società Ingegneri ed Architetti di Torino, 1972, p. 71-74. In Italian.

A73-27390 # Reduction of jet noise (Riduzione della rumorosità dei getti). M. Marini and G. Ruspa (Fiat S.p.A., Turin, Italy). In: Italian contributions to present aerospace activities; Conference, 2nd, Turin, Italy, June 9, 10, 1972, Proceedings. Turin, Italy, Società Ingegneri ed Architetti di Torino, 1972, p. 75, 76. 5 refs. In Italian.

Results of a study carried out in a series of acoustic and fluid-dynamic tests on various models of multilobed discharge silencers in a 1:4.35 scale with respect to the real size. It is shown that an improvement in sound attenuation is obtained from a lobed nozzle (eight lobes) with respect to a conical nozzle under real conditions, even in the approach phase. A.B.K.

A73-27394 # Certain fatigue phenomena in aeronautical structures with stiffened shells (Su alcuni fenomeni di fatica in strutture aeronautiche a guscio irrigidite). A. Salvetti, A. Del Puglia, and C. Casarosa (Pisa, Università, Pisa, Italy). In: Italian contributions to present aerospace activities; Conference, 2nd, Turin, Italy, June 9, 10, 1972, Proceedings. Turin, Italy, Società Ingegneri ed Architetti di Torino, 1972, p. 89-96. 15 refs. In Italian.

Review of the principal trends of development of research being carried out on an equipment complex particularly designed for the investigation of fatigue phenomena in structural components of aircraft. The research discussed deals (1) with the effect of repeated buckling by compression on the fatigue strength of stiffened panels, and (2) with the 'fail-safe' proportioning of stiffened panels subjected predominantly to tensile loads. A.B.K.

A73-27459 Response-optimum control of the angular and torsional oscillations of an elastic flying wing. E. A. Klestov and T. K. Sirazetdinov. (*Avtomatika i Telemekhanika*, Oct. 1972, p. 57-66.) *Automation and Remote Control*, vol. 33, no. 10, Mar. 1, 1973, pt. 1, p. 1611-1619. 7 refs. Translation.

An idealized model of an elastic aircraft of the 'flying wing' type is analyzed, and a response-optimum control function is synthesized for its angular motions and torsional oscillations during flight in a homogeneous turbulent atmosphere. An inequality-type constraint is imposed on the energy required for implementation of the control function. (Author)

A73-27460 Synthesis of searchless self-adjusting systems based on the root locus method. I. I. N. Krutova. (*Avtomatika i Telemekhanika*, Oct. 1972, p. 90-105.) *Automation and Remote Control*, vol. 33, no. 10, Mar. 1, 1973, pt. 1, p. 1641-1654. 8 refs. Translation.

The paper deals with the formulation of the problem, and the general design principles for searchless self-adjusting systems (SSAS) of certain classes on the basis of the root locus method. The basic ideas of the method are elucidated as applied to multiloop automatic control systems. The problem is divided into two parts: synthesis of the basic loop and synthesis of the self-adjusting loops. The method of synthesizing the basic loop of an SSAS is illustrated on the example of the pitch channel of an aircraft. (Author)

A73-27480 # Application of certain generalized data from wind-tunnel tests with plane subsonic compressor cascades to the calculation of the characteristic flow regimes in supersonic cascades

(Ispol'zovanie nekotorykh obobshchenii dannykh produkov ploskikh dozvukovykh kompressornykh reshetok dlia rascheta kharakternykh rezhimov obtekaniia reshetok so sverkhzvukovym profilirovaniem). A. I. Burmistrov and V. S. Talyzina. *Mashinostroenie*, no. 2, 1973, p. 168, 169. 5 refs. In Russian.

A73-27572 Potential applications of acoustic matched filters to air-traffic control systems. P. M. Grant, J. H. Collins, B. J. Darby, and D. P. Morgan (Edinburgh, University, Edinburgh, Scotland). *IEEE Transactions on Microwave Theory and Techniques*, vol. MTT-21, Apr. 1973, p. 288-300. 68 refs. Research supported by the Science Research Council and Ministry of Defence of England.

The potential role of acoustic matched filters in the demanding field of civil and military air-traffic control (ATC) systems is examined. Highlighted are the problems of current ATC systems and their significant aspects of acoustic matched filters and their expeditious usage in modems employing band spreading for a multi-subscriber environment and certain envisaged ATC systems deemed necessary for future traffic growth that could benefit materially from acoustic technology. (Author)

A73-27599 How real are the pilot's problems. C. Balfour and I. G. Smith (University College, Cardiff, Wales). *New Scientist*, vol. 57, Mar. 22, 1973, p. 672, 673.

An attempt is made to distinguish the special aspects of the pilot's work from the general trade union demand which a powerful group can make on the employer through pressure on the public. Pilots are victims of technological change since they have, to a large extent, become systems monitors. Pilots face a long seniority ladder, and it may take 20 or more years to become a captain. A union shop and high membership put pilots in a strong negotiating position. However, they complain of lack of job security and inattentiveness on the part of management. F.R.L.

A73-27652 Satellite systems for mobile communications and surveillance; Proceedings of the International Conference, London, England, March 13-15, 1973. Conference supported by the Institution of Electrical Engineers. London, Institution of Electrical Engineers (IEE Conference Publication, No. 95), 1973. 203 p. Members, \$13.; nonmembers, \$19.80.

The papers deal with the use of satellites for maritime and aircraft communications, for navigation, and for commercial purposes. Economic and governmental aspects of satellite operation are discussed, and experimental programs are described. Attention is given to various types of antennas for use on satellites and on the ground. Installation and operation of antennas is treated. Some satellite-balloon and balloon-aircraft experiments are discussed, as well as procedures for replacing aeronautical satellites. F.R.L.

A73-27654 Factors relating to the choice of antenna characteristics for the aircraft terminal in an aeronautical satellite communications/surveillance system. A. C. MacKellar (Civil Aviation Authority, London, England). In: Satellite systems for mobile communications and surveillance; Proceedings of the International Conference, London, England, March 13-15, 1973.

London, Institution of Electrical Engineers, 1973, p. 9-13.

A73-27655 The disc antenna - A possible L-band aircraft antenna. D. J. Brain and J. R. Mark (GEC-Marconi Electronics, Ltd., Great Baddow, Essex, England). In: Satellite systems for mobile communications and surveillance; Proceedings of the International Conference, London, England, March 13-15, 1973.

London, Institution of Electrical Engineers, 1973, p. 14-17.

Review of the design and performance of the basic disk antenna radiator, and discussion of the effects of its various parameters. It is

shown to present a low silhouette or, if necessary, capable of being recessed into an aircraft skin. The antenna has a half-power beamwidth of approximately 80 deg and a gain of typically +5 dB relative to a correspondingly polarized isotropic radiator. M.V.E.

A73-27656 A radiating element giving circularly polarised radiation over a large solid angle. M. J. Sidford (Royal Aircraft Establishment, Farnborough, Hants., England). In: Satellite systems for mobile communications and surveillance; Proceedings of the International Conference, London, England, March 13-15, 1973. London, Institution of Electrical Engineers, 1973, p. 18-25.

Description of a slot-dipole antenna element designed primarily for use in aircraft antenna systems for civil aeronautical satellite communications. This element is shown to be capable of producing useful gain with good circularity of polarization over a wide solid angle. The practicability of achieving a shallow profile design suitable for airframe mounting is demonstrated. M.V.E.

A73-27658 The provision of ground station facilities for an aeronautical satellite system. R. L. Turner (Marconi Communication Systems, Ltd., Chelmsford, Essex, England). In: Satellite systems for mobile communications and surveillance; Proceedings of the International Conference, London, England, March 13-15, 1973. London, Institution of Electrical Engineers, 1973, p. 30-34.

Consideration of the system constraints and requirements associated with the fixed ground communication stations for an aeronautical satellite system. It is shown that once a set of satellite and communication system parameters has been postulated, then the selection of ground station equipment is largely a compromise between technical and financial considerations. M.V.E.

A73-27666 The use of satellites for aircraft communications and air traffic control. L. J. Braybrook (Ministry of Defence, London, England). In: Satellite systems for mobile communications and surveillance; Proceedings of the International Conference, London, England, March 13-15, 1973. London, Institution of Electrical Engineers, 1973, p. 75-83.

Review of the communication service potential and technological requirements of satellite utilization in aircraft communications and air traffic control. It is shown that an aeronautical satellite service could offer a communications link suitable not only for high-quality pilot-to-controller voice communications but also for digital data transmissions with low error rates for both air traffic control and airline operations. Reviewed technological aspects include air traffic route coverage, surveillance methods, channel characteristics for system evaluation, and research and development requirements. A fully operational satellite-based air traffic control and aircraft communications capability is felt to be achievable by the 1980s. M.V.E.

A73-27667 Factors affecting the frequency chosen for aircraft to satellite communications. D. Hirst (Royal Aircraft Establishment, Farnborough, Hants., England). In: Satellite systems for mobile communications and surveillance; Proceedings of the International Conference, London, England, March 13-15, 1973. London, Institution of Electrical Engineers, 1973, p. 84-97.

Discussion of the frequency-dependent factors that affect the performance of aircraft-serving communications systems based on geostationary satellites. Special attention is given to transmission from the satellite and reception by the aircraft which represent the critical link of the system because of the limited power available within the satellite and because of the limited antenna gain achievable at the aircraft. Following a review of the effects of free-space, atmospheric, and ionospheric attenuation, as well as those of scintillation upon propagation, the influences of system noise temperature and sea reflection are examined, along with those of

(dc-to-rf) conversion efficiency and of receiver bandwidth. Using the data presented, it is possible to compare the performance of aeronautical satellite systems under a variety of parametric conditions. M.V.E.

A73-27668 Message organisation in the ground segment of an aeronautical satellite system. T. Slator (GEC-Marconi Co., Ltd., England) and A. E. Gilham (Marconi Communication Systems, Ltd., Chelmsford, Essex, England). In: Satellite systems for mobile communications and surveillance; Proceedings of the International Conference, London, England, March 13-15, 1973. London, Institution of Electrical Engineers, 1973, p. 98-102.

The general problem is that of a comparatively small number of land based users and a comparatively large instantaneous aircraft population (100 to 300) requiring access to a few voice and data channels. These requirements involve consideration of channel access control, arrangement of data messages, automatic data handling, data channels for independent surveillance, fault recognition, and inter-connection of separate ground segments. F.R.L.

A73-27670 Traffic channel assignment in the mobile services. G. L. Gridale (GEC-Marconi Electronics Co., Ltd., Great Baddow, Essex, England). In: Satellite systems for mobile communications and surveillance; Proceedings of the International Conference, London, England, March 13-15, 1973. London, Institution of Electrical Engineers, 1973, p. 112-115.

The means which could be adopted to assign channels of communication of acceptable quality for calls are examined, so that users may be provided with rapid service and the satellite links may be efficiently utilized. While an aeronautical satellite communication system could use channels in a similar way to the present terrestrial system, the large number of subscribers and the traffic pattern of a maritime system needs a more controlled channel assignment. A digital calling method is proposed as a solution. The digital technology available and the stable performance expected in a satellite communication system would enable automated operation to be introduced into ship-to-shore communication. F.R.L.

A73-27671 Long haul airlines and satellite communications. N. G. Anslow and J. O. Clark. In: Satellite systems for mobile communications and surveillance; Proceedings of the International Conference, London, England, March 13-15, 1973. London, Institution of Electrical Engineers, 1973, p. 116-124.

The political, operational, technical, and economic problems which will require solution prior to there being a viable operational satellite communications system for aviation purposes are outlined. Operators, who will eventually be required to provide capital running costs, do not accept many of the system proposals being thrust upon them. A need is recognized for future improvements in long distance air-to-ground communications, and it would appear that relay by synchronous satellite would offer the best prospect for achieving such improvements, but at great cost. One major systems engineering problem concerns the choice of frequency band; another is the need to consider independent surveillance. F.R.L.

A73-27680 * Balloon-aircraft ranging, data, and voice experiment. S. Wishna (NASA, Washington, D.C.). In: Satellite systems for mobile communications and surveillance; Proceedings of the International Conference, London, England, March 13-15, 1973. London, Institution of Electrical Engineers, 1973, p. 194-197.

The test facilities used in the experiment consisted of a ground station, a balloon platform, radar tracking stations, and a test aircraft. As a direct result of the experiment, several modifications have been incorporated into the equipment. The two most important modifications were the introduction of a 10-sec delay into the search

mode and the use of differentially coded phase shift keying for the data channel. G.R.

A73-27731 **XFV-12 may spur Navy VTOL family.** C. A. Robinson, Jr. *Aviation Week and Space Technology*, vol. 98, Apr. 16, 1973, p. 12-17.

Developing an augmentor wing V/STOL prototype aircraft, the XFV-12A, is a technology investment the Navy believes could pay dividends with a whole new family of multimission airplanes for the 1980s. The lifting principle for the XFV-12A is aerodynamic augmentation from an ejector system in the aft sections of the wing and canard surfaces. Engine thrust is augmented by large quantities of ambient air that is drawn in over the flaps by the ejector nozzles, creating rapid lift by pulling in outside air at a ratio of 7.5 lb/sec to 1 lb/sec nozzle or primary air diverted from the engine. F.R.L.

A73-27732 **FS-28 - A contribution to a possible development trend in light-aircraft design (FS-28 - Ein Beitrag zur möglichen Entwicklungsrichtung im Leichtflugzeugbau).** *Deutscher Aerokurier*, vol. 17, Mar. 1973, p. 152-156. In German.

The FS-28 is a test aircraft of a study group which includes two institutes of a university in West Germany and a German aerospace firm. The first flight with the new aircraft was made on December 20, 1972. The development of the aircraft is connected with an investigation of the possibilities for utilizing new aerodynamic developments in glider design in light motor aircraft. The use of suitable composite structures in the design of light aircraft is a second study objective. The design of the new aircraft is discussed together with its performance characteristics, the wing structure, the fuselage, the tail unit, the landing gear, the propeller, and the installation of the engine. G.R.

A73-27791 # **Stability and nonlinear oscillations of a helicopter (Ustoichivost' i nelineinye kolebaniia vertoleta).** R. F. Ganiev (Akademiia Nauk Ukrainskoi SSR, Institut Mekhaniki, Kiev, Ukrainian SSR) and A. A. Shcherbina (Kievskii Institut Inzhenerov Grazhdanskoi Aviatsii, Kiev, Ukrainian SSR). *Prikladnaia Mekhanika*, vol. 9, Feb. 1973, p. 42-52. 7 refs. In Russian.

A solid body standing on elastic supports on the ground is used as a helicopter model for an analysis of the oscillations of a helicopter in a static coordinate system and in a coupled coordinate system with resonance. Conditions of helicopter stability, eliminating oscillations, are defined. These conditions involve constraints on the parameters of elastic supports and on the inertial characteristics of the helicopter. Phase trajectories are plotted to describe the stable and unstable periodic motions of a helicopter on the ground. V.Z.

A73-27815 # **Motion of a wing of solid profile at a variable distance from a screen (O dvizhenii kryla telesnogo profilja s peremennym otstoianiem ot ekrana).** Iu. I. Zharii and V. N. Kravets. In: *Boundary-value problems of mathematical physics*. Kiev, Institut Matematiki AN USSR, 1971, p. 264-274. In Russian.

Consideration of the problem of the motion of a wing of solid profile in an ideal incompressible fluid at a variable distance from a screen within the framework of small-perturbation theory. A study is made of the linear problem of the effect of perturbations in the distance from the screen on the hydrodynamic characteristics of the wing. The solution to this problem is obtained with the aid of potential-type integral operators. An example is presented in which the influence function is determined for a wing of given profile. A.B.K.

A73-27927 # **Evaluation of lift and drag of a family of conically cambered wings at off design Mach numbers.** V. S. Holla (Indian Institute of Science, Bangalore, India), A. N. Subash (Indian Space Research Organization, Space Science and Technology Centre, Trivandrum, India), and K. Ajaykumar. *Aeronautical Society of India, Journal*, vol. 24, Nov. 1972, p. 390-402. 5 refs.

A73-27934 # **Exhaust emissions from gas turbine engines.** K. S. Shah and K. V. Rastogi (Malviya Regional Engineering College, Jaipur, India). *Aeronautical Society of India, Journal*, vol. 24, Nov. 1972, p. 427, 428.

The pollutants given out by gas turbine engines consist mainly of unburned hydrocarbons, carbon monoxide, carbon dioxide, and oxides of nitrogen. The quenching of the flame at the combustion chamber wall produces unburnt hydrocarbons. Nitric oxide is produced in the combustor, and incomplete conversion of NO to nitrogen dioxide occurs in the atmosphere. The effect of engine operating conditions and methods of reducing emissions are discussed. Air fuel ratio is the most important variable influencing the emissions. F.R.L.

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STAR ENTRIES

N73-19994# Royal Netherlands Aircraft Factories Fokker, Schiphol-Oost. Dept of Dynamics and Computation.
SOME TEST CASES; BASED ON ANALYTICAL METHODS IN LINEARIZED SUPERSONIC OSCILLATING LIFTING SURFACE THEORY. PART 2

A. J. L. R. Hasekamp 11 Jan. 1972 279 p refs
 (FOK-X-440) Avail: NTIS HC \$16.00

Algo 60 procedures are described which calculate velocity potential and pressure distribution on 3 types of planforms oscillating harmonically in a supersonic mainstream linearized theory. The formulations underlying the procedures are based on analytical methods, so that results from each procedure are exact within linearized theory, apart from errors due to calculation with finite precision. Author

N73-19995*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio.

OVERALL AND BLADE-ELEMENT PERFORMANCE OF A TRANSONIC COMPRESSOR STAGE WITH MULTIPLE-CIRCULAR-ARC BLADES AT TIP SPEED OF 419 METERS PER SECOND

George Kovich and Lonnie Reid Washington Mar. 1973 111 p refs
 (NASA-TM-X-2731, E-6823) Avail: NTIS HC \$3 00 CSCL 21E

A 50-centimeter-diameter axial-flow transonic compressor stage with multiple-circular-arc blades was designed and tested to study the effects of blade shape on efficiency and stall margin. At design speed, peak efficiency of 0.80 occurred at an equivalent weight flow of 29.0 kilograms per second. Measured total pressure ratio and total temperature ratio at peak efficiency were 1.69 and 1.20, respectively. The stall margin at design speed and an equivalent weight flow of 29.0 kilograms per second was 9 percent. The measured stall margin at design weight flow and speed was 15 percent. A comparison of rotor performance made with and without the stator showed a decrease in pressure ratio, peak efficiency, and maximum weight flow with the addition of the stator. Author

N73-19997*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

PERFORMANCE OF A LOW-PRESSURE-RATIO CENTRIFUGAL COMPRESSOR WITH FOUR DIFFUSER DESIGNS

Hugh A. Klassen Washington Mar. 1973 26 p refs
 (NASA-TN-D-7237; E-7296) Avail: NTIS HC \$3.00 CSCL 20D

A low-pressure-ratio centrifugal compressor was tested with four different diffuser configurations. One diffuser had airfoil vanes. Two were pipe diffusers. One pipe diffuser had 7.5 deg cone diffusing passages. The other had trumpet-shaped passages designed for linear static-pressure rise from throat to exit. The fourth configuration had flat vanes with elliptical leading edges similar to those of pipe diffusers. The side walls were contoured to produce a linear pressure rise. Peak compressor efficiencies were 0.82 with the airfoil vane and conical pipe diffusers, 0.80 with the trumpet, and 0.74 with the flat-vane design. Surge margin and useful range were greater for the airfoil-vane diffuser than for the other three. Author

N73-19998*# Boeing Commercial Airplane Co., Seattle, Wash.
DESIGN INTEGRATION AND NOISE STUDIES FOR JET STOL AIRCRAFT. TASK 7B: WIND TUNNEL INVESTIGATION OF A 14-PERCENT-THICK AIRFOIL WITH UPPER SURFACE BLOWING AT HIGH SUBSONIC MACH NUMBERS Final Research Report, Jun. 1972 - Jan. 1973
 Avtar S Mahal and I J Gilchrist Jan 1973 44 p refs
 (Contract NAS2-6344)

(NASA-CR-114560; D6-60182) Avail: NTIS HC \$4.25 CSCL 01A

An exploratory wind tunnel test has been conducted at Mach numbers from 0.60 to 0.80 to investigate the effects of nozzle geometry and upper surface blowing on the aerodynamic characteristics of a 14-percent-thick airfoil. Measured data included lift, drag, pitching moments, surface pressures, and nozzle thrust. Author

N73-19999*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

STEADY, SUBSONIC, LIFTING SURFACE THEORY FOR WINGS WITH SWEEP, PARTIAL SPAN, TRAILING EDGE CONTROL SURFACES

Richard T. Medan Washington Apr. 1973 35 p refs
 (NASA-TN-D-7251, A-4521) Avail: NTIS HC \$3.00 CSCL 01A

A method for computing the lifting pressure distribution on a wing with partial span, swept control surfaces is presented. This method is valid within the framework of linearized, steady, potential flow theory and consists of using conventional lifting surface theory in conjunction with a flap pressure mode. The cause of a numerical instability that can occur during the quadrature of the flap pressure mode is discussed, and an efficient technique to eliminate the instability is derived. This technique is valid for both the flap pressure mode and regular pressure modes and could be used to improve existing lifting surface methods. Examples of the use of the flap pressure mode and comparisons among this method, other theoretical methods, and experiments are given. Discrepancies with experiment are indicated and candidate causes are presented. It is concluded that the method can lead to an efficient and accurate solution of the mathematical problem when a partial span, trailing edge flap is involved. Author

N73-20003# Hydronautics, Inc., Laurel, Md.

ON THE AERODYNAMICS OF WAKE VORTICES

Clinton E. Brown Oct 1972 36 p refs Revised
 (AD-754055; TR-7115; AFOSR-72-1209TR) Avail: NTIS CSCL 01/2

The effect of wing span loading on the development of fully rolled up wing trailing vortices is discussed. It is shown that parabolic wing loadings produce potential flow maximum core rotary speeds which are finite and less than fifty percent of the downwash speeds at the plane of symmetry. The development of turbulent cores is analyzed and core growth is predicted to occur as the two thirds power of time whereas the peak velocities fall off as the inverse one third power. Axial flow effects of the wing profile drag and lifting system are shown to lead to axial jets on the vortex axis which may either follow the aircraft or exceed the free stream velocity depending on the ratio of profile drag to induced drag. Author (GRA)

N73-20004# Douglas Aircraft Co., Inc., Long Beach, Calif.

A GENERAL METHOD FOR CALCULATING THREE-DIMENSIONAL INCOMPRESSIBLE LAMINAR AND TURBULENT BOUNDARY LAYERS. 1: SWEEP INFINITE CYLINDERS AND SMALL CROSS FLOW

Tuncer Cebeci, G. J. Mosinskis, and Kalle Kaups Nov. 1972 69 p refs

(Contract N00014-72-C-0111)
 (AD-754440; MDC-J5694) Avail: NTIS CSCL 01/3

The report presents a general method for solving the laminar and turbulent boundary layer equations for swept infinite cylinders and for small cross flows. In the equations the Reynolds shear stress terms are eliminated by using an eddy viscosity concept. An efficient two-point finite-difference method is used to solve

the governing equations. The method has been programmed on the IBM 0/165. Author (GRA)

N73-20005 National Lending Library for Science and Technology, Boston Spa (England).

AIR EFFECTS IN AIRCRAFT HYDRAULIC SYSTEMS: MEASURES FOR THEIR REMOVAL

E. Koch 4 Dec. 1972 18 p refs Transl. into ENGLISH from Oelhydraulik und Pneumatic, v 15, no 11, 1971 p 465-469 In ENGLISH and GERMAN

(NLL-NEL-TT-2420-(6075.461)) Avail: Natl. Lending Library, Boston Spa, Eng. 2 NLL photocopy coupons

The effects of air in the pressure medium of hydraulic systems on the compressibility of the oil-air mixture are discussed. The nature of the occurrence of air in oils is described. Typical hydraulic systems are examined to show susceptibility to air contamination. Methods for removing air from hydraulic systems are reported.

Author

N73-20006* General Electric Co., Schenectady, N.Y. Research and Development Center.

SUBSONIC AND SUPERSONIC JETS AND SUPERSONIC SUPPRESSOR CHARACTERISTICS

H. T. Nagamatsu and R. E. Sheer, Jr. 10 Nov. 1972 121 p refs

(Contract NASw-1784)

(NASA-CR-131297) Avail: NTIS HC \$8.25 CSCL 01C

Convergent and parallel flow nozzles were used with room temperature air to investigate the flow and acoustic characteristics over a Mach number range of 0.6 to 1.5. For subsonic jets the maximum sound pressure levels occurred at 19.1 from the axis and the sound pressure level decreased monotonically with increasing angle. But for supersonic jets the sound pressure was nearly constant over most of angular positions. The power spectra for subsonic jets were similar with the peak occurring at 4 KHz and for a Mach 1.4 jet the peak occurred at 5 KHz. Near field sound pressure level distributions were quite similar for subsonic jets, but for supersonic jets the distributions were quite different. Mean and fluctuating velocity contours were determined for a convergent nozzle with the impact and piezoelectric impact pressure gage probes for Mach numbers of 0.6 to 1.4. A supersonic suppressor of 191 tubes and shrouds was investigated at Mach numbers of 1.4 and 0.7.

Author

N73-20007 Cranfield Inst. of Technology (England). Coll. of Aeronautics.

AEROPLANE DESIGN STUDY STOL AIRLINER (A7-1). PART 1: CONFIGURATION DESCRIPTION AND DATA

D. Howe and R. E. Ward Jun. 1972 32 p refs

(CRANFIELD-AERO-12-Pt-1) Avail: NTIS HC \$3.75

The aerodynamic configuration and design parameters of a short takeoff and landing airliner are discussed. The aircraft was designed to operate from 2,000 foot long single runways. Normal cruising speed is Mach 0.83 at 30,000 feet altitude. The estimated gross weight is 115,000 pounds. Approach speed is 79 knots at a landing weight of 100,000 pounds. The high lift coefficients are obtained either by externally blown jet flaps or an augmentor wing arrangement.

Author

N73-20008* National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

WING UPPER SURFACE FLAP Patent Application

Howard W. Stone, Jr., inventor (to NASA) Filed 14 Dec. 1972 10 p

(NASA-Case-LAR-11140-1; US-Patent-Appl-SN-315068) Avail: NTIS HC \$3.00 CSCL 01C

A system for providing yaw control in vehicles flying at high angles of attack and high supersonic and hypersonic speeds is described. The system consists of flaps mounted on the leading edges of a swept wing which can be deflected to provide a yawing moment to compensate for loss of yaw control normally provided by the rudder. A diagram of the installation is provided and the aerodynamic characteristics of the system are explained.

Author

N73-20009 National Aviation Facilities Experimental Center, Atlantic City, N.J.

DESIGN CALCULATIONS FOR A HALON 1301 DISTRIBUTION TUBE FOR AN AIRCRAFT CABIN FIRE EXTINGUISHING SYSTEM Final Report, Jun. - Aug. 1972

Jack A. Jones and Constantine P. Sarkos Apr. 1973 30 p refs

(Proj. 184-732-03X)

(FAA-NA-73-3; FAA-RD-73-32) Avail: NTIS HC \$3.50

Theoretical calculations were performed to aid in the design of a perforated tube that will uniformly distribute Halon 1301 throughout the unventilated passenger cabin of a commercial air transport. Conditions for the calculations were those of a passenger cabin of a DC-7 fuselage, with a volume of 4000 cubic feet and a length of 72 feet, being used as a test article for evaluating the performance of such a system. Four separate calculations were made to determine the: (1) size and number of orifices in the tube required for various Halon 1301 discharge rates; (2) pressure drop as a function of tube diameter and discharge rates; (3) time required to fill the tube with Halon 1301 for various tube diameters; and (4) cabin temperature and pressure after completion of Halon 1301 discharge. Author

N73-20010* National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

A NONLINEAR THEORY FOR SONIC-BOOM CALCULATIONS IN A STRATIFIED ATMOSPHERE

Michael Schorling Washington Mar. 1973 36 p refs

(NASA-TN-D-7105; L-8094) Avail: NTIS HC \$3.00 CSCL 20A

The exact solutions to the equations of gas dynamics are given with respect to the axis of slender lifting bodies in a stratified atmosphere. The boundary condition is satisfied by using slender-body theory. The solution predicts the magnitude of the pressure rise of the sonic boom and estimates the nonlinear effects in the vicinity of the cutoff point.

Author

N73-20013* National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

ANALYTICAL STUDY OF THE PERFORMANCE OF A GUST ALLEVIATION SYSTEM FOR A STOL AIRPLANE

Waldo I. Oehman Washington Apr. 1973 40 p refs

(NASA-TN-D-7201; L-8654) Avail: NTIS HC \$3.00 CSCL 01C

An analytical study has shown that a gust alleviation system for a STOL airplane in a cruise condition could reduce the root mean square of the normal acceleration of the airplane flying in random turbulence by as much as 50 percent. This alleviation is obtained by driving the flaps in response to normal acceleration and by moving the elevator in proportion to the commanded flap deflection angle and to a pitch-rate signal.

Author

N73-20014* National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

LOW SPEED WIND TUNNEL INVESTIGATION OF A LARGE SCALE LIFT FAN STOL TRANSPORT MODEL

Adolph Atencio, Jr., Leo P. Hall, and Jerry V. Kirk Feb. 1973 123 p refs Prepared in cooperation with Army Air Mobility Res. and Develop. Lab., Moffett Field, Calif.

(NASA-TM-X-62231) Avail: NTIS HC \$8.50 CSCL 01B

The low-speed aerodynamic characteristics of large scale V/STOL transport models with lift fan and lift-cruise fan propulsion systems are discussed. The model of this investigation had two fans mounted side by side in the nose section of the fuselage. This permitted a reasonably deep inlet on the inboard side of each fan while the outboard side had a fairly shallow inlet. Lift-cruise fans were installed on the aft section of the fuselage. Hood-type deflection ducts were used to turn the fan flow from the cruise direction to the lift direction for STOL performance. Fan performance is shown for all four fans both statically and with crossflow. Longitudinal force and moment results are shown for a representative tip speed (forward speed) range through wing supported flight. Lateral-directional characteristics are also presented. The results are presented without analysis.

Author

N73-20015# National Transportation Safety Board, Washington, D.C.

AIRCRAFT ACCIDENT REPORTS, BRIEF FORMAT: US CIVIL AVIATION. ISSUE NO. 5: 1971 ACCIDENTS

9 Jan. 1973 529 p

(NTSB-BA-73-1) Avail: NTIS HC \$28.50

This publication contains selected aircraft accident reports, in brief format, occurring in U. S. Civil Aviation operations during calendar year 1971. The 953 General Aviation accidents contained in this publication represent a random selection. The brief format presents the facts, conditions, circumstances, and probable cause(s) for each accident. Additional statistical information is tabulated by type of accident, phase of operation, kind of flying injury index, aircraft damage, conditions of light, pilot certificate, injuries, and causal factors. Author

N73-20016# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

ECONOMICS AND TERMINAL AREA ENVIRONMENTAL IMPACT OF STOL TRANSPORTATION

Elwood C. Stewart Feb. 1973 15 p

(NASA-TM-X-62239) Avail: NTIS HC \$3.00 CSCL 01C

The impact of short takeoff and landing aircraft in meeting the needs of short haul transportation systems is analyzed. The objectives of the short haul system are evaluated on the basis of the following criteria: (1) service to the passenger, (2) economic viability, and (3) terminal area environment conditions caused by community noise, ground and air decongestion, and air pollution. Data are presented in the forms of tables, charts, and graphs. An itemization of the conclusions reached after the preliminary investigation is included. Author

N73-20017# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.

A PRELIMINARY EVALUATION OF NOISE REDUCTION POTENTIAL FOR THE UPPER SURFACE BLOWN FLAP

R. E. Hayden, T. D. Scharon, Y. Kadman, J. Wilby, and M. J. Rudd [1972] 44 p

(Contract NAS1-11839)

(NASA-CR-112246; BBN-2478) Avail: NTIS HC \$4.25 CSCL 01C

An assessment of the basic acoustic characteristics and noise reduction potential of an upper surface blown flap consisting of a rectangular nozzle and a single turning flap which was designed to approximate a typical takeoff setting is presented. The noise reduction concepts studied were (1) replacing a section of the flap trailing edge with a porous material and (2) active modification of the flow field using blowing near the trailing edge. Diagrams of the airfoil section and test equipment are provided. Photographs of airflow conditions across the aerodynamic surface are included. Author

N73-20018# Lockheed-California Co., Burbank.
FLIGHT SERVICE EVALUATION OF PRD-49/EPOXY COMPOSITE PANELS IN WIDE BODIED COMMERCIAL TRANSPORT AIRCRAFT Final Report

John H. Wooley, Dale R. Paschal, and Eugene R. Crilly Mar. 1973 72 p refs

(Contract NAS1-11621)

(NASA-CR-112250) Avail: NTIS HC \$5.75 CSCL 01C

L-1011 aircraft fairing panel configurations were selected as test parts to compare the fabrication, costs and service performance characteristics of PRD-49 and fiberglass. These parts are currently fiberglass reinforced structure and the purpose of this program is to evaluate the results of direct substitution of PRD-49 fabric for the fiberglass. Three ship sets of these panels have been fabricated for a five year flight service evaluation on three L-1011 commercial airliners operating in widely diverse route structures. The standard tools and machining techniques used for fiberglass parts are unacceptable for cutting, trimming, and drilling the tougher PRD-49 fibers. Therefore, a machining development study was undertaken to provide the necessary new tools and machining techniques. After incorporating these new developments in the fabrication and installation of the panels, a manufacturing cost study revealed that the labor hours were only increased by about 12.5 percent. Author

N73-20019# Kanner (Leo) Associates, Redwood City, Calif.

EFFICIENCY STUDIES ON COCKPIT DISPLAYS

R. Beyer Washington NASA Apr 1973 33 p refs Transl. into ENGLISH from the 5th Yearly Meeting of the DGLR (Berlin), 4-6 Oct 1972 30 p

(Contract NASw-2481)

(NASA-TT-F-14846) Avail: NTIS HC \$3.75 CSCL 01C

A comparative evaluation of two forms of cockpit displays should take into account the control accuracy obtainable and the workload to which the pilot is subjected in following the indications of the displays in both cases. Factors to be considered for an assessment of cockpit displays include data for aircraft control, experimental psychological data, physiological measurements and subjective evaluations. The examples discussed show the complexity of the evaluation process for a given cockpit display. Author

N73-20020# Linguistic Systems, Inc., Cambridge, Mass.

DESCRIPTION AND IMPLEMENTATION OF A METHOD FOR CHARACTERIZING NOISE SOURCES IN JETS

J. Taillet Washington NASA Apr. 1973 27 p refs Transl. into ENGLISH from "Description et Mise en Oeuvre d'une Methode de Caracterisation des Sources de Bruit dans les Jets" Chantillon-sous-Bagneux, France, ONERA report Presented at the 8th Congr. of the Intern. Council of the Aeron. Sci., Amsterdam, 28 Aug. - 2 Sep. 1972

(Contract NASw-2482)

(NASA-TT-F-14851) Avail: NTIS HC \$3.50 CSCL 01C

A technique for characterizing noise sources in jets which is based on the measurement of infrared emission is described. The proposed method is an extension of Lighthill's theory and takes as the initial variables the mean parameters and the moments derived from experimentally obtained fluctuating parameters, which are introduced into a computer program yielding the spectrum and the radiation pattern of the sonic far field. The acoustic variables can thus be calculated from the measured characteristics of the jet turbulence, so that the problem of noise reduction is reduced to an aerodynamics problem. Author

(Contract NASw-2482)

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N73-20022# New York Univ., N.Y.

STUDIES OF ENGINE-AIRFRAME INTEGRATED HYPERSONIC VEHICLES

Heywood Saland, Herbert Fox, and Walter Hoydysh [1972] 32 p refs

(Grant NGR-33-016-131)

(NASA-CR-112300) Avail: NTIS HC \$3.75 CSCL 01C

A parametric study of an integrated airframe and engine is presented for a hypersonic transport at an altitude of 70,000 feet and a free stream Mach number of 6. The engine considered is a subsonic combustion ramjet using conventional hydrocarbon fuels. The lift-to-drag ratio of the aircraft for two configurations, one with full capture and accelerated flight and the other allowing spillage of the leading shock and in unaccelerated flight, is studied. The parameters varied are the engine efficiencies, the angle of attack, the combustion rates, as well as the captured mass flow. Lift-to-drag ratios on the order of 6.5 are obtained. Author

N73-20023# Advisory Group for Aerospace Research and Development, Paris (France).

A SUMMARY OF THE ANALYSIS OF GUST LOADS RECORDED BY COUNTING ACCELEROMETERS ON SEVENTEEN TYPES OF AIRCRAFT

I. W. Kaynes (RAE, Farnborough) Dec. 1972 713 p refs Presented at the 35th Struct. and Mater. Panel Meeting, Toulouse, France, 25 Sep. 1972

(AGARD-R-605; AGARD-586-Add) Avail: NTIS HC \$7.75

The collection and processing of gust load data obtained from counting accelerometers during twenty years of recording is described. Tables of the accelerations and equivalent gusts are presented, the latter having been calculated by both discrete and spectral gust models. The gust frequency distributions are discussed. Author

N73-20024# Army Electronics Command, Fort Monmouth, N.J.
AN ANALOG COMPUTER SIMULATION OF A GENERAL-

IZED HELICOPTER ROTOR SYSTEM

Tunis Robbins Nov. 1972 57 p refs

(DA Proj. 1H1-62202-A-219)

(AD-754547; ECOM-4043) Avail: NTIS CSCL 01/3

The report describes an analog simulation of a generalized single-rotored helicopter rotor system as programmed on an EAI 231R-V analog computer. The simulation described is modeled from equations of motion of sufficient detail so as to permit the use of the simulation in flight control and avionics design studies. The program is suitable for use in a hybrid computer total forces and moments simulation or as a part of a more simplified analog computer model of a single rotored helicopter. An automatic setup and check program is described which allows rapid reconfiguration of the analog rotor program to represent many different kinds of rotor systems, including the hingeless and articulated types with any number of blades. Author (GRA)

N73-20025# Naval Postgraduate School, Monterey, Calif.
**GENERALIZED PERFORMANCE LIMITS FOR PROPELLERS,
 WINDMILLS AND LIFTING ROTORS WITH AXES PARALLEL
 TO THE UNDISTURBED FLOW**

Theodore H. Gawain Dec. 1972 104 p ref

(AD-754072; NPS-57GN72121A) Avail: NTIS CSCL 01/3

The report generalizes the classical momentum theory as usually applied to propellers, windmills and lifting rotors into a single unified treatment. It also extends the analysis to include the regime in which flow through part or all of the actuator disc is reversed with respect to the remote flow field. Dimensional analysis is used in a systematic manner to reduce the final results to their simplest and most significant forms. It is shown that the performance of these devices can always be represented by a single parameter family of curves in which the parameter expresses the extent to which the performance of the actual device falls short of the theoretical limit. Detailed algebraic solutions are derived in closed form for the performance of both the idealized zero torque and finite torque actuators, these represent performance limits which any comparable real device may approach but never exceed. A qualitative analysis is presented concerning the development of the vortex ring state. The fundamental dynamic stability of the ideal lifting rotor is also analyzed. While this paper deals with a classical topic in fundamental fluid mechanics, the approach employed is original and many of the results derived here are in a form that is essentially new. Author (GRA)

N73-20026# National Bureau of Standards, Washington, D.C.
AIR DENSITY AND HELICOPTER LIFT Final Report

Frank E. Jones Jan. 1973 58 p refs

(Contract NAonr-15-72, NR Proj. 213-096)

(AD-754420; NBS-10882; JANAIR-721201) Avail: NTIS CSCL 20/4

An analysis has been made of ideal and real gas equations as they apply to the calculation of air density in the region of interest for helicopter flight. The uncertainties in calculated air density due to uncertainties in measurements of temperature, pressure and humidity have been investigated and estimates have been made of measurement accuracies which would be required to enable calculation of air density with a desired relative uncertainty. A reference system has been assembled to provide measurements of temperature, pressure and dew-point temperature aboard a helicopter. This system is to be used in making calculations of reference air density for flight tests of a system for computing hover lift margin and several devices for measuring air density. GRA

N73-20027# System Development Corp., Santa Monica, Calif.
**ANNOTATED BIBLIOGRAPHY ON CUMULATIVE FATIGUE
 DAMAGE AND STRUCTURAL RELIABILITY MODELS**

V. K. Murthy and G. B. Wartz Dec. 1972 262 p refs

(Contract F33615-71-C-1776; AF Proj. 7071)

(AD-754062; SDC-SP-3663; ARL-72-0161) Avail: NTIS CSCL 01/3

The authors selected almost one hundred publications in the area of modeling cumulative fatigue damage of airframe and helicopter rotor blade structures bringing to light the salient contributions as well as the limitations and assumptions in each of these papers. GRA

N73-20028*# Michigan Univ., Ann Arbor
**PROCEEDINGS OF THE 8TH ANNUAL CONFERENCE ON
 MANUAL CONTROL**

Richard W. Pew Wright-Patterson AFB, Ohio AFFDL Jul. 1972 649 p refs Conf. held at Ann Arbor, Mich., 17-19, May 1972

(Contract NSR-23-005-364)

(NASA-CR-131244; AD-754908; AFFDL-TR-72-92) Avail: NTIS HC \$34 50 CSCL 01/3

The volume presents recent developments in the field of manual control theory and applications. The papers give analytical methods as well as examples of the important interplay between man and machine, such as how man controls and stabilizes machine dynamics, and how machines extend man's capability. Included in the broad range of subjects are procedures to evaluate and identify display systems, controllers, manipulators, human operators, aircraft, and non-flying vehicles. Of particular interest is the continuing trend of applying control theory to problems in medicine and psychology, as well as to problems in vehicle control. Author (GRA)

N73-20029# Calspan Corp., Buffalo, N.Y.
**FLIGHT INVESTIGATION OF VARIOUS LONGITUDINAL
 SHORT-TERM DYNAMICS FOR STOL LANDING AP-
 PROACH USING THE X-22A VARIABLE STABILITY AIR-
 CRAFT Final Report, Aug. 1971 - Mar. 1972**

R. E. Smith, J. V. Lebacqz, and J. M. Schuler Jan. 1973 218 p refs

(Contract N00019-71-C-0044)

(AD-754840; CAL-TB-3100-F-2) Avail: NTIS CSCL 01/3

The first in-flight flying qualities experiment using the variable stability X-22A aircraft investigated longitudinal flying qualities requirements for STOL aircraft in terminal area operations. Emphasis was placed on defining minimum requirements for the short-term response in VFR and IFR landing approaches at representative steep STOL approach conditions of 65 and 80 knots. Evaluation flights were conducted in negligible and moderate turbulence for a wide range of short-term frequencies and dampings. Identification of the dynamics of the evaluation configurations was performed, to a large extent, by a new, advanced digital identification technique developed for the X-22A aircraft. Author (GRA)

N73-20030# Mississippi State Univ., State College, Dept. of
 Aerophysics and Aerospace Engineering.

**MEASUREMENTS OF VELOCITY COMPONENTS IN THE
 WAKE OF A FULL SCALE HELICOPTER ROTOR IN HOVER
 Final Report, Sep. 1970 - Sep. 1971**

Donald W. Boatwright Aug. 1972 129 p refs

(Contract DAAJ02-67-C-0105; DA Proj. 1F1-62204-A-139)

(AD-754644; AASE-72-59, USAAMRDL-TR-72-33) Avail: NTIS CSCL 01/3

The report presents three-component wake velocity measurements made with a split-film total vector anemometer. The measurements were made in the wake of a full-scale OH-13E helicopter rotor which was mounted on a 60-foot rotor test tower at Mississippi State University. Time-averaged velocity distributions along wake radii at various distances below the rotor disk were measured for two conditions of disk loading and three combinations of blade pitch and rotor speed. Instantaneous velocity measurements were made across the helical vortex trails to investigate the effects of blade pitch and rotor speed on vortex structure, core size, transport velocity, and distribution of axial and tangential velocity components within the vortices. Author (GRA)

N73-20031# Air Force Systems Command, Wright-Patterson
 AFB, Ohio, Foreign Technology Div.
**THE OPERATION OF A TWO-CHAMBER PNEUDRAULIC
 SHOCK ABSORBER**

N. A. Melik-Zade 4 Jan. 1973 19 p refs Transl. into ENGLISH from Mashinoved (Moscow), no. 2, 1971 p 44-50 (AF Proj. 1369)

(AD-754609; FTD-MT-24-964-72) Avail: NTIS CSCL 01/3

For the most common types of two chamber, pneumohydraulic shock absorbers for S type landing gear, the author presents

the functions permitting the shock absorber's initial charging, motion, and force parameters, which arise during the static and dynamic compression of the landing gear by different methods, to be defined. The shock absorber's operational equations allow the author to create a generalized program for computer solution of the system of dynamic equations of the motion of a landing gear with different types of one chamber and two chamber shock absorbers
GRA

N73-20032# Honeywell, Inc. Minneapolis, Minn. Government and Aeronautical Products Div.

ADVANCED HYDROFLUIDIC STABILIZATION SYSTEM Final Technical Report, 23 Apr. 1971 - 23 Apr. 1972

Mark E. Ebsen and James O. Hedeon Ft. Eustis, Va Army Air Mobility R and D Lab. Oct. 1972 150 p refs
(Contract DAAJ02-71-C-0040; DA Proj. 1F1-62204-AA-44)
(AD-754602; W0502-FR; USAAMRD-TR-72-46) Avail: NTIS CSCL 01/3

The results of a design study to define and analyze a hydrofluidic flight control system for helicopters, incorporating pilot relief modes, are presented. The system defined provides the pilot with stability augmentation in three axes, over the total aircraft flight envelope, and with pitch and roll attitude hold, heading hold, and altitude hold over the normal range of cruise airspeeds. To obtain a relatively simple, low-cost system, control panel switching, electrical display gyros for attitude and heading signals, and series servoactuators for both stability augmentation and outer-loop modes are used. The study results indicate that a simple hydrofluidic flight control system which will provide significant relief for the pilot can be mechanized.

Author (GRA)

N73-20033# National Transportation Safety Board, Washington, D C. Bureau of Aviation Safety

AIRCRAFT ACCIDENT REPORT: HUGHES AIR WEST DC-9, N9345, AND US MARINE CORPS F-4B, 151458 NEAR DURANTE, CALIFORNIA, 6 JUNE 1971

22 Sep. 1972 51 p
(PB-212987; NTSB-AAR-72-26) Avail: NTIS HC \$3.00 CSCL 01B

A Hughes Air West DC-9, N9345, and a U.S. Marine Corps F-4B, 151458, collided in flight near Duarte, California, at approximately 1811 P.d.t., June 6, 1971. All 49 occupants aboard the DC-9 and the pilot of the F-4B were fatally injured. The National Transportation Safety Board determines that the probable cause of this accident was the failure of both crews to see and avoid each other but recognizes that they had only marginal capability to detect, assess, and avoid the collision.

Author (GRA)

N73-20034# Notre Dame Univ., Ind Dept. of Aerospace and Mechanical Engineering.

PARAFOIL POWERED FLIGHT PERFORMANCE Final Report John D. Nicolaides Jan. 1972 116 p refs

(Contract F33615-71-C-1093; AF Proj. 6065)
(AD-754907; AFFDL-TR-72-23) Avail: NTIS CSCL 01/3

The predicted flight performance of a powered parafoil flight vehicle is calculated from solutions which are obtained from the parafoil equations of motion. Flight vehicle total weights of 350, 400, 500, and 540 pounds are considered. Parafoil wing areas of 200 square feet and 400 square feet are considered. Wing loadings include .875, 1.0, 1.25, 1.35, 1.75, 2.0, and 2.7 pounds per square foot. Steady state flight trim angles of attack cover a range from -6 degrees to -80 degrees. The flight performance analyses include level flight, climbing flight, and descending flight. The computed flight parameters include the total velocity, the rate of climb (sink), the angle of climb (descent), and the horsepower required for the type of flight under consideration.

Author (GRA)

N73-20035# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.

EVALUATION OF ENERGY MANEUVERABILITY PROCEDURES IN AIRCRAFT FLIGHT PATH OPTIMIZATION AND PERFORMANCE ESTIMATION Final Technical Report, Jul. 1967 - Aug. 1970

David T. Johnson Nov. 1972 87 p refs
(AD-754909; AFFDL-TR-72-58) Avail: NTIS CSCL 01/2

An assessment is made of the applicability of energy maneuverability techniques (EM) to flight path optimization. A series of minimum time and fuel maneuvers using the F-4C aircraft were established to progressively violate the assumptions inherent in the EM program and comparisons were made with the Air Force Flight Dynamics Laboratory's (AFFDL) Three-Degree-of-Freedom Trajectory Optimization Program and a point mass option of the Six-Degree-of-Freedom flight path program. It was found the EM results were always optimistic in the value of the payoff functions with the optimism increasing as the percentage of the maneuver involving constant energy transitions increases. For the minimum time paths the resulting optimism was less than 2% for the maneuvers where the constant energy percentage was less than 35% followed by a rather steeply rising curve approaching in the limit 100% error for paths which are comprised entirely of constant energy transitions.

Author (GRA)

N73-20036# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div

DETERMINATION OF OPTIMUM PARAMETERS OF THE MEANS USED TO PROTECT THE COMPARTMENTS OF AN AIRCRAFT FROM AERODYNAMIC HEAT AT HIGH SPEEDS AND DURING A PROLONGED FLIGHT

F. G. Yasinskii 5 Jan. 1973 21 p refs Transl into ENGLISH from 'Samoletostr. Tekh. Vozdush. Flota (USSR), no. 22, 1970 p 61-69

(AD-754606; FTD-HT-23-1755-72) Avail: NTIS CSCL 01/3

Optimum parameters of the means used to protect the aircraft compartments from aerodynamic heat are determined. The thermal conductivity coefficient is expressed in the form of a linear temperature function when studying the external and internal heat insulators. Coupling equations are used in computations using an electronic digital computer.

Author (GRA)

N73-20037# Defense Documentation Center, Alexandria, Va. **SHORT TAKE-OFF PLANES** Report Bibliography, Oct. 1960 - May 1972

Jan. 1973 219 p refs
(AD-754500; DDC-TAS-72-74) Avail: NTIS CSCL 01/3

The annotated bibliography contains unclassified and unlimited references on short take-off planes. Discussed are design, configurations, wing-body configurations, flight testing, wind tunnel tests, aerodynamic configurations, aerodynamic characteristics, handling qualities, performance and stability of short take-off planes Corporate Author-Monitoring Agency, Subject, Title, and Personal Author Indexes are included.

Author (GRA)

N73-20041*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

THREE AXES CONTROLLER Patent Application Charles L. Bailey, Jr. inventor (to NASA) Filed 15 Mar. 1973 22 p

(NASA-Case-MS-C-12394-1; US-Patent-App-SN-341662) Avail: NTIS HC \$3.25 CSCL 131

Aircraft and spacecraft single-hand controllers are described which employ the principle of independent rotational movements about one or more axes. The controller can be manipulated to provide mutually independent controls of yaw, pitch, and roll axes. The hand grip is attached to a pitch control means and mounted about the pitch axis, which is perpendicular to the longitudinal axis through the controller. The pivotal mounting includes a resilient force mechanism which provides a stabilizing force to maintain the grip in neutral position. Rotation of the grip about the pitch axis produces direct rotation of a transducer element and an electrical indication of pitch. Diagrams are included.

NASA

N73-20049# AiResearch Mfg. Co., Phoenix, Ariz.

ADVANCED AUXILIARY POWER SYSTEM Final Technical Report, Nov. 1968 - May 1972

Andrew D. Meshew and Donald F. Swenski Wright-Patterson AFB, Ohio AFAPL 30 Nov. 1972 512 p
(Contract F33615-69-C-1100; AF Proj. 3145)

N73-20174

(AD-754903; SY-6055-R8-Rev-1; SC-6308, AFAPL-TR-72-59)
Avail: NTIS CSCL 10/2

The purpose of the program was to advance the technology of small auxiliary power units, using the secondary power system requirements of a hypothetical fighter aircraft of mid-1970 as a goal and an auxiliary power system as a test bed for exploratory development. The APU was 10 in. in diameter by 24 in. long, and the design-point performance goal was 300 equivalent shaft horsepower at 2200F turbine inlet temperature and sea

Author (GRA)

N73-20174* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

DOPPLER COMPENSATION BY SHIFTING TRANSMITTED OBJECT FREQUENCY WITHIN LIMITS Patent

Charles R. Laughlin, Roger C. Hollenbaugh, and Walter K. Allen, inventors (to NASA) Issued 6 Feb. 1973 6 p Filed 18 Jun. 1970 Supersedes N70-41978 (08 - 24, p 4467) Continuation-in-part of US Patent Appl. SN-701679, filed 30 Jan. 1968

(NASA-Case-GSC-10087-4; US-Patent-3,715,663;

US-Patent-Appl-SN-47440; US-Patent-Class-325-4;

US-Patent-Class-325-5; US-Patent-Class-325-7;

US-Patent-Class-325-8; US-Patent-Class-325-9;

US-Patent-Class-325-12; US-Patent-Class-325-17;

US-Patent-Class-325-63; US-Patent-Class-343-179;

US-Patent-Appl-Sn-701679) Avail: US Patent Office CSCL 17B

A system and method are disclosed for position locating, deriving centralized air traffic control data, and communicating via voice and digital signals between a multiplicity of remote aircraft, including supersonic transports, and a central station. Such communication takes place through a synchronous satellite relay station. Side tone ranging patterns, as well as the digital and voice signals, are modulated on a carrier transmitted from the central station and received on all of the supersonic transports. Each aircraft communicates with the ground stations via a different frequency multiplexed spectrum. Supersonic transport position is derived from a computer at the central station and supplied to a local air traffic controller. Position is determined in response to variable phase information imposed on the side tones at the aircraft. Common to all of the side tone techniques is Doppler compensation for the supersonic transport velocity.

Official Gazette of the U.S. Patent Office

N73-20182# National Aviation Facilities Experimental Center, Atlantic City, N.J

EVALUATE IMPROVED AIRPORT BEACON Final Report, Jan. 1970 - Nov. 1972

R. Johnston Mar 1973 25 p

(FAA Proj. 071-312-02X)

(FAA-NA-73-1; FAA-RD-73-25) Avail: NTIS HC \$3.25

Two forms of experimental beacons, strobe and incandescent, were tested to determine their suitability as improved replacement for the standard 36-inch rotating airport beacon presently in use. Neither unit demonstrated a clearcut superiority over the standard beacon, and the need for further development effort was indicated. A type of low-cost incandescent airport beacon was evaluated at the same time and found suitable for use at smaller, secondary airports.

Author

N73-20183# Lincoln Lab., Mass. Inst. of Tech., Lexington.

CONCEPTS FOR IMPROVEMENT OF AIRPORT SURVEILLANCE RADARS

C. Muehe, J. Cremin, M. Labitt, M. Labitt, V. Sferrino, B. Gold, Hofstetter E., and D. Pruslin 26 Feb. 1973 58 p refs

(Contracts DOT-FA72WAI-242, F19628-73-C-0002)

(ATC-14) Avail: NTIS HC \$5.00

The performance of operational airport surveillance radars is discussed. The subjects covered are: (1) the types of clutter which affect operation, (2) methods for overcoming clutter, and state-of-the art techniques incorporated into the radar system. Two radars, one at S-band and one at UHF, are analyzed to show compliance with requirements for air route traffic surveil-

lance. It is concluded that the major improvements in performance will be derived from the use of linear optimum signal processing.

Author

N73-20184# Lincoln Lab., Mass. Inst. of Tech., Lexington.
DEVELOPMENT OF A DISCRETE ADDRESS BEACON SYSTEM Quarterly Technical Summary Report, 1 Oct. - 31 Dec. 1972

1 Jan. 1973 110 p refs

(Contracts DOT-FA72WAI-261; F19628-70-C-0230; Proj. 034-241-012)

(FAA-RD-73-12, QTSR-4) Avail: NTIS HC \$7.50

The development of a discrete address beacon system (DABS) for air traffic control applications is discussed. The subjects presented are: (1) DABS link design modulation, (2) transponder design and cost studies, (3) transponder antenna/airframe pattern measurements, (4) sensor monopulse antenna-processor studies, and (5) rotating antenna traffic capability. DABS prototype field tests are recommended. A description of the DABS experimental facility hardware, software, and implementation status is included.

Author

N73-20207# Mitre Corp., Bedford, Mass.

SUMMARY OF FY 1972 ACTIVITIES ON AIR FORCE SYSTEMS COMMAND (AFSC) PROGRAM 634A: COMMUNICATION, NAVIGATION IDENTIFICATION (CNI) SYSTEM DEVELOPMENT PLANNING

E. Ferrari Dec. 1972 86 p refs

(Contract F19628-73-C-0001; AF Proj. 691A)

(AD-754930; MTR-2441, ESD-TR-72-333) Avail: NTIS CSCL 17/2

The objectives of AFSC Program 634A are to identify and evaluate new approaches for fulfilling Air Force common-user communications, navigation and identification requirements. This report describes the activities and status of efforts in the areas of requirements, message traffic, equipment data base, costs, design and evaluation criteria, and system concepts.

Author (GRA)

N73-20240*# Martin Marietta Corp., Denver, Colo.

STUDY OF FEASIBILITY OF SOLID-STATE ELECTRIC SWITCH GEAR FOR AIRCRAFT AND SPACECRAFT

E. Buchanan and D. Waddington Mar. 1973 155 p

(Contract NAS3-15824)

(NASA-CR-121140; MCR-72-327) Avail: NTIS HC \$9.75 CSCL 09A

The design of a solid-state circuit breaker that can be interconnected to a second breaker to form a transfer switch is presented. The breaker operates on a nominal 270 volt dc circuit and controls power to loads of up to 15 amperes. Automatic overload trip is provided as a function of excess energy measured through the breaker and/or excess current through the breaker. After an overload trip, up to nine preprogrammable attempts to reclose may be tried with programmable delays between each attempt. The breaker or switch is remotely controllable. Test data on performance in the laboratory over temperatures from minus 45 to 100 C are provided. The feasibility of solid-state switch gear has been established.

Author

N73-20262# Naval Air Systems Command, Washington, D.C.
ELECTROMAGNETIC COMPATIBILITY MANUAL. APPENDIX A THROUGH APPENDIX G.

May 1972 483 p refs

(AD-754412; NAVAIR-5335-App) Avail: NTIS CSCL 09/3

The following topics are discussed. Electromagnetic compatibility control plan for XY-1A Weapon System; Electromagnetic interference control plan for data link subsystem; XY-2A aircraft weapon system electromagnetic compatibility test plan. Electromagnetic interference test plan, Glossary, designators, and abbreviations; Computational aids.

GRA

N73-20263# Naval Air Systems Command, Washington, D.C.

ELECTROMAGNETIC COMPATIBILITY MANUAL

Joseph J. Fisher May 1972 829 p refs

(AD-754411; NAVAIR-5335) Avail: NTIS CSCL 09/3

The material in the manual, with its contributions for improvements in the state-of-the-art of electromagnetic compatibility, provides a reference on methods for the reduction of electromagnetic interference and accomplishing electromagnetic compatibility in and between aircraft weapons systems.

Author (GRA)

N73-20269# Advisory Group for Aerospace Research and Development, Paris (France). Large Wind Tunnels Working Group. **THE NEED FOR LARGE WIND TUNNELS IN EUROPE**

Dec. 1972 96 p refs

(AGARD-AR-60) Avail: NTIS HC \$7.00

The Report of the Large Wind-Tunnels Working Group of the AGARD Fluid Dynamics Panels, follows nine meetings between December 1971 and November 1972. Review of existing position and future prospects, the role of the wind-tunnel in research and development, existing European wind-tunnels present national plans for wind-tunnels, future needs, options for new large low-speed and transonic tunnels, a proposed time schedule for provision of new tunnels, and proposals for a collaborative work program to clarify existing problems in wind-tunnel design and operation. It is concluded that the first priority is for a new large pressurized transonic wind-tunnel in Europe; four possible options for realization of this need are given, and an Engineering Study is proposed, with a Work Statement, to assess and evaluate the engineering requirements of the options. The second priority, of importance almost equal to the first, is for a new large low-speed wind-tunnel. This should be of 18 m or 25 m width; the Group has not been able to agree between these figures. Provision of new European supersonic and hypersonic facilities should begin when the subsonic and transonic requirements have been met; long term technical needs for these are defined. Author

N73-20271# Federal Aviation Administration, Washington, D.C. **AIRPORT DESIGN STANDARDS: EFFECTS AND TREATMENT OF JET BLAST**

13 Jul. 1972 18 p refs

(AC-150/5325-6A) Avail: NTIS HC \$3.00

Criteria on the jet engine blast velocities associated with aircraft in common use in air carrier service, the effects of these blast velocities during ground operations, and suggested methods for counteracting or minimizing the effects are presented. The areas considered are: (1) personnel and equipment operation, (2) taxiways, (3) pavement edge, (4) cargo and maintenance areas, and (5) terminal areas. Graphs of blast velocities for various aircraft at different stages of operation are developed. The design and installation of blast fences are analyzed. The effects of blast erosion on off-pavement areas are reported. Author

N73-20277*# Pennsylvania State Univ., University Park. Dept of Aerospace Engineering. **AEROACOUSTIC RESEARCH IN WIND TUNNELS: A STATUS REPORT**

James Bender and R. E. A. Arndt Feb. 1973 163 p refs

(Contract NAS2-6312)

(NASA-CR-114575; PSU-AERSP-73-1) Avail: NTIS HC \$10.25 CSCL 14B

The increasing attention given to aerodynamically generated noise brings into focus the need for quality experimental research in this area. To meet this need several specialized anechoic wind tunnels have been constructed. In many cases, however, budgetary constraints and the like make it desirable to use conventional wind tunnels for this work. Three basic problems are inherent in conventional facilities: (1) high background noise, (2) strong frequency dependent reverberation effects, and (3) unique instrumentation problems. The known acoustic characteristics of several conventional wind tunnels are evaluated and data obtained in a smaller 4- x 5-foot wind tunnel which is convertible from a closed jet to an open jet mode are presented. The data from these tunnels serve as a guideline for proposed modifications to a 7- x 10-foot wind tunnel. Consideration is given to acoustic treatment in several different portions of the wind tunnel. Author

N73-20278# Systems Consultants, Inc., McLean, Va. Management and Data Systems Div.

STATISTICAL METHOD FOR MEASURING AERONAUTICAL ACTIVITY AT NON-TOWERED AIRPORTS Final Report, Dec. 1971 - Jul. 1972

Bruce Brown and Carl Carlson Jan. 1973 96 p

(Contract DOT-FA72WA-2774)

(SCI-2040; FAA-RD-73-18) Avail: NTIS HC \$7.00

A study to evaluate existing procedures for estimating annual operations at non-tower airports develop new alternative methods with equal or superior qualifications and present necessary comparison data concerning statistical accuracy and cost to permit the FAA to select a standardized technique to be used throughout the country is reported. For this purpose an analytical procedure was developed which evaluated both existing and new alternative techniques by comparing their predictive qualities with a set of known operations data representative of airports in each region of the United States. The principal results, the basis of the analysis, documentation of comparative studies and identification of recommended alternative estimation techniques are included. The statistical foundations of each estimating technique have been rigorously examined in this study and these efforts are thoroughly documented. Author

N73-20280# Saphier, Lerner, Schindler, Environetics, Inc., New York.

NEW YORK OFFSHORE AIRPORT FEASIBILITY STUDY

Lawrence Lerner and Marshall A. Graham Washington FAA Mar. 1973 31 p

(Contract DOT-FA71WA-2626)

(FAA-RD-73-45) Avail: NTIS HC \$3.50

The technical and economic feasibility of an offshore airport for the New York Metropolitan region are discussed. The study included analyses of a series of major tasks and subtasks which affect airport planning including: (1) air traffic projections, (2) air traffic control, (3) meteorology, airport design and layout, (4) oceanographic and geologic factors, (5) facilities engineering and construction (with particular emphasis on the special factors due to the site on water), (6) ground access systems, and (7) environmental factors such as marine ecology, noise and air pollution, solid waste disposal and radioactivity. A multimodal concept was considered including a deep-draft harbor at the selected location. Review of these program areas led to the conclusion that the selected site should be south of the barrier beaches of Long Island and that the development of this offshore airport is feasible. Author

N73-20283# Army Missile Command, Redstone Arsenal, Ala. Ground Equipment and Materials Directorate.

GROUND SUPPORT EQUIPMENT AIRBORNE LAUNCHER VIBRATION ISOLATION DESIGN

James M. Oliver 6 Sep. 1972 46 p refs

(DA Proj. 1M2-62303-A-214)

(AD-754537; RL-TR-72-9) Avail: NTIS CSCL 19/5

A theoretical analysis of simple mathematical models of mechanical systems is carried out with a view toward the design of a vibration isolation system for helicopter mounted rocket launchers. Possible future problems and their possible solutions are discussed. An alternative to the vibration isolation system as a means of reducing launching errors due to helicopter induced motion is given. Author (GRA)

N73-20284# Naval Air Development Center, Warminster, Pa. Air Vehicle Technology Dept.

TEST PLAN TO SUBSTANTIATE THE CAPACITY OF E-2A ARRESTED LANDINGS

Robert B. Cadman 7 Nov. 1972 9 p refs

(AD-754752; NADC-72216-VT) Avail: NTIS CSCL 01/5

The E-2A arresting hook A-frame is currently adequate for 500 arrested landings. It is the purpose of this effort to extend the life to 3,000 arrested landings. Author (GRA)

N73-20285# Naval Air Development Center, Warminster, Pa. Air Vehicle Technology Dept.

HOOK BOUNCE TEST OF THE E-2A AIRPLANE A-FRAME

Final Report

Robert B. Cadman 27 Dec. 1972 14 p

(AD-754753; NADC-72218-VT) Avail: NTIS CSCL 01/5

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

Author (GRA)

N73-20286# Princeton Univ., N.J. Dept. of Aerospace and Mechanical Sciences.

RESEARCH ON NOISE GENERATED BY DUCTED AIR-FUEL COMBUSTION SYSTEMS Annual Report, 1 Mar. 1971 - 29 Feb. 1972

Edelbert G. Plett and Martin Summerfield 1 Mar. 1972 45 p refs

(Contract N00014-67-A-0151-0029)

(AD-754094) Avail: NTIS CSCL 14/2

The development of a jet noise facility to study the interaction of the flow with bluff bodies inside the duct resulting in more intense noise than is expected from the jet itself is described. The long range objective is to use the information on noise due to bluff bodies and non-steady combustion inside the duct to relate their relative importance as a source of noise in an aircraft jet engine. The construction of the flow system and anechoic chamber is described. An analytical model is developed which incorporates sources of noise both inside and outside the engine.

Author (GRA)

N73-20287# Naval Postgraduate School, Monterey, Calif. A DESCRIPTION OF THE TURBOPROPULSION LABORATORY IN THE AERONAUTICS DEPARTMENT AT THE NAVAL POSTGRADUATE SCHOOL

Michael H. Vavra and Raymond P. Shreeve Sep. 1972 46 p refs

(AD-754380; NPS-57VA72091A) Avail: NTIS CSCL 14/2

Extensive facilities have been developed at the Naval Postgraduate School for teaching and research in turbomachinery. In eight years of growth, more than 30 Naval officers have completed theses toward advanced engineering degrees. The report briefly describes the existing equipment and mentions examples of research both completed and underway. Particular details can be obtained from the listed references. The purpose of the report is to provide a convenient reference for present and prospective students and to satisfy inquiries from sources external to the School.

Author (GRA)

N73-20288# Naval Air Development Center, Warminster, Pa. Air Vehicle Technology Dept.

HOOK BOUNCE TEST OF THE C-2A AIRPLANE ARRESTING GEAR A-FRAME Final Report

R B. Cadman 27 Nov. 1972 13 p

(AD-754077; NADC-72217-VT) Avail: NTIS CSCL 01/5

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

Author (GRA)

N73-20289# Naval Air Development Center, Warminster, Pa. Air Vehicle Technology Dept.

TEST PLAN TO SUBSTANTIATE THE CAPACITY OF THE C-2A ARRESTING HOOK A-FRAME TO SUSTAIN 3,000 ARRESTED LANDINGS

Robert B. Cadman 15 Sep. 1972 10 p refs

(AD-754076; NADC-72178-VT) Avail: NTIS CSCL 01/5

The C-2A arresting hook A-frame is currently adequate for 500 arrested landings. It is the purpose of this effort to extend the life to 3,000 arrested landings.

Author (GRA)

N73-20296# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.

TRANSPORTATION IN THE ARCTIC

F. C. Paddison and A. M. Stone Apr. 1972 101 p refs

(Contract N00017-72-C-4401)

(AD-754381; APL-TG-1190) Avail: NTIS CSCL 13/6

There is no year-round transportation in the Arctic. Year-round roads and railroads and high-bearing-load air fields to accommodate today's heavy-lift cargo aircraft could be built to the edge of the broad Arctic Ocean, if military necessity or potential resource development warranted it. Shallow-draft barges and boats will continue to be used to transport bulk cargo during the brief season around the perimeter of the Arctic Ocean. Large, very powerful icebreaker cargo ships for transport through the Arctic Ocean ice mantle are feasible and have been demonstrated; however, docking, loading, and general operational problems must be solved. Travel across the Arctic Ocean ice mantle with a truly amphibious craft, the Surface Effect Vehicle (SEV) currently under development will eventually provide long range year-round transportation over the Arctic Ocean's permanent ice cover. The SEV with low footprint pressures can travel not only over the pressure ridged rubble fields of the pack ice, but also over the tender summer tundra without subsequent effect. The report discusses all the above points and, in addition, briefly reviews the history of exploration of the Arctic. The extent of Arctic ground and air transportation facilities in the USSR, USA, Canada, Greenland, Iceland, and Scandinavia is shown. The Arctic Ocean icebreaker cargo ship is discussed, as is the search and rescue problem. Arctic air, ground, and marine techniques are summarized, and the Arctic SEV is discussed and the plans for its development outlined.

Author (GRA)

N73-20326# Illinois Univ., Urbana. Dept. of Mechanical and Industrial Engineering.

A STUDY OF THE EFFECTS OF BOUNDARY LAYER ON AXISYMMETRIC JET-ON BASE PRESSURE IN TRANSONIC AND SUPERSONIC FLOWS Final Summary Report

Alva L. Addy Dec. 1972 13 p refs

(Contract DAAH01-70-C-0888)

(AD-754640) Avail: NTIS CSCL 20/4

The onset and effects of plume-induced boundary-layer separation on the afterbody during powered supersonic flight were investigated. Plume-induced separation occurs for configurations designed for overall drag reduction since boattailing, base bleed, nozzle exit angle, and nozzle extension tend to increase significantly the base pressure. However, each configuration and set of operating conditions must be studied. The purpose of this report is to present only a brief summary of the investigation and to reference the publications which contain the details.

GRA

N73-20335# California Univ., Berkeley. Dept. of Mechanical Engineering

DISCRETIZATION OF A VORTEX SHEET, WITH AN EXAMPLE OF A ROLL-UP

Alexandre J. Chorin and Peter S. Bernard Nov. 1972 17 p refs

(Contract N00014-69-A-0200-1052)

(AD-755007; FM-72-5) Avail: NTIS CSCL 20/4

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 (GRA)

N73-20447# Lockheed Missiles and Space Co., Palo Alto, Calif. Research Lab.

STUDY OF HIGH-ALTITUDE AIRCRAFT WAKE DYNAMICS.**TASK 1: PROBLEM DEFINITION. Final Report**

H. Hoshizaki, R. J. Conti, L. B. Anderson, K. O. Redler, and J. W. Meyer Dec. 1972 207 p refs

(Contract DOT-OS-20082)

(AD-754918; DOT-TST-90-3) Avail: NTIS CSCL 04/1

The purpose of the High-Altitude Aircraft Wake Dynamics Study has been to investigate the chemically reacting wake of an aircraft flying at subsonic and supersonic velocity in the upper troposphere and stratosphere. This is of interest because of the effects these exhaust gases could have upon the chemical balance in the stratosphere. In the study, the chemical and fluid mechanical behaviors of important emission species were traced from the time the species exited the engine exhaust nozzle to the time aircraft-induced perturbations to the atmospheric environment were no longer important. The important features of chemically reacting aircraft wakes have been identified. The aircraft wake is modeled in terms of the jet regime (wake age approximately 10 sec) vortex regime (approximately 100 sec) and the wake dispersion regime (approximately 100 sec). The important thermochemical reactions were found to take place in the jet regime. GRA

N73-20464# Pressman Enterprises, Lexington, Mass
PROBLEM AREAS OF STRATOSPHERIC CHEMICAL DYNAMICS Interim Scientific Report, 23 Apr. - 1 Jun. 1972
Jerome Pressman May 1972 58 p refs
(Contract DOT-TSC-369)
(PB-213111; DOT-TSC-369-2) Avail: NTIS HC \$3 00 CSCL 04A

Recommendations identifying areas for further necessary study of natural stratospheric chemical dynamics, and the perturbations that might be induced by the exhaust emissions of aircraft flying in the stratosphere are reported. Author (GRA)

N73-20465# Pressman Enterprises, Lexington, Mass.
SURVEY OF STRATOSPHERIC AIRCRAFT WAKE CHEMICAL DYNAMICS Interim Scientific Report
Jerome Pressman Jul 1972 58 p refs
(Contract DOT-TSC-369)
(PB-213114; DOT-TSC-369-3) Avail: NTIS HC \$3 00 CSCL 04A

Presented is a survey and critical evaluation of information pertaining to the stratospheric aircraft wake chemical dynamics including both the hydrodynamics and chemistry of the phenomenon. Author (GRA)

N73-20466# Pressman Enterprises, Lexington, Mass.
SURVEY OF STRATOSPHERIC CHEMICAL DYNAMICS
Interim Scientific Report
Jerome Pressman Apr. 1972 83 p refs
(Contract DOT-TSC-369)
(PB-213126; DOT-TSC-369-1) Avail: NTIS HC \$3 00 CSCL 04A

A survey and critical evaluation of information are reported pertaining to the natural stratospheric composition and chemical dynamics and to the perturbations that might be induced by the exhaust emissions of aircraft flying in the stratosphere. Author (GRA)

N73-20468# Naval Aerospace Medical Research Lab., Pensacola, Fla.
INTERCORRELATIONS AND SELECTED DESCRIPTIVE STATISTICS FOR 96 ANTHROPOMETRIC MEASURES ON 1549 NAVAL AVIATION PERSONNEL Medical Research Progress Report
William F. Moroney and Margaret J. Smith Oct. 1972 88 p refs
(AD-754780; NAMRL-1165; PR-2) Avail: NTIS CSCL 01/3

A previous report by the authors showed the need for cockpit designers to consider the correlations between anthropometric features when designing workspaces. It was proposed that both the correlations between anthropometric features and the normal bivariate distributions for specific correlations be made available to designers. The present report makes correlations between 96 anthropometric features available to designers. GRA

N73-20473# Office of the Secretary of Transportation, Washington, D.C.

CLIMATIC IMPACT ASSESSMENT PROGRAM: WORKSHOP ON COMPUTATIONAL MODELING OF THE ATMOSPHERE Final Proceedings

Robert L. Underwood Jul. 1972 116 p refs Workshop held at Asilomar, Pacific Grove, Calif., 11-14 Apr. 1972
(PB-212819; DOT-TST-90-1) Avail: NTIS HC \$3.00 CSCL 04A

On 11-14 April 1972, the Department of Transportation sponsored a workshop on computational modeling of the atmosphere pertinent to assessment of possible climatic changes that might result from the projected 1985-1990 world high altitude aircraft fleet. These proceedings record the deliberations of the two separate workshop panels: the fluid dynamics modeling panel and the chemistry panel. Author (GRA)

N73-20474* National Aeronautics and Space Administration, Washington, D.C.

DISPLAY SYSTEM Patent

Anne W. Story, inventor (to NASA) Issued 30 Jan. 1973 7 p
Filed 16 Jul 1970 Supersedes N70-40019 (08 - 22, p 4127)
(NASA-Case-ERC-10350; US-Patent-3,714,624,
US-Patent-Appl-SN-55535, US-Patent-Class-340-27R) Avail:
US Patent Office CSCL 09E

A situational display and a means for creating the display are disclosed. The display comprises a moving line or raster, on a cathode ray tube, which is disposed intermediate of two columns of lamps or intensifications on the cathode ray tube. The raster and lights are controlled in such a manner that pairs of lights define a line which is either tracked or chased by the raster in accordance with the relationship between the optimum and actual values of a monitored parameter.

Official Gazette of the U.S. Patent Office

N73-20499# Advisory Group for Aerospace Research and Development, Paris (France)

AGARD FLIGHT TEST INSTRUMENTATION SERIES, VOLUME 2: IN-FLIGHT TEMPERATURE MEASUREMENTS
F. Trenkle, M. Reinhardt, W. D. Mace, ed., and A. Pool, ed
Feb. 1973 171 p refs
(AGARD-AG-160-Vol-2, AGARDograph-160-Vol-2) Avail: NTIS HC \$10 75

The field of temperature measurements in aircraft at Mach numbers up to 2.3 and altitudes up to 80,000 feet is reported. After a general discussion of the requirements of aircraft temperature measurements, and the available temperature sensing technology, the detailed techniques of using resistance probes and thermocouples, as well as the associated electrical leads, circuits, and indicators, are explained. A discussion of heat transfer processes, primarily between moving fluids and solids, includes terminology, the systematics of temperature measurements, and the concept of total temperature as the main operational parameter. One section deals with errors in temperature measurements, as functions of various parameters, in gases, liquids and solids. Typical laboratory and in-flight calibration techniques for thermometry are described, followed by discussions of data handling, error analysis, and the limits of present methods. Author

N73-20531*# AiResearch Mfg. Co., Phoenix, Ariz.
BACKSWEEP IMPELLER AND VANE ISLAND DIFFUSER AND SHROUD FOR NASA ADVANCED CONCEPTS COMPRESSOR TEST RIG Final Report, 1 May 1970 - 30 Nov. 1972

G. L. Perrone, M. R. Holbrook, and J. M. McVaugh Mar. 1973 47 p
(Contract NAS3-15328)
(NASA-CR-120942; AT-6131-R) Avail: NTIS HC \$4.50 CSCL 131

A centrifugal impeller based on an existing backswep design was defined. In addition, a vane diffuser was designed to match this impeller and also to be compatible with an existing 6:1

N73-20540

compressor test rig. The mechanical integrity of this design was verified by analysis. Hardware was procured and inspected to insure conformity with design tolerances. An overspeed test was successfully conducted on one of the impellers fabricated under this program. Author

N73-20540# Battelle Columbus Labs., Ohio.
SLEEVE BEARING MATERIALS AND LUBRICANTS FOR ADVANCED AIRFRAMES
Keith F. Dufrane, Fred F. Zugaro, and William A. Glaeser 29 Jan. 1973 42 p refs
(Contract N00019-72-C-0178)
(AD-754759) Avail: NTIS CSCL 01/3

Hardened 440C stainless steel shafts were found to have excellent compatibility with beryllium-copper bearings at high bearing stress levels. Therefore, this steel holds considerable promise for use as a high-performance, corrosion-resistant shaft material. Hardened 300-M shafts were subject to fatigue cracking at bearing stresses above 40,000 psi (the fatigue cracking was similar to that experienced with AISI 4340). Shot peening prior to plating and baking after plating was found to increase the fatigue resistance sufficiently to permit operation at 60,000 psi. Three greases meeting the MIL-G-81322 specification performed well at temperatures to 350 F, and additions of either AsSbS4 or MoS2 were found to enhance the grease performance even further. Author (GRA)

N73-20546# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE EFFECT OF THE OVALITY OF THE BALLS OF A RADIAL-THRUST BEARING ON THE AXIAL VIBRATION OF A RAPIDLY ROTATING ROTOR OF AN ENGINE
I. A. Baranov and A. I. Ilyankov 3 Jan. 1973 20 p refs
Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Aviats. Tekhn. (Kazan), v. 14, no. 2, 1971 p 39-45
(AF Proj. 3048)

(AD-754615; FTD-MT-24-1299-72) Avail: NTIS CSCL 13/9
It is shown that ovality of radial thrust bearing balls generate vibrations in an engine with a rapidly rotating turbine, and that the vibration spectrum contains harmonic components which are multiples of the double frequency of revolution of the balls. Formulas for calculating the amplitudes of these components are proposed. Author (GRA)

N73-20610*# Grumman Aerospace Corp., Bethpage, N.Y.
INVESTIGATION OF KC-135 FLIGHT SAMPLES SOLIDIFIED IN NEAR-ZERO GRAVITY
D. Larson, Jr. and G. Busch Jan. 1973 36 p refs
(Contract NAS8-28728)
(NASA-CR-124179; RM-566) Avail: NTIS HC \$4.00 CSCL 11D

An analysis was conducted of three KC-135 flight samples that had been solidified in near-zero gravity. These samples had been generated during near-zero gravity testing of M553 experiment Skylab flight hardware. The samples evaluated were all Star-J Satellite, a cobalt base alloy. The analytical procedures (optical microscopy, scanning electron microscopy, electron microprobe, X-ray diffraction, differential scanning calorimetry, and microhardness) to be used on the Skylab flight samples were optimized and the analytical results are presented. Author

N73-20656 National Lending Library for Science and Technology, Boston Spa (England).
METHODS OF DETERMINING THE ELECTRICALLY DANGEROUS ZONES IN NIMBO-STRATUS
V. S. Aleksandrov et al [1972] 16 p refs Transl into ENGLISH from Gidromet. Inst., Proc. All Union Conf. Problems Met. Safety Supersonic Aviat., 24-26 Mar 1971 (Leningrad), 1971 p 313-323 (NLL-M-22800-(5828.4F)) Avail Natl Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

The probability of an aircraft being struck by lightning in thunderstorms was investigated. Conditions for the production

of lightning in clouds are discussed along with the conditions in which aircraft are struck by lightning. It is concluded that in clouds with high water content, there is a marked increase in the probability of encountering large charges on an aircraft, and that most instances of aircraft being struck by lightning occur between +5 and -15 C F.O.S.

N73-20662# Federal Aviation Administration, Washington, D.C.
ENGINEERING AND DEVELOPMENT PROGRAM PLAN: WEATHER
Feb. 1973 61 p
(FAA-ED-15-1) Avail. NTIS HC \$5 25

The FAA research and development activities relating to aviation weather are discussed. The plan has been structured with the primary purpose of providing tailored weather information for use by pilots and air traffic controllers. There are two program subdivisions (program elements) in the plan: (1) weather data acquisition, generally involving the development of measurement techniques and hardware devices to be used in gathering precise weather data; and (2) weather data processing and distribution, concerned primarily with converting raw weather data into meaningful information and disseminating this information to pilots and air traffic controllers. The plan describes progress and accomplishments, current objectives, prospects for products and funding data for the projects involved. Author

N73-20675# Ultrasystems, Inc., Irvine, Calif.
HEAT PRODUCTION FOR AIR FORCE FOG DISSIPATION PROGRAM Final Report, 15 Apr. 1971 - 27 Oct. 1972
Frank C. Price 27 Oct 1972 57 p
(Contract F19628-71-C-0139; AF Proj 7605)
(AD-754900, SN-246; AFCRL-72-0626) Avail: NTIS CSCL 04/2

A heating system was supplied and operated to support an AFCRL test program of warm fog dispersal. The system consisted of four parallel rows of liquid propane burners and associated tanks, pumps, and fuel lines. The maximum heat release was 600 million Btu/hr which was adequate to clear fog along a 400-ft width, 200 ft high in 10 mph winds of 40 degrees range in direction. A total of 191 tests were run: 63 with fog and 128 with clear air. This report describes the system and presents a log of the heating rates and burner arrangements which were operated for the tests conducted by AFCRL. Author (GRA)

N73-20686 Massachusetts Inst. of Tech., Cambridge. Charles Stark Draper Lab.
SUMMARY OF NEW DEVELOPMENTS AT THE DRAPER LABORATORY
Robert A. Duffy In AGARD Inertial Navigation Components and Systems Feb. 1973 5 p

Research projects involving the development of inertial guidance systems and components are discussed. The application of inertial guidance to tactical and strategic missile systems is analyzed. The efforts of the laboratory in support of the Apollo project are examined. Fault tolerant design concepts in digital computer construction are advocated as a means of achieving improved reliability. Systems for stabilizing Orbital Astronomical Observatory satellites are reported. Specific systems for lunar exploration, commercial air transportation, oceanography, flight control, and biomedical experiments are briefly discussed. P.N.F.

N73-20694 Teldix Luftfahrt-Ausruestungs G.m.b.H., Heidelberg (West Germany).
INVESTIGATIONS ON THE OPTIMIZATION OF AIDED INERTIAL NAVIGATION SYSTEMS
Rainer S. Sindlinger In AGARD Inertial Navigation Components and Systems Feb. 1973 16 p refs

The stringent performance requirements for modern, self-contained aircraft navigation systems can only be met by integrated systems combining several independent navigation sensors, like inertial measurement unit, Doppler radar, and radio position fixing

devices (e.g. Tacan) Some investigations on the optimization of such integrated navigation systems are discussed. It will be shown, that high navigation accuracy can be obtained even with medium-performance sensors by implementation of an optimal estimation and control filter, and by the use of methods reducing the influence of some inertial sensor errors on the system performance. The basic rule for the realization of an effective integrated navigation system is to use sensors with complementary characteristics, but with mutually balanced accuracy. Author

N73-20698 Air Force Avionics Lab, Wright-Patterson AFB, Ohio.

THE EVOLUTION OF ESG TECHNOLOGY

Robert R. Warzynski and Ronald L Ringo *In* AGARD Inertial Navigation Components and Systems Feb. 1973 8 p

Two electrostatic gyro (ESG) navigation systems are described: the gimballed ESG aircraft navigation system (GEANS) and the strapdown ESG micro-navigator (MICRON). The ESG, its drift error sources, the exploratory program that preceded the development of the GEANS and MICRON, and the status of the GEANS and MICRON development are reported. Author

N73-20700 Air Force Flight Dynamics Lab, Wright-Patterson AFB, Ohio

INERTIAL SYSTEM ENHANCEMENT OF FLIGHT CONTROL
Max L. Lipscomb and Fred D. Smith *In* AGARD Inertial Navigation Components and Systems Feb. 1973 11 p refs

The functions of vehicle flight control to which a quality inertial system will contribute, and in a number of cases make possible, is discussed. The status of programs aimed toward more fully defining and implementing these flight control functions, including all weather landing as well as automatic steering, is outlined with the results achieved to date. Functional requirements which will be levied on the inertial system are listed and examined as to the parameters measured or computed, reliability, criticality relating to flight safety, practicality of the system for broad applications from both simplicity of operation and economical standpoints, and physical aspects. Both established and probable requirements of an acceptable system are noted. The requirements will of necessity stress the fact that such a system is a safety flight item and reliability is extremely critical. A brief survey is presented of the trends and developments toward the systems which will be required to achieve universal integration of inertial navigation system signals into the flight control system functions. Several different types of inertial systems now under development are discussed to illustrate the technology which may yield applicable systems. Author

N73-20701 Army Electronics Command, Fort Monmouth, N.J. Navigation Systems Team.

DESIGN OF A KALMAN DERIVED, FIXED, GAIN, HYBRID NAVIGATION SYSTEM

W. R. Light, Jr., R. F. Clark, C. T. Elliott, M. J. Fisher, C. J. Galanti, J. A. Knight, and I. Levine *In* AGARD Inertial Navigation Components and Systems Feb. 1973 10 p refs

At present, there exists a major effort to develop cost-effective navigation systems for application to U.S. Army aircraft. Major factors involved in the design of one candidate for such an application (a loran/inertial hybrid system) are discussed. The design factors addressed include selection of a measurement processing technique to be used in conjunction with a Kalman filter algorithm, and the modification of this algorithm to provide Kalman derived, fixed feedback gains, free of geographic dependence. Relative performance of the fixed gain and Kalman systems is assessed through analysis of data from both Monte Carlo computer simulations and actual flight test. Author

N73-20704 Marconi-Elliott Avionic Systems Ltd., Rochester (England), Inertial Navigation Div.

THE USE OF A CLUSTER ROTATED INERTIAL SYSTEM, IN A STRIKE AIRCRAFT ENVIRONMENT

D. G. Harris *In* AGARD Inertial Navigation Components and Systems Feb. 1973 7 p

The Jaguar inertial system is described which involves the use of spatial commutation of the horizontal inertial sensor errors, to achieve the required performance. The development program concerned with the realization of the system is reviewed. A brief review of the theory of cluster rotation and its advantages, is followed by description of the way the technique was applied to improve the performance of an existing platform. Other aspects of the inertial navigation system, where the design was influenced by the use of the rotation technique are then described. The sequence of laboratory and flight trials during which problem areas were discovered, and the methods for solving the problems are discussed. Author

N73-20709 Ferranti, Ltd., Edinburgh (Scotland), Inertial Systems Dept.

GYRO CHARACTERISTICS FOR RAPID GYRO-COMPASSING

K. R. Brown and D. Anderson *In* AGARD Inertial Navigation Components and Systems Feb. 1973 18 p ref

Inertial navigation system alignment, of course, includes finding north by gyrocompassing, and around 2.5 minutes must be met if the overall reaction time of the aircraft is not to be limited by the system. It is found that for all practical purposes the equipment must be switched on from cold and this necessitates the use of the inertial instruments before they reach their designed operating temperature. The results are given of a program of work over many years, to determine the parameters of single-axis floated gyroscopes, when used in inertial systems requiring rapid reaction under these conditions. New parameters of gyro drift have been obtained, and the new technique of system operation based on these is outlined. The performance obtained with an inertial navigation system using these techniques is given to illustrate the benefits to be gained. Author

N73-20710 LTV Aerospace Corp., Dallas, Tex.

A-7 AIRCRAFT AIRBORNE, GROUND, AND SHIPBOARD INERTIAL NAVIGATOR ALIGNMENT METHODOLOGY AND RESULTS

M. G. Johnson, Jr. *In* AGARD Inertial Navigation Components and Systems Feb. 1973 10 p

The A-7D/E aircraft navigation system is described and in particular the alignment method. The particular functions which the system performs are outlined. The alignment techniques are described in a basic fashion without delving into a detailed derivation. Finally, some experience gained during the A-7 program is presented along with test results. Author

N73-20713 Singer Co., Little Falls, N.J. Aerospace and Marine Systems Group.

FAULT ISOLATION AND MAINTENANCE CONCEPTS OF AN ADVANCED INERTIAL NAVIGATION SYSTEM

Francis H. Murphy *In* AGARD Inertial Navigation Components and Systems Feb. 1973 9 p

The design concepts, hardware characteristics, and system tradeoffs are described which have been considered for a self-contained advanced inertial navigation system. Included in this system is an automatic self-annunciating fault isolation capability. The system is packaged in a single LRU and has been organized to be modular in construction with fault annunciation to both the module level for flight line level maintenance and to the functional circuit hybrid chip at the intermediate level. Details are presented on the various built-in test functions, as well as validation of the built-in test hardware by utilization of the BITE-on-BITE concept. Software monitoring is discussed, including built-in flight line self-test, calibration and in-flight performance monitoring utilizing existing redundancy within the platform subsystem. The utilization of a calibration computer card is also discussed. This card, an interchangeable replacement for the operational computer card, is utilized to

perform periodic calibration of the platform subsystem without the need for any additional external support calibration equipment. The report concludes with a summary of the methods used to fault isolate and the maintenance action required at the various operational levels. Author

N73-20717 Aerospace Guidance and Metrology Center, Newark Air Force Station, Ohio. Plans and Management Staff Office. **LIFE CYCLE COST ANALYSIS OF INERTIAL SYSTEMS FOR AIRCRAFT AND AIR TO SURFACE MISSILES**
Donald L. Hardy, Jr. and Russell M. Genet. In AGARD Inertial Navigation Components and Systems Feb. 1973 5 p refs

Life cycle cost analysis of Inertial Navigation Systems (INS) is becoming more significant to all users today as performance goals more closely achieve their objectives. Cost of ownership models and analyses were developed that contribute to current and future assessments of this important area. These analyses are based on an extensive accumulation of inertial systems data. The current analyses include a critical assessment of the current model and its data, a taxonomic analysis of INS applications, and a sensitivity analysis of all input model parameters. These analyses have led to development of new models which will more accurately predict the cost of ownership of a given inertial system. The primary usefulness of the models will be for: (1) generalized analysis of, and (2) discrimination between, the cost of ownership of aircraft and air to surface missile inertial systems. Specific references are made to the most sensitive parameters of any cost of ownership analysis concerning inertial navigation systems. These parameters are of great use in knowing how little data is actually needed to make management and technical discussions. The types of decisions and applications managers and design personnel need to make concerning inertial systems are also outlined. Author

N73-20719# Systems Control, Inc., Palo Alto, Calif. **OCEANIC ATC SURVEILLANCE SYSTEMS STUDY Final Report, Jun. 1971 - Jan. 1973**
Feb. 1973 209 p refs
(Contract DOT-TSC-260-2)
(FAA-RD-73-8) Avail: NTIS HC \$12.50

A general approach is discussed for modeling the interaction of the major elements of the Oceanic ATC System: (1) the onboard navigation system, (2) the surveillance system, and (3) the ATC procedures. This modeling approach includes the time/position dependence in the description of the navigation drift error and the surveillance positioning error and includes the return maneuvers of aircraft receiving surveillance alarms. In addition, both strategic and tactical control strategies are considered. Using route safety or collision risk as the performance measure it is shown that with all aircraft equipped with INS the lateral separation standard can be reduced from 120 n.m. to 45 n.m. and the longitudinal standard from 15 to 10 minutes. If an independent surveillance system is included, the lateral separation can be further reduced to 30 n.m. Extensive tradeoff studies are performed to determine the most sensitive parameters of the Oceanic ATC System. Author

N73-20720# Federal Aviation Administration, Washington, D.C. **AN OVERVIEW OF THE FAA ENGINEERING AND DEVELOPMENT PROGRAMS, 1973 - 1974**
Mar. 1973 64 p refs
(FAA-EM-73-2) Avail: NTIS HC \$5.25

FAA efforts to improve aircraft traffic control on the ground, near the airport, and en route are discussed. The engineering and development programs described in this document are intended to assist all airport users and operators, including general aviation, air carriers, and military. The programs will improve the safety and efficiency of air travel and thereby increase its public acceptance. They will benefit passengers, pilots, the airlines, airport operators and aircraft owners alike. Author

N73-20722# Systems Consultants, Inc., McLean, Va Management and Data Systems Div.

INSTRUCTIONAL MANUAL FOR MEASURING AERONAUTICAL ACTIVITY AT NON-TOWERED AIRPORTS

Bruce Brown and Carl Carlson Feb. 1973 32 p
(Contract DOT-FA72WA-2774)
(SCI-2-2040; FAA-RD-73-19) Avail: NTIS HC \$3.75

The procedures that are required to develop accurate estimates of annual traffic levels at non-towered airports are described. Coverage is given to the techniques for estimating local, itinerant and total aircraft operations due to air carrier, military or general aviation activities. In addition, methods for estimating passenger traffic are included. The estimating techniques require that surveys be made to gather samples of traffic activity at the non-towered airports. Guidelines for conducting airport traffic surveys are included and the necessary computational steps for converting the sampled data to annual estimates are defined. Author

N73-20726# Ohio Univ., Athens. Dept. of Electrical Engineering **DEVELOPMENT OF A GYRO-LESS DIGITAL FLIGHT DIRECTOR**

David L. Horwitz Oct. 1972 65 p refs
(Contract DAAB07-68-C-0084)
(AD-754028; EER-16-11; ECOM-0084-S-2) Avail: NTIS CSCL 17/7

Precise aircraft control is becoming more critical with the present increasing air traffic. This research presents a new type of digital flight director which is free of gyroscopic references. This digital flight director (controller or compensator) is derived by two methods, the (root locus) trial and error method and Truxal's Method. The first method showed the feasibility of a gyro-less controller. Using the second method, a digital flight director is obtained that offers precise aircraft control on a defined route. The derivation and testing of these controllers are discussed in detail in this report. Author (GRA)

N73-20727# Ohio Univ., Athens. Dept. of Electrical Engineering. **OPTIMUM ADAPTIVE PHASE ESTIMATION RECEIVER FOR ONE-WAY RANGING AIRCRAFT NAVIGATION**

Patrick H. Garrett Oct. 1972 178 p refs
(Contract DAAB07-68-C-0084)
(AD-754031; EER-16-10; ECOM-0084-S-5) Avail: NTIS CSCL 17/7

The report presents a comprehensive investigation of improved signal processing techniques for precise, low-frequency, one-way ranging for aircraft navigation. Author (GRA)

N73-20730# Aerospace Systems, Inc., Burlington, Mass. **FUNCTIONAL ERROR ANALYSIS AND MODELING FOR ATC SYSTEM CONCEPTS EVALUATION Final Report, May 1971 - May 1972**

William C. Hoffman, Walter M. Hollister, and Robert W. Simpson May 1972 107 p refs
(Contract DOT-TSC-212)
(PB-213148; ASI-TR-72-9; DOT-TSC-212-72-1) Avail: NTIS HC \$3.00 CSCL 17G

A functional error analysis and modeling study of the air traffic control (ATC) system is described. The work was performed to support the ATC system concepts evaluation program of the Transportation Systems Center (TSC), which will be conducted on their Multi-Modal Transportation System Simulation. The dominant functional error sources in the ATC system are identified and models of these errors are developed for implementation in the TSC simulation. The models are constructed to be as realistic as possible without placing excessive computational requirements on their realization. The models were developed in four categories: target dynamics, air data system, navigation systems and surveillance systems. Author (GRA)

N73-20731# Army Electronics Command, Fort Monmouth, N.J. **DESIGN OF A KALMAN DERIVED, FIXED GAIN, HYBRID NAVIGATION SYSTEM**

W. R. Light, Jr., R. F. Clark, C. T. Elliott, M. J. Fisher, and C. J. Galanti Nov 1972 34 p refs
(DA Proj. 1F1-62202-A-96)
(AD-754548; ECOM-4044) Avail: NTIS CSCL 17/7

At present, there exists a major effort to develop cost-effective

navigation systems for applications to U.S Army aircraft. Major factors involved in the design of one candidate for such an application (a LORAN/Inertial hybrid system) are discussed in this report. The design factors addressed include selection of a measurement processing technique to be used in conjunction with a Kalman filter algorithm, and the modification of this algorithm to provide Kalman derived, fixed feedback gains, free of geographic dependence. Relative performance of the fixed gain and Kalman systems is assessed through analysis of data from both Monte Carlo computer simulations and actual flight tests. Author (GRA)

N73-20757# Rhode Island State Planning Program, Providence.
AIRCRAFT NOISE EVALUATION
Jun. 1972 29 p refs Sponsored by HUD
(PB-212875; RISPP-TP-72-23) Avail: NTIS HC \$3.00 CSCL 20A

The current methods utilized to measure and evaluate effects of aircraft noise are reported Composite noise ratings (CNR) developed by the FAA and the noise exposure forecasts (NEF) as developed by the Statewide Planning Program from HUD Noise Assessment Guidelines are analyzed as they apply specifically to the Theodore F. Green State Airport exterior noise standards. The conclusions drawn are: (1) Noise exposure zones delineated by these methods contain a wide range of actual noise conditions which should not be generalized into zones in this manner. (2) The application of these zones to the Theodore F. Green State Airport substantially overstates the number of persons adversely affected by aircraft noise. Author (GRA)

N73-20758# Office of the Secretary of Transportation, Washington, D.C.
TRANSPORTATION NOISE AND ITS CONTROL
Jun. 1972 31 p
(PB-213007; DOT-P-5630.1) Avail: NTIS MF \$0.95; SOD HC \$0.70 CSCL 20A

The booklet outlines specific aspects of the noise problem caused by the various modes of transportation - sub and supersonic aircraft, highway noise, (trailer trucks, passenger cars, motorcycles, and sports cars), and rapid transit noise. Author (GRA)

N73-20759# Wilsey and Ham, South Pasadena, Calif.
AIRCRAFT NOISE IMPACT-PLANNING GUIDELINES FOR LOCAL AGENCIES Final Report
R. Dale Beland and P. Patrick Mann Nov 1972 254 p refs
Prepared in cooperation with Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
(Contract HUD-H-1675)
(PB-213020; WH-979-1) Avail: NTIS HC \$6.75 CSCL 20A

Information developed in the Metropolitan Aircraft Noise Abatement Policy Studies reports and other case studies of aircraft noise abatement are analyzed and presented in a form that provides a practical tool for the local planner, local government and others in developing a comprehensive aircraft noise abatement policy and program. The manual contains a discussion of the entire process of developing a noise abatement program including defining the existing noise situation, determining where this noise situation may conflict with existing or proposed development, developing a program for reducing conflicts, evaluating impact of the program on the community, implementing the program through legislation and action programs. Author (GRA)

N73-20815# Naval Air Engineering Center, Philadelphia, Pa.
Ground Support Equipment Dept.
GROUND SUPPORT EQUIPMENT: LOW POLLUTANT FUELS Final Report, Sep. 1971 - Aug. 1972
Thomas Dale Weikel Sep. 1972 33 p refs
(AD-755151; NAEC-GSED-59) Avail: NTIS CSCL 21/4

Alternate fuels, with an emphasis on liquefied natural gas are briefly reviewed for feasibility of use in aircraft ground support equipment to reduce air pollution. Electricity, steam, and Wankel engines were also investigated. It was concluded that the most practical system is the use of liquefied petroleum gas and

catalytic converters on present gasoline engine support equipment. Author (GRA)

N73-20816# Stanford Research Inst., Menlo Park, Calif.
THE CHEMISTRY OF FUEL DEPOSITS AND THEIR PRECURSORS
Frank R. Mayo, Norman A. Kirshen, Harold Richardson, and Roger S. Stringham Dec 1972 44 p refs
(Contract N00019-72-C-0161; SRI Proj PYU-1681)
(AD-754459) Avail: NTIS CSCL 21/4

The objective of the work described was to determine the chemistry of deposit formation in jet turbine fuel systems. This involved the determination of the nature and method of formation of deposit precursors that should have higher molecular weights and polarities than the fuels. Three approaches have been tried: Oxidations of refluxing n-decane at 155C, Comparison of distillation residues of a standard fuel, and Removal of higher molecular weight products from other oxidation products by precipitation from pentane at -78C. The present status of the jet fuel deposit problem is summarized. Author (GRA)

N73-20823*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
AERODYNAMIC PERFORMANCE OF A CORE-ENGINE TURBINE STATOR VANE TESTED IN A TWO-DIMENSIONAL CASCADE OF 10 VANES AND IN A SINGLE VANE TUNNEL
Roy G. Stabe and John F. Kline Washington Mar. 1973 16 p
(NASA-TM-X-2766; E-7293) Avail: NTIS HC \$3.00 CSCL 21E

A turbine stator vane was tested in a two-dimensional cascade of 10 vanes and in a single-vane tunnel. The single-vane tunnel was a cold air version of a tunnel which will be used for high temperature heat transfer testing of cooled turbine vanes. The purpose of the investigation was to determine if the flow conditions in the single-vane tunnel were sufficiently similar to those of a 10-vane cascade to permit meaningful heat transfer testing. The vane was tested over a range of ideal exit critical velocity ratios. The principal measurements were vane surface static pressure and cross-channel surveys of exit static pressure, total pressure, and flow angle. A brief description of the test vane and tunnels is included. The results of the exit surveys, the vane surface pressure distributions, and overall performance in terms of flow and loss for the two test configurations are compared. Author

N73-20825# Magnavox Co., Fort Wayne, Ind. Government and Industrial Group.
JET ENGINE BURN THROUGH INVESTIGATION. VOLUME 1: SONIC ANALYSIS Final Report, Jun. - Sep. 1972
Richard W. Schumacker Mar. 1973 81 p refs
(Contract DOT-FAT2-575)
(FAA-RD-72-149-Vol-1) Avail: NTIS HC \$6.25

A sonic analysis of jet engine burn-through was conducted to determine the acoustic characteristics of simulated failures. Two types of jet engines were modified to simulate the burn-through failures. Magnetic tape recordings of the modified engines were made to determine: (1) the extent of the acoustic spectrum, (2) the relationship of engine speed to failure related sound pressure levels and acoustic spectrum, (3) the effect of sensor location on burn-through detection, and (4) the characteristic acoustic spectra at burn-through. The data were analyzed by real time spectrum analysis and mean square techniques. It was determined that acoustic detection of burn-through failure is feasible. Author

N73-20826*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
EXHAUST NOISES IN JET ENGINES Patent Application
Ira R. Schwartz, inventor (to NASA) Filed 23 Mar. 1973 25 p
(NASA-Case-ARC-10712-1; US-Patent-Appl-SN-344410) Avail: NTIS HC \$3.25 CSCL 21E

This invention relates generally to that class of motive power sources commonly referred to as jet engines and more particularly to improvements to such engines for reducing, the

noise generated by the turbulent intermixing of the exhaust gases with the ambient atmosphere
NASA

N73-20831# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

METHOD OF CALCULATING A TWO-PHASE EJECTOR, M. E. Deich, G. V. Tsiklauri, Yu. F. Kalinin, and N. A. Dikii 11 Dec. 1972 21 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Energ. i Transp. (Moscow), no. 2, 1971 p 123-129

(AD-754051; FTD-MT-24-1495-72) Avail: NTIS CSCL 21/5

A method of designing a two phase two component injector is presented on the basis of an experimental study. The operation of the injector is compared under subsonic and supersonic conditions. It is shown that for fixed conditions (nozzle geometry and initial parameters) there is a certain optimum area of the throat of the exit cone where the highest back pressure is reached. Author (GRA)

N73-20832# Naval Air Propulsion Test Center, Trenton, N.J. Propulsion Technology and Project Engineering Dept.

J52-P-8 ENGINE COMPRESSOR STALL MARGIN ACCEPTANCE TESTS

Joseph F. Boytos, William A. Rich, and Richard T. Lazarick Nov. 1972 32 p refs

(AD-755152; NAPTC-PE-10) Avail: NTIS CSCL 21/5

Two J52-P-8 engines were tested in a sea level cell to develop a method for determining acceptable compressor stall margin. One engine had good stall margin, the other was a stall-reject based on ground static Bodie tests in an A-4 aircraft. Tests were limited to steady-state calibrations, inlet distortion, and power extraction; accelerations, decelerations, and bodies with standard and enriched fuel schedules. Both engines had acceptable uninstalled steady-state and transient stall margin and steady state distorted inlet stall margin. Author (GRA)

N73-20837# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CARBON DEPOSITS IN JET ENGINES

K. K. Papok, V. A. Piskunov, and P. G. Yurenya 22 Sep. 1972 180 p refs Transl. into ENGLISH of the mono. "Nagary v Reaktivnykh Dvigatelyakh" Moscow, Izd-vo Transport, 1971 p 1-110

(AF Proj. 7343)

(AD-754607; FTD-MT-24-1946-71) Avail: NTIS CSCL 21/5

In the book the questions of the formation of carbon deposits and its influence on the reliability, efficiency, and service life of aviation jet engines are examined. Soviet and foreign materials about the properties of carbon deposits, conditions of their formation, and the influence of various factors on the formation of deposits are generalized. In the book there is comprehensive examination of the influence of fuels of various chemical and fractional composition and also the varying kinds of additives on the formation of deposits. Basic methods and means are stated for the evaluation of the deposit forming properties of aviation fuels and oils. Author (GRA)

N73-20956 Deutsche Gesellschaft fuer Luft- und Raumfahrt, Porz (West Germany).

ON THE MANAGEMENT OF GERMAN AEROTECHNOLOGY DURING THE FIRST HALF CENTURY 1900 TO 1945 [VON DER FUEHRUNG DER DEUTSCHEN LUFTFAHRTTECHNIK IM ERSTEN HALBEN JAHRHUNDERT 1900 - 1945]

Adolf Baumker *In its* Management in Sci. and Technol. Sep. 1971 p 20-43 In GERMAN

German aeronautical development during the first half of the century is characterized by: (1) The discovery or pioneer period from 1900 to 1941; (2) operational warfare from 1918 to 1941; (3) air traffic and glider development from 1923 to 1932; and (5) warfare, collapse, and destruction from 1940 to 1945. Transl. by G.G.

N73-20957 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Troisdorf-spich (West Germany).

FROM THE WGL TO THE DGLR: ON SIXTY YEARS OF WORK FOR AERONAUTICS [VON DER WGL ZUR DGLR: AUS SECHS JAHRZEHNTE TAEITIGKEIT FUER DIE LUFTFAHRT]

Werner Schulz *In its* Management in Sci. and Technol. Sep. 1971 p 44-71 In GERMAN

The scientific career of Dr. Theodor Benecke is briefly outlined. Technical and scientific contributions of the German aeronautical societies to aerospace sciences and organizations are described. Transl. by G.G.

N73-20958 Deutsche Botschaft, London (England). **INTERNATIONAL SCIENTIFIC COOPERATION WITH AGARD [INTERNATIONALE WISSENSCHAFTLICHE ZUSAMMENARBEIT IM RAHMEN DER AGARD]**

Rudolf Schrader *In* DFVLR Management in Sci. and Technol. Sep. 1971 p 73-79 In GERMAN

The activities of Dr. Theodor Benecke as official representative for aeronautical research at the German Department of Defense in cooperation with AGARD are described. Work sessions covered problems of aerospace medicine, avionics, propagation of electromagnetic waves, flow dynamics, propulsion and energy, structures and materials, and guidance and control. Transl. by G.G.

N73-20959 Advisory Group for Aerospace Research and Development, Paris (France).

AGARD-GERMAN COOPERATION

Frank Wattendorf *In* DFVLR Management in Sci. and Technol. Sep. 1971 p 80-87

Dr. Theodor Benecke's activities and accomplishments as Chairman of the Advisory Group for Aerospace Research and Development at AGARD - NATO are described. Typical cooperation projects for mutual benefit constituted development of V/STOL aircraft, low altitude defense, Transall; G 91; F 104 G; and the German-French Research Institute at St. Louis, France. G.G.

N73-20960 National Aero- and Astronautical Research Inst., Amsterdam (Netherlands)

SOME GUIDELINES ON DIRECTION, MANAGEMENT, AND ACTIVITIES OF THE NLR [EINIGE HAUPTLINIEN VON LEITUNG, MANAGEMENT UND TAEITIGKEITSFELD DER NATIONALEN LUFT-UND RAUMFAHRTVERSUCHSANSTALT IN DEN NIEDERLANDEN]

Hendricus I. VanderMaas and Anthonie Marx *In* DFVLR Management in Sci. and Technol. Sep. 1971 p 88-113 In GERMAN

Organization, management, and activities at the National Institute for Aerospace Research of the Netherlands are reported. Scientific projects consider the development of lightweight aircraft configurations with good aerodynamic properties for civilian as well as military applications. Technological research is limited to guidance and control of rockets, systems analyses, materials and construction for aerospace environments, and space simulation. Cooperation of the institute with AGARD members contributes to general scientific and technical aerospace developments. Transl. by G.G.

N73-20961 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Aachen (West Germany).

MISSION AND ORGANIZATION OF THE DFVLR: TWO YEARS OF INTEGRATED SOCIETY OF GERMAN AERONAUTICAL AND SPACE FLIGHT RESEARCH [UEBER DIE AUFGABE UND DIE ORGANISATION DER DFVLR: ZWEI JAHRE EINHEITSGESELLSCHAFT DER DEUTSCHEN LUFT-UND RAUMFAHRTFORSCHUNG]

Volker Aschoff *In its* Management in Sci. and Technol. Sep. 1971 p 114-146 In GERMAN

The development history of the German Society for Aerospace Research is outlined and its scientific and geographic organizations are described. The various institutes of the society are assigned

individual research on flow mechanics; flight mechanics and control; materials and construction, propulsion and energy; electronics; and aerospace physics, simulation, and medicine.

Transl. by G.G.

N73-20968 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany).

FUTURISTIC VIEWPOINTS FOR MANAGING A MAJOR RESEARCH FACILITY [ZUKUNFTSORIENTIERTE GESICHTSPUNKTE BEIM FUEHREN EINER GROSS-FORSCHUNGS-EINRICHTUNG (MIT HINWEISEN AUF DIE LUFT- UND RAUMFAHRTFORSCHUNG)]

Manfred Schroeder *In its Management in Sci. and Technol.* Sep 1971 p 242-256 refs In GERMAN

Advanced automation and the application of modern technologies require close cooperation between research management, university, industry, and government. Successful management of a large research organization considers goal definition, public relations, motivation, education, and co-determination as primary tools. It is suggested that advanced co-determination models are developed that provide input from institute scientists and engineers into the management process and the selection of research projects. Computer and nuclear technologies are also valuable contributors to technical developments in aerospace research.

Transl. by G.G.

N73-20969 Politecnico di Torino (Italy).

OBSERVATIONS ON SOME TECHNICAL ASPECTS OF GUIDED AIR CUSHION VEHICLES [CONSIDERAZIONI SU ALCUNI ASPETTI TECNICI DEI VEICOLI, GUIDATI A CUSCINO D'ARIA]

Giuseppe Gabrielli *In DFVLR Management in Sci. and Technol.* Sep. 1971 p 258-276 refs In ITALIAN

Controllable air cushion vehicle technology is considered for passenger transports over short and medium long distances in connection with existing transportation media. Special attention is given to specific workloads, relationships to optimal speed, payload profits, and propulsion group systems.

Transl. by G.G.

N73-20970# Committee on Interstate and Foreign Commerce (U. S. House).

AIR PASSENGER FEES - STATE AND LOCAL CHARGES

Washington GPO 1972 200 p refs Hearings on H.R. 2337, H.R. 14847, and H.R. 10326 (and identical bills) before Comm on Interstate and Foreign Com., 92d Congr., 2d Sess., 19 and 23 Jun. 1972

Avail. Subcomm. on Transportation and Aeronautics

Testimony related to the government's role in regulating the operations of civil aviation is presented. Reference is made to proposed legislation dealing with state taxation and the Federal share of funds to be used for airport construction, maintenance, and improvement. These hearings, which include consideration of present and proposed air passenger fees, took place on 19 June and 23 June, 1972.

J.M.M.

N73-20990# Coverdale and Colpitts, New York.

LOGAN AIRPORT TRAVEL STUDY Final Report

31 Oct. 1972 124 p refs Sponsored in part by Mass. Dept. of Public Works

(Contract DOT-UT-207)

(PB-212814; UMTA-MA-09-0007-72-1) Avail: NTIS HC \$3.00 CSCL 13B

An origin-destination survey was conducted among air travelers, visitors, and employees at Boston's Logan International Airport. The study focused on the air travel market in various geographic areas, the principal modes used for ground travel between these areas and Logan Airport, and the current volume of ground travel by each principal mode used for airport access. Emphasis is placed on the relative attractiveness of rapid transit for ground travel to and from the airport. The data reveal principal concentrations of trip generators, modal split, major travel corridors, and other conclusions.

GRA

N73-20995 Mississippi State Univ., State College.
AN ANALYSIS OF THE DESIGN OF AIRFOIL SECTIONS FOR LOW REYNOLDS NUMBERS Ph.D. Thesis

Stanley Jay Miley 1972 198 p

Avail: Univ. Microfilms Order No. 72-20272

A theoretical investigation of the influences of low Reynolds numbers on the design of airfoil sections has been performed. The airfoil design philosophy instituted by Wortmann and the mathematical design tools developed by Eppler served as a foundation for the study. All theoretical methods employed were done so only after their use could be justified on the basis of demonstrable validity in the physical reality. In particular, boundary layer transition criteria and turbulent flow prediction methods were subjected to a comparative study. Based on the requirement to achieve transition upstream of a major adverse pressure gradient, the results of the theoretical investigation demonstrate that as the Reynolds number is progressively lowered below 4 times one million, to obtain a practical operating range of lift coefficients, one becomes more and more restricted to reflex profiles whose lower surfaces contain pressure gradients which can be supported only by a laminar boundary layer.

Dissert. Abstr.

N73-20996 Illinois Univ., Urbana.

THE DETERMINATION OF THE GEOMETRIES OF MULTIPLE ELEMENT AIRFOILS OPTIMIZED FOR MAXIMUM LIFT COEFFICIENT Ph.D. Thesis

Allen Wen-shin Chen 1972 97 p

Avail: Univ. Microfilms Order No. 72-19807

Optimum airfoils in the sense of maximum lift coefficient are obtained. The maximum lift coefficient is achieved by requiring that the turbulent skin friction be zero in the pressure rise region on the upper surface. Under this constraint, the pressure distribution is optimized. The optimum pressure distribution consists of a uniform stagnation pressure on the lower surface, a uniform minimum pressure on the upper surface immediately downstream of the front stagnation point followed by a Stratford zero skin friction pressure rise. When multiple-element airfoils are under consideration, this optimum pressure distribution appears on every element. The parameters used to specify the pressure distribution on each element are the Reynolds number and the normalized trailing edge velocity.

Dissert. Abstr.

N73-20997# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

RESULTS OF FULL-SCALE WIND TUNNEL TESTS ON THE H.126 JET FLAP AIRCRAFT

Thomas N. Aiken and Anthony M. Cook Washington Apr. 1973 66 p refs

(NASA-TN-D-7252; A-3611) Avail: NTIS HC \$3.00 CSCL 20D

The aerodynamic characteristics of the full-scale H.126 jet flap aircraft were studied in a 40- by 80-foot wind tunnel. The H.126 aircraft is designed for research on flight characteristics of an aircraft using the jet flap principle. Static longitudinal, lateral, and directional characteristics were measured at a Reynolds number of 2.5 to 2.7 million. The jet control power as well as the aerodynamic characteristics were measured and are presented herein with limited discussion. The primary configuration variables were flap and aileron deflection.

Author

N73-20998# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A METHOD FOR ESTIMATING STATIC AERODYNAMIC CHARACTERISTICS FOR SLENDER BODIES OF CIRCULAR AND NONCIRCULAR CROSS SECTION ALONE AND WITH LIFTING SURFACES AT ANGLES OF ATTACK FROM 0 DEG TO 90 DEG

Leland H. Jorgensen Washington Apr. 1973 38 p refs

(NASA-TN-D-7228; A-4700) Avail: NTIS HC \$3.00 CSCL 01A

An engineering-type method is presented for estimating normal-force, axial-force, and pitching-moment coefficients for slender bodies of circular and noncircular cross section alone and with lifting surfaces. Static aerodynamic characteristics computed by the method are shown to agree closely with

experimental results for slender bodies of circular and elliptic cross section and for winged-circular and winged-elliptic cones. However, the present experimental results used for comparison with the method are limited to angles of attack only up to about 20 deg and Mach numbers from 2 to 4. Author

N73-20999# Aircraft Research Association, Ltd., Bedford (England).

A COMPARISON OF WING PRESSURE DISTRIBUTIONS MEASURED IN FLIGHT AND ON A WIND TUNNEL MODEL OF THE SUPER VC 10

G. C. Browne, T. E. B. Bateman, M. Pavitt, and A. B. Haines
London Aeron. Res. Council 1972 71 p refs Supersedes ARC-33317
(ARC-R/M-3707; ARC-33317) Avail: NTIS HC \$5.75; HMSO £ 2.50; PHI \$9.80

Pressure distributions measured in flight for ten Mj in the range from $M = 0.70$ to 0.88 are compared with corresponding results from tunnel tests at a Reynolds number of 5.4×10 to the 6th power. In all these conditions the flow over the wing upper surface was supercritical. The scale effect is small but measurable, the shock wave tending to be slightly further aft in flight by up to about 0.05 c. Three other discrepancies between flight and tunnel results are: the suction level ahead of the shock over part of the span is somewhat lower in flight; there is a tendency for the shock-induced separation to extend to the trailing edge earlier in flight; and there are detailed differences in the flow through and behind the forward shock wave near the wing root. The first two of these effects are shown to be at least partly due to the presence on the aircraft wing surface of the external tubing used for measuring pressures. In general, apart from these particular differences, there is good agreement between the flight and tunnel pressure distributions. Author (ESRO)

N73-21000# Royal Aircraft Establishment, Farnborough (England). Structures Dept.

A REVIEW OF COMPARATIVE THEORETICAL AND EXPERIMENTAL AERODYNAMIC DATA RELEVANT TO ZERO- AND LOW-FREQUENCY AEROELASTIC PROBLEMS

A. S. Taylor London Aeron. Res. Council 1972 51 p refs Supersedes RAE-TR-70089, ARC-32451
(ARC-R/M-3708, RAE-TR-70089; ARC-32451) Avail: NTIS HC \$4.75; HMSO £ 1.90; PHI \$7.65

Resumes of the contents of reports which give comparative theoretical and experimental aerodynamic loading data and, in some cases, structural deformation data, relevant to zero- and low-frequency aeroelastic problems are provided in tabular form. There is a broad classification of reports according to whether data have been obtained from tests on nominally rigid models with built-in warp or from tests on flexible models or full-scale aircraft. Details of reports which contain only experimental data are also tabulated. From an analysis of the data it is concluded that, in the limited range for which the flow is attached and the flow field is wholly subsonic or supersonic, theoretical methods can provide estimates of aeroelastic distortion effects which are adequate for engineering purposes, but that there is an urgent need to develop theoretical and/or empirical methods of estimating such effects for important design cases which occur outside this restricted flow regime. Author (ESRO)

N73-21001# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Aerodynamik.

CALCULATION OF THE FRICTION EFFECT ON THE LIFT OF AN AIRFOIL SECTION WITH SLOTTED FLAP (BERECHNUNG DES REIBUNGSEINFLUSSES AUF DEN AUFTRIEB EINES SPALTKLAPPENPROFILS)

Johannes Steinheuer 1973 42 p refs In GERMAN; ENGLISH summary
(DLR-FB-73-04) Avail: NTIS HC \$4.25, DFVLR, Porz, West Ger. 11 DM

A method is presented for the determination of the lift of a slotted flap airfoil profile by purely computational means. The method is based on existing procedures for the solution of the inviscid potential-flow problem and for the calculation of the

boundary layer development. The validity of a new relation between the reduction of lift and the skin friction coefficient has been ascertained by comparison with measurements for a single airfoil. The optimal flap position as determined by the calculations agrees very well with experimental results. Further numerical examples show that the method predicts the effect of variation in Reynolds number in the right sense. Author (ESRO)

N73-21002# Northrop Corp., Hawthorne, Calif. Aircraft Div.
THE CALCULATION OF THREE-DIMENSIONAL SUPERSONIC FLOWS AROUND SPHERICALLY-CAPPED SMOOTH BODIES AND WINGS. VOLUME 2: MANUAL FOR COMPUTER PROGRAMS Final Report, 1 Dec. 1971 - 3 Jul. 1972

Chong-Wei Chu and Sidney A. Powers Sep. 1972 207 p
(Contract F33615-72-C-1429; AF Proj. 1366)
(AD-753696; NOR-72-87-Vol-2; AFFDL-TR-72-91-Vol-2) Avail: NTIS CSDL 20/4

The report describes the theories, the numerical methods and the computer programs developed for determining the inviscid three-dimensional flow about smooth shapes at supersonic speeds. Volume II is a user's manual for the computer programs and provides the detailed information needed to set up and use the programs. These programs can determine the supersonic flow past smooth blunted bodies for any angle of attack for which the initial value surface remains on the blunted nose. The lowest usable Mach number is on the order of 2.0, with lower values attainable by careful attention to the initial value surface solution. There is no computational upper limit on the Mach number.

Author (GRA)

N73-21003 Case Western Reserve Univ., Cleveland, Ohio.
AUTOMATED OPTIMUM DESIGN OF AIRCRAFT WINGS TO SATISFY STRENGTH, STABILITY, FREQUENCY AND FLUTTER REQUIREMENTS Ph.D. Thesis

Singiresu Sambasiva Rao 1972 270 p
Avail: Univ. Microfilms Order No. 72-18728

The optimum design of complex structures to satisfy strength, stability, frequency and flutter requirements is considered. More specifically, the minimum weight design of supersonic aircraft wing structures with finite element modeling is considered for this exploratory study. The wing is assumed to fly through a series of flight conditions with different fuel configurations while supporting a specified payload. The restrictions imposed upon the behavior of the structure involve limitations on displacements, stresses, flutter Mach numbers and the range in which the natural frequencies are allowed to fall. Elastic buckling constraints are introduced by treating a typical portion of the wing skin as an isotropic stiffened plate. The constant stress triangular plate elements, the rectangular shear panels and the pin-jointed bar elements are used to idealize the multiweb wing structure.

Dissert. Abstr.

N73-21004 Virginia Polytechnic Inst. and State Univ., Blacksburg.
ANALYTICAL INVESTIGATION OF THE TILT ROTOR WHIRL INSTABILITY Ph.D. Thesis

James Scheiman 1972 251 p
Avail: Univ. Microfilms Order No. 72-20413

A generalized analytical study of the whirl instability of a rotating propeller or rotor system is presented. The mathematical model consists of rigid members with three degrees-of-freedom at the wing root and the wing-drive-shaft joints. In addition, each blade has lagging and flapping freedom. Two dimensional aerodynamics, including compressibility and stall effects, are included. Whirl stability boundaries and characteristics are presented. The parameters investigated include both mechanical and operating variations such as shaft stiffness, number of blades and air density. It was found that decreasing forward speed can result in a whirl instability when blade stall is taken into account. No condition was found in which the rotor went into a forward precessional mode of motion. Dissert. Abstr.

N73-21005 Illinois Univ., Urbana.
AN AUTOMATED PROCEDURE FOR THE OPTIMIZATION OF AEROSPACE STRUCTURES Ph.D. Thesis

Walter Joseph Dwyer 1972 172 p
 Avail: Univ. Microfilms Order No. 72-19821

The development of a new structural optimization algorithm, which is a combination of a modified fully stressed design technique and a redesign procedure based on gradients to deflection constraint surfaces, is discussed. The algorithm is incorporated into a large finite element program based on the displacement method of a structural analysis. Using an IBM 360/75 computer, the program is capable of obtaining optimum distributions of material for structural idealizations consisting of up to three thousand elements and six thousand degrees of freedom, and subjected to a maximum of twenty loading conditions. Constraints may be placed on the maximum and minimum size of any of the elements, on the stresses in the elements, and on the displacements of the nodal points of the structure. Dissert. Abstr.

N73-21006* Michigan Univ., Ann Arbor.
STRUCTURAL MODELING OF AIRCRAFT TIRES
 S. K. Clark, R. N. Dodge, J. I. Lackey, and G. H. Nybakken
 Washington NASA Mar. 1973 81 p refs Revised
 (Grant NGL-23-005-010)
 (NASA-CR-2220; Rept-05608-16-T-Rev) Avail. NTIS HC \$3.00 CSCL 01B

A theoretical and experimental investigation of the feasibility of determining the mechanical properties of aircraft tires from small-scale model tires was accomplished. The theoretical results indicate that the macroscopic static and dynamic mechanical properties of aircraft tires can be accurately determined from the scale model tires although the microscopic and thermal properties of aircraft tires can not. The experimental investigation was conducted on a scale model of a 40 x 12, 14 ply rated, type 7 aircraft tire with a scaling factor of 8.65. The experimental results indicate that the scale model tire exhibited the same static mechanical properties as the prototype tire when compared on a dimensionless basis. The structural modeling concept discussed in this report is believed to be exact for mechanical properties of aircraft tires under static, rolling, and transient conditions. Author

N73-21007* Politecnico di Milano (Italy). Ist. di Ingegneria Aerospaziale.

COMPARISONS BETWEEN ANALOGICAL AND NUMERICAL METHODS FOR STUDYING THE RESPONSE OF AN AIRCRAFT TO GUSTS [CONFRONTI FRA METODI ANALOGICI E NUMERICI PER LO STUDIO DELLA RISPOSTA DI UN VELIVOLO ALLA RAFFICA]

Luigi Puccinelli 1970 16 p refs In ITALIAN
 (Publ-97) Avail: NTIS HC \$3.00

Two mathematical models for representing nonstationary aerodynamic characteristics of a wing subjected to sharp variations in the angle of attack are used to study the response of an airfoil to ascending vertical gusts. Considering the airfoil to be a rigid body with two degrees of freedom, the flow over the wing in the horizontal plane of the tail and the drag encountered by the tail are calculated. The results obtained using analog and numerical methods are compared. Transl by F.O.S.

N73-21008* Advisory Group for Aerospace Research and Development, Paris (France).

ADVANCED ROTORCRAFT, VOLUME 1
 Feb. 1973 237 p refs Presented at the 39th meeting of the Flight Mech. Panel of AGARD, Hampton, Va., 20-23 Sep 1971 (AGARD-CP-121) Avail: NTIS HC \$14.00

The proceedings of a conference on rotary wing aircraft developments are presented. The objectives of the symposium are given as: (1) review of experiences gained from existing helicopter operations, (2) review of lessons obtained from flight tests of experimental helicopters, (3) discussion of the future of advanced rotorcraft, and (4) ground test facilities for research and development of new rotorcraft.

N73-21009 Service Technique, Aeronautique, Paris (France).
TACTICAL FLIGHT OF HELICOPTER AND REPERCUSSIONS

ON THE CONCEPTION [LE VOL TACTIQUE DE L'HELICOPTERE ET LES REPERCUSSIONS SUR SA CONCEPTION]
 M. Berthoux In AGARD Advanced Rotorcraft, Vol. 1 Feb. 1973 5 p In FRENCH

Certain reflections on the aspects of the problem of tactical helicopter flight are made in light of experience acquired in the domain of aeromobility. After having examined the tactical environment, research was done on the effects of such environments on helicopter performance. Transl. by E.H.W.

N73-21010 Royal Aircraft Establishment, Bedford (England).
THE OPERATION OF HELICOPTERS FROM SMALL SHIPS
 J. B. B. Johnston In AGARD Advanced Rotorcraft, Vol. 1 Feb. 1973 15 p

Procedures for operating helicopters from the decks of small ships are discussed. The subjects presented are: (1) an overall view of the operation, (2) types of helicopters in use, (3) types of ships used, (4) problem of deck size and superstructure, (5) nature and effect of air flow around the ship, and (6) problem of ship motion. Preliminary flight tests to investigate the identified problems are reported. Author

N73-21011 Societe Nationale Industrielle Aerospatiale, Paris (France).

TEN YEARS EXPERIENCE WITH THE HELICOPTER FROM OPERATION IN FRENCH ARMY [DIX ANS D'EXPERIENCE AVEC LES HELICOPTERES EN OPERATION DANS LES ARMEES FRANCAISES]

A Renaud In AGARD Advanced Rotorcraft, Vol. 1 Feb. 1972 3 p In FRENCH

Helicopter performance as determined by a ten year study in various military environments is reported. Data cover operational systems, special equipment, and various environmental situations including tactical operations. Helicopter support activities are also discussed. Transl by E.H.W.

N73-21012 Service Technique Aeronautique, Paris (France).
RELIABILITY AND SAFETY OF OPERATING MECHANICAL HELICOPTER PIECES [FIABILITE ET SECURITE EN OPERATION DES PIECES MECANIQUES POUR HELICOPTERES]

S Berner In AGARD Advanced Rotorcraft, Vol. 1 Feb. 1973 9 p In FRENCH

After determining the service life of the mechanical parts of a helicopter, fail safe system characteristics, qualifications of transmission box mechanisms, their initial contribution and potential utilization were determined. Fabrication materials and procedures from both Britain and the U.S. are compared. Transl. by E.H.W.

N73-21013 Army Aviation Systems Test Activity, Edwards, AFB, Calif.

GREATER SAFETY, MAINTAINABILITY, AND RELIABILITY THROUGH IMPROVED HELICOPTER FLIGHT TESTING

Gerald E. Swecker In AGARD Advanced Rotorcraft, Vol. 1 Feb. 1973 15 p refs

Data obtained from helicopter flight test programs are presented. Greater safety, maintainability, and reliability are being assured through constantly improved flight testing techniques and the use of state-of-the-art instrumentation, data acquisition, and data reduction equipment. More stringent helicopter performance criteria are placing greater demands on the test agencies to devise new methods and procedures for collecting and analyzing data. Included are such programs as: (1) the AH-1G (Cobra) helicopter and a simplified approach to finding height loss during dive recovery from throttle chops; (2) recommendation of limiting AH-1G tail rotor control; (3) OH-6A g loads experienced at high frequencies during weapons firing; (4) recommended pilot cues to define a safe AH-1G envelope following engine failure; (5) investigation of large sideslip and pitch excursions following throttle chops in the TH-55 helicopter; (6) identification of requirements for AH-1G instrument-flight-rule (IFR) evaluation; (7) results from OH-58 and AH-1G helicopter height-velocity (H-V) (autorotational) testing with discussion of application to operational use; and (8) AH-1G maneuvering limits from

return-to-target profiles. Tests conducted with the AH-1G helicopter determined return-to-target time, height lost during pullout from a dive, and other maneuvering characteristics. The concept of energy maneuverability has been established, and significant data have been added to the literature. Author

N73-21014 Naval Air Test Center, Patuxent River, Md. Rotary Wing Branch.

A NEW LOOK AT HELICOPTER LEVEL FLIGHT PERFORMANCE

Allen B. Hill *In* AGARD *Advanced Rotorcraft*, Vol. 1 Feb. 1973 9 p

Helicopter level flight performance data are presented as power coefficient ($c_{sub p}$ versus tip speed or advance ratio for a range of thrust coefficients ($c_{sub t}$)). This data presentation was developed from momentum and blade element theory. The power coefficient is a nondimensional expression for the main rotor shaft horsepower required. The main rotor shaft horsepower required consists of profile, parasite and induced power. The advance or tip speed ratio is a nondimensional ratio of flight and main rotor rotational speed. The thrust coefficient is a nondimensional expression for thrust required. It should probably be called the weight coefficient, since vertical drag is normally ignored, and thrust is replaced by gross weight. A representative classic helicopter level flight performance curve is presented.

Author

N73-21015 Royal Aircraft Establishment, Bedford (England). **SOME FLIGHT EXPERIMENTS ON THE XH-51 N HELICOPTER**

P. Brotherhood and C. A. James *In* AGARD *Advanced Rotorcraft*, Vol. 1 Feb. 1973 12 p refs

Flight tests of the XH-51N helicopter are reported. The tests were primarily concerned with helicopter stability and control. Several combinations of gyroscopes and control springs were evaluated. The principal effects of the changes in configuration were variations in control sensitivity and rotor damping. A variation in static stability due to a differently shaped gyro. arm was reported.

Author

N73-21016 Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).

INFLUENCE OF ELASTIC COUPLING EFFECTS ON THE HANDLING QUALITIES OF A HINGELESS ROTOR HELICOPTER

G. Reichert and H. Huber *In* Agard *Advanced Rotorcraft*, Vol. 1 Feb. 1973 15 p refs

Stability and control of a helicopter with a hingeless rotor system is mainly influenced by the elastic flapping motion of the rotor blades. On a rotor with torsionally flexible blades or elasticity in the control system there can be additional aeroelastic effects, which act as control inputs on the blades. After a short description of the rotor system and the analytical model, the reasons and the influences of elastic coupling effects on the stability and control behavior of a hingeless rotor helicopter are discussed. There are effects which result from the aerodynamic characteristics and from the chordwise mass-distribution on the blade. Additional coupling effects result from flapping and inplane deflections out of the pitching control axis similar to a pitch-flap-lag-coupling. Theoretical results are compared with flight test data.

Author

N73-21017 Westland Helicopters, Ltd., Yeovil (England). **GROUND AND FLIGHT TEST EXPERIENCE WITH THE WESTLAND SCOUT HINGELESS ROTOR HELICOPTER**

D. E. H. Balmford *In* AGARD *Advanced Rotorcraft*, Vol. 1 Feb. 1973 12 p

The flight test experience gained during the basic clearance of a Westland Scout helicopter fitted with a reduced scale version of the hingeless rotor system is discussed. The basic clearance was aimed at producing an aircraft with sufficient capability to embark upon a series of research tasks and as such was devoted to investigating the airworthiness and handling of the aircraft broadly within the limit of the flight envelope of the standard

production Scout fitted with an articulated rotor. Provided that these limits could be approached reasonably closely it was considered that the aircraft would be adequate for its research tasks. A statement of the present status of flight testing of the Lynx helicopter is included.

Author

N73-21018 Societe Nationale Industrielle Aerospatiale, Paris (France).

SOME THOUGHTS ON THE SA 341 GAZELLE SPEED RECORD

J. Soulez-Lariviere *In* AGARD *Advanced Rotorcraft*, Vol. 1 Feb. 1973 4 p

The speed record establishment for helicopters by the SA 341 helicopter is discussed. The nature of the course flown and the requirements for successful completion are described. The preparation of the helicopter for the record try is reported. Lessons to be drawn from this experience for future record tries are analyzed.

Author

N73-21019 Army Air Mobility Research and Development Lab., Moffett Field, Calif.

PROGRESS IN ROTOR-BLADE AERODYNAMICS

P. F. Yaggy and I. C. Statler *In* AGARD *Advanced Rotorcraft*, Vol. 1 Feb. 1973 15 p refs

The primary factors inhibiting the performance of rotary wing aircraft are identified. The inhibiting factors are examined and discussed with respect to developments in the aerodynamics of the rotor, the mathematical modeling of its wake, and the prediction of dynamic airloads and their effects on flying qualities. Recent developments in rotor flow studies, rotor blade pressure distributions, rotor blade boundary layer analyses, airfoil behavior in rotors, and rotor aerodynamics are presented.

Author

N73-21020 Army Air Mobility Research and Development Lab., Fort Eustis, Va. Structures Div.

SURVEY OF ROTARY WING LOADS AND STABILITY ANALYSIS PROBLEMS

H. I. MacDonald *In* AGARD *Advanced Rotorcraft*, Vol. 1 Feb. 1973 6 p

A survey of some of the problems encountered in the prediction of structural design loads and aeroelastic stability margins during the development of rotary wing aircraft is presented. The importance of accurate prediction of structural design loads for improved reliability, performance, and stability of aircraft is stressed. Variations in analysis methods employed by various manufacturers are discussed. The complexity involved in the prediction of rotary wing loads and aeroelastic stability, the effects on cost effectiveness, and areas where complex analysis is advantageous are reported.

Author

N73-21021 United Aircraft Corp., Stratford, Conn.

IMPACT OF NEW STRUCTURAL CONCEPTS ON SYSTEM CAPABILITIES

Edward S. Carter *In* AGARD *Advanced Rotorcraft*, Vol. 1 Feb. 1973 11 p refs

The impact of structural concepts on rotary wing system capabilities is examined. Current vertical takeoff aircraft system capabilities in terms of payload and gross weight ratio are reported. Examples of advances in vertical takeoff aircraft design are submitted. Specific developments in rotor blade construction, variable geometry concepts, drive systems, transmissions, and airframes are presented.

Author

N73-21022 Boeing Co., Philadelphia, Pa. Vertol Div.

EVALUATION, DEVELOPMENT, AND ADVANTAGES OF THE HELICOPTER TANDEM DUAL CARGO HOOK SYSTEM

Gregory J. Wilson and Newton N. Rothman *In* AGARD *Advanced Rotorcraft*, Vol. 1 Feb. 1973 8 p refs

Helicopter transport of external cargo for military applications, efficient use of available rotary-wing equipment, and enhancement of aircraft safety is examined. Improvements in this technique could provide the transport of external cargo at the maximum

speed of the helicopter, routine operation under instrument flight rules (IFR), precise placement of the load, and could eliminate the problems in hover such as the dust cloud and static electricity. Feasibility studies have shown the potential of the tandem dual hook concept as a viable base on which to build an improved cargo-handling system. Production incorporation of a dual cargo hook system is planned for the heavy-lift helicopter (HLH). The system incorporates other features such as variable longitudinal hook positioning, differential winching, load motion feedback, and augmentation of the cargo system operator's vision under conditions of poor light and thick dust. The requirements for an improved helicopter external cargo-handling system, the programs which have established the feasibility of a tandem dual cargo hook system, and the system slated for the heavy-lift helicopter are reported. Author

N73-21023 Westland Helicopters, Ltd., Yeovil (England).

MATERIALS FOR ADVANCED ROTORCRAFT

J. P. Jones *In* AGARD Advanced Rotorcraft, Vol. 1 Feb. 1973 6 p refs

The development and application of composite materials for constructing airframes of vertical takeoff aircraft are discussed. The properties of carbon reinforced plastics are described and specific areas of application for airframes and rotors are identified. The design features which produce better handling qualities of rotary wing aircraft and which are possible by the use of improved composite materials are examined. Author

N73-21024 Hawker Siddeley Aviation, Ltd., Woodford (England).

STOPPED ROTOR AIRCRAFT USING CIRCULATION CONTROLLED ROTORS

John Taylor *In* AGARD Advanced Rotorcraft, Vol. 1 Feb. 1973 15 p refs

The fundamental problems of the stopped rotor aircraft are examined. The aerodynamic characteristics of the circulation controlled rotor are discussed and the results of test data presented. Finally, the evolution of a typical stopped rotor aircraft design using circulation controlled rotors is illustrated. Author

N73-21025 Giravions Dorand Co., Paris (France).

FIELDS OF APPLICATION OF JET FLAPPED ROTORS.

M. Kretz *In* AGARD Advanced Rotorcraft, Vol. 1 Feb. 1973 12 p refs

Analysis of the field of application of the jet-flap rotor shows the cost-effectiveness of this technique when applied to heavy helicopter and stoppable rotor designs. Comparison with equivalent mechanically driven heavy-lift rotorcraft shows empty-weight gains of 30 to 40 percent. Initial cost gains for these vehicles is even higher, approaching 50 percent. The feasibility of an aircraft having a 0.85 Mach number capability and possessing a stoppable and stowable nonfolding two-bladed rotor has been established. The weight analysis also demonstrates the attraction of the jet-flap concept, which combines the features of both low weight and low cost, with a long duration hovering capability. The jet-flap rotor thus makes it possible for the same aircraft to have the high airspeed characteristics of a modern airplane coupled with the lowspeed advantages of a helicopter. Author

N73-21026 Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).

RESEARCH AND DEVELOPMENT ON ROTORS WITH TIP REACTION DRIVE IN GERMANY

Christoph Fischer *In* AGARD Advanced Rotorcraft, Vol. 1 Feb. 1973 12 p refs

Activities on cold, hot and mixed cycle tip jet propulsion for rotors are reported. Research and programs on cold and large mixed cycle systems are described. For both projects some results of component testing flight tests are discussed. Aspects of the flight mechanics as decoupling of movements in hovering and advantages of wide rpm-range are shown. Concluding remarks on the operational applicability and new missions favoring torque-free rotor drive systems are added. Author

N73-21027 Boeing Co., Philadelphia, Pa. Vertol Div.

SURVEY OF TILT ROTOR TECHNOLOGY DEVELOPMENT

K. B. Gillmore *In* AGARD Advanced Rotorcraft, Vol. 1 Feb. 1973 11 p refs

A review is made of the development of tilt rotor technology since the XV-3 program in the late 1950's. A brief comparison of the capabilities of the tilt rotor with other rotary wing configurations for a transport mission is shown. Tilt rotor performance and dynamic model tests are described. Analytical methodology development is reviewed and predictions are shown to compare well with model test data in the areas of performance, aeroelastic stability and flying qualities. It is concluded that the technology is now in hand to develop a prototype vehicle.

Author

N73-21028 Societe Nationale Industrielle Aerospatiale, Marignane (France).

FENESTRON: NEW SOLUTION OF TAIL ROTOR [LE FENESTRON, SOLUTION NOUVELLE DE ROTOR DE QUEUE]

J. Gallot *In* AGARD Advanced Rotorcraft, Vol. 1 Feb. 1973 7 p In FRENCH

A method for determining flight performance and flight qualities of a Fenestron type tail rotor is presented. Data cover vulnerability, effects of vibration on stationary flight performance, flight control, and maintenance. Transl by E.H.W.

N73-21029 United Aircraft Corp., Stratford, Conn.

DEVELOPMENT OF THE ABC ROTOR

Robert K. Burgess *In* AGARD Advanced Rotorcraft, Vol. 1 Feb. 1973 17 p refs

The development of the advancing blade concept (ABC) rotor is traced from conception through small scale model wind tunnel testing, full scale analysis, design, fabrication and ultimate wind tunnel testing of a 40 ft diameter rotor. The principal design tradeoffs resulting from the early analyses and testing are discussed along with their expected impact on the full scale rotor characteristics. Materials and manufacturing methods employed are covered including the more important difficulties that were surmounted during the nearly five years of development. Finally, the major test programs are outlined including blade balancing, turbine test bed operation and full scale wind tunnel testing facility up to speeds of 180 knots and advance ratios of .91. Significant results of these tests are presented, and applications to aircraft systems discussed. Author

N73-21030 Royal Aircraft Establishment, Bedford (England).

RAE EXPERIENCE IN THE USE OF A PILOTED GROUND-BASED SIMULATOR FOR HELICOPTER HANDLING STUDIES

T. Wilcock *In* AGARD Advanced Rotorcraft, Vol. 1 Feb. 1973 12 p refs

Two studies using a ground-based piloted flight simulator for the assessment of helicopter handling qualities are described. The first simulation, of a Westland Wessex, was performed to establish the simulation techniques required for effective representation of handling behaviour. The second study was of the Westland Lynx, and was conducted prior to the first flight of that helicopter in order to provide assistance in the early development program. Results of the two simulations are discussed, and the experience gained from these tests is used to suggest some requirements for valid simulation. Author

N73-21031# Advisory Group for Aerospace Research and Development, Paris (France).

AERODYNAMICS OF ROTARY WINGS

Feb. 1973 449 p refs In ENGLISH; partly in FRENCH Presented at Fluid Dyn. Panel Specialists Meeting, Marseilles, 13-15 Sep. 1972

(AGARD-CP-111) Avail. NTIS HC \$24.50

The proceedings of a conference on the fluid dynamics of rotary wings and methods for calculation and analysis of the aerodynamics and dynamics of rotary wing systems are presented. The subjects discussed include the following: (1) calculation of rotor wake characteristics and inflow distribution, (2) factors affecting performance at hover and high advance ratio, (3) description of analytical methods for calculating rotor unsteady

aerodynamics, (4) trends in rotor blade airfoil design, and (5) measurement of aerodynamic noise generated by rotary wings.

N73-21032 United Aircraft Corp., East Hartford, Conn.
ROTOR WAKES: KEY TO PERFORMANCE PREDICTION
 Anton J. Landgrebe and Marvin C. Cheney, Jr. *In* AGARD Aerodyn. of Rotary Wings Feb. 1973 19 p refs

The history of helicopter performance prediction methods and the influence of rotor wakes are traced from the simple momentum techniques used in the early years of propellers and rotors to the current state-of-the-art computer programs simulating the rotor's complex vortex structure. Analytical and experimental techniques are described which define the geometry of the vortex field of a hovering rotor and its effect on rotor performance. It was concluded that the most important factor which influences the prediction of hover performance was the interference caused by the tip vortex during its first revolution. Integrated performance in forward flight was generally not sensitive to variable inflow; however, when combined with unsteady airfoil data, variable inflow produced significant effects on blade torsional responses. Author

N73-21033 Army Air Mobility Research and Development Lab., Moffett Field, Calif.
AN ACTUATOR DISC THEORY FOR ROTOR WAKE INDUCED VELOCITIES
 Robert A. Ormiston *In* AGARD Aerodyn. of Rotary Wings Feb. 1973 19 p refs

A general actuator disc theory is presented for predicting the time-averaged downwash distribution, and steady state force and moment response characteristics of helicopter rotors in forward flight. Particular attention is given to a proper definition of the rotor potential flow problem. The formulation of the theory is conceptually based on classical fixed-wing lifting-line theory to enhance its versatility and provide insight about the complex physical features of the rotor downwash distribution. The method of solution expresses the rotor downwash in a fourier series where the coefficients are given as a summation of influence functions. It is shown that the rotor wake vorticity can be assumed to lie in a flat planar wake for a wide range of flight conditions, thus simplifying the Biot-Savart integration for the downwash. The vorticity elements in the flat planar wake are decomposed into simple circular and linear elements to further simplify the integrations. Author

N73-21034 Westland Aircraft, Ltd., Yeovil (England).
THE STRUCTURE OF THE ROTOR BLADE TIP VORTEX
 C. V. Cook *In* AGARD Aerodyn. of Rotary Wings Feb. 1973 14 p refs

The results of a set of experiments to measure the velocity distribution through a helicopter rotor blade tip vortex are presented. The experiments were conducted on a single full scale rotor blade operating at a representative tip speed on a whirl tower. The rotor was mounted in the inverted position (thrusting downward) to reduce the ground effects and produce a steady flow through the rotor. The vortex velocity distributions were measured for a range of vortex ages and a number of blade loadings, the highest of which was above that normally associated with a hovering rotor. A vortex "age" range in terms of blade rotation of approximately 70 to 380 degrees of azimuth was covered. Flow visualisation using smoke was employed to determine the trajectory of the vortex and a hot wire anemometer to measure the induced velocities associated with the tip vortex. Author

N73-21035 Georgia Inst of Tech., Atlanta. School of Aerospace Engineering.
A VORTEX ANALYSIS OF A SINGLE BLADED HOVERING ROTOR AND A COMPARISON WITH EXPERIMENTAL DATA
 Robin B. Gray and George W. Brown *In* AGARD Aerodyn. of Rotary Wings Feb. 1973 14 p refs

A theoretical method is developed for determining the geometry and strength distribution of the vortex wake generated by a single-bladed hovering helicopter rotor. The analysis begins with a simple model of the ultimate wake geometry and then proceeds to establish the corresponding nondimensional tip-vortex strength. This simple vortex-wake model is adjusted by procedures that are based on the Biot-Savart law to obtain a first approximation for the tip-vortex geometry. Next, an estimate of the blade collective pitch angle is found from blade-element considerations. Then, a first approximation for the geometries and strengths of the vortex-sheet filaments that are shed from the blade trailing edge is determined by marching inboard from the blade tip. Thus, a simultaneous solution for the filament strengths is not required. Further adjustments to the wake geometry, the strengths of the inboard filaments, and the collective pitch are made until succeeding changes become acceptably small. Author

N73-21036 Societe Nationale Industrielle Aerospatiale, Marseille (France).
ROTOR STATIONARY FLIGHT AND LARGE ADVANCEMENT PARAMETERS [ROTOR EN VOL STATIONNAIRE ET A GRAND PARAMETRE D'AVANCEMENT]
 J. Soulez-Lariviere *In* AGARD Aerodyn. of Rotary Wings Feb 1973 29 p *In* FRENCH

A technique which permits vertical flight by a helicopter rotor is disclosed. The historical development of a conduit is explored, after which the diverse shock limitations on stationary and translation flight are examined. A historical account is also given of the methods used to improve and calculate the performance of helicopter rotors. Transl by E.H.W.

N73-21037 Societe Nationale Industrielle Aerospatiale, Marseille (France).
ROTOR REQUIREMENTS BEYOND THE USUAL FLIGHT DOMAIN OF ONERA LARGE WIND TUNNEL AT MONDANE [COMPORTEMENT D'UN ROTOR AU-DELA DU DOMAINE DE VOL USUEL A LA GRANDE SOUFFLERIE DE MODANE]
 Michel Lecarme *In* AGARD Aerodyn. of Rotary Wings Feb. 1973 14 p *In* FRENCH; ENGLISH summary

Several series of tests have been performed on a 4.150 meter diameter experimental rotor in the large wind tunnel. The blades stiffness and available power of test equipment in the wind tunnel made a number of measurements and visualizations possible in some severe configurations and at high tip speeds. During the exploration of the test envelopes for various sets of blades, a tip speed ratio of 87 was reached; the retreating blade stall was studied at several values of preset parameters, such as: wind speed, rotor tip speed, rotor shaft tilt, and collective pitch. The present rotor head is not provided with cyclic pitch control. Operating limits for a conventional rotor were determined in terms of tip speed ratio. Development of retreating blade stall is affected by the reverse flow area and vortex interactions and this stall produces disturbances which increase as the tip speed ratio decreases. Author

N73-21038 United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft Div.
AERODYNAMIC FACTORS INFLUENCING OVERALL HOVER PERFORMANCE
 Evan A. Fradenburgh *In* AGARD Aerodyn. of Rotary Wings Feb 1973 11 p refs

Improvements in basic rotor design practice are described and results of several series of model rotor tests are discussed. Moderate values of blade root cutout are shown to have an unanticipated effect on hovering efficiency. A large root cutout decreases figure of merit of the rotor, but also reduces vertical drag of a typical airframe below the rotor, cutting the aerodynamic penalty to about half of what tests of the rotor alone would indicate. Tests of a tilt-rotor model show that, unlike the conventional single rotor helicopter configuration, the rotors do not benefit from a partial ground effect caused by the airframe in the rotor downwash field. The relationship of blade twist and ground effect is discussed, and the influence of ground proximity

on vertical drag is presented. It is shown that net airframe vertical drag can be zero or negative when the aircraft is close to the ground. Additional systematic experimentation is clearly needed, as is the development of theory to cover the various relationships involved in overall hover efficiency
Author

N73-21039 Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).

THE ROTOR IN AXIAL FLOW

Herbert Zimmer *In* AGARD Aerodyn. of Rotary Wings Feb. 1973 16 p refs

The aerodynamic characteristics of rotary wings under axial flow conditions are discussed. An outline of the calculation methods is given. A vortex method is used for one type of calculation. A momentum-blade element method is applied in another case because of the widely separated flow. Emphasis is placed on quick solution of the equations because of the need for frequent use in a design cycle and during performance calculations.
Author

N73-21040 Canadair, Ltd., Montreal (Quebec).

THE DEVELOPMENT OF AN EFFICIENT HOVERING PROPELLER/ROTOR PERFORMANCE PREDICTION METHOD

D. C. Gilmore and I. S. Gartshore (British Columbia Univ.) *In* AGARD Aerodyn. of Rotary Wings Feb. 1973 24 p refs

The development of a method for predicting the performance of heavily loaded propellers and rotors in steady hovering flight is described. The method has two particularly useful characteristics: (1) certain simplifying assumptions which allow consistency in the analytical model to be achieved with only a few small scale iterations and (2) a need for only a part of the wake to be specified. The analytical model, built up from three basic elements, includes a single vortex filament shed from the tip of each blade, a vortex sheet shed inboard of the point of maximum bound circulation on each blade, and an outboard sheet rolling up to form the tip vortex at an arbitrary angle. Roll-up angle affects the circumferential variation of induced velocity components but not their mean values. Application of the method to three propellers shows that accuracy of results is dependent upon realism of the assumed wake geometry.
Author

N73-21041* National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

A SUMMARY OF CURRENT RESEARCH IN ROTOR UNSTEADY AERODYNAMICS WITH EMPHASIS ON WORK AT LANGLEY RESEARCH CENTER

John F. Ward and Warren H. Young, Jr *In* AGARD Aerodyn. of Rotary Wings Feb. 1973 20 p refs Prepared in cooperation with Army Air Mobility R and D Lab., Fort Eustis, Va.

The basic unsteady aerodynamic environment of the rotary wing is summarized. Some of the observed trends in the state of the art are discussed. Some of the research needs that will require attention are reported. A review of a number of research investigations as a part of a joint NASA/Army rotorcraft project is presented. The research is directed toward achieving a better understanding of rotor unsteady airfoils. The investigations include: (1) rotor maneuver loads; (2) level flight and maneuver wake prediction; (3) tip-vortex flow; (4) blade-vortex interactions; (5) dynamic stall; (6) transient Mach number air loads; and (7) development of variable geometry rotors.
Author

N73-21042 Office National d'Etudes et de Recherches Aérospatiales, Paris (France).

AERODYNAMIC FORCES COMPUTATION AND MEASUREMENT ON AN OSCILLATING AEROFOIL PROFILE WITH AND WITHOUT STALL

J. J. Philippe and M. Sagner *In* AGARD Aerodyn. of Rotary Wings Feb. 1973 13 p refs *In* FRENCH; ENGLISH summary

Research projects on computing and measuring aerodynamic forces on oscillating airfoil profiles are discussed. The

problems created by unsteady aerodynamic stalling of rotary wings are emphasized. The experimental findings are analyzed as a function of mean angle of attack, oscillations amplitude, reduced frequency, and Mach number. Computed results are compared with experimental data.
Author

N73-21043 Aix-Marseilles Univ. (France). Inst. de Mecanique des Fluides.

AERODYNAMIC EFFORTS ON A LARGE WING PROFILE WITH QUICK HARMONIC MOVEMENT PARALLEL TO SIEVE FLOW [EFFORTS AERODYNAMIQUES SUR UN PROFIL D'AILE ANIME D'UN MOVEMENT HARMONIQUE PARALLELE A L'ECOULEMENT MOUVEMENT DE TAMIS]

J. Valensi and J. Rebont (CNRS) *In* AGARD Aerodyn. of Rotary Wings Feb. 1973 14 p refs *In* FRENCH

The effects of drag, lift, and pitching moments on a rectangular wing profile system were measured. Measurements were taken at different incidences and different values of advancement parameters.
Transl. by E.H.W.

N73-21044* National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

A COMPRESSIBLE UNSTEADY THEORY FOR HELICOPTER ROTORS

Charles E. Hammond and G. Alvin Pierce (Ga. Inst. of Tech.) *In* AGARD Aerodyn. of Rotary Wings Feb. 1973 15 p refs

Prepared in cooperation with Army Air Mobility Res. and Develop. Lab., Ft. Eustis, Va (For availability see N73-21031 12-02) (Contract DAHCO4-68-C-0004)

An aerodynamic theory is presented which allows the determination of the unsteady aerodynamic loading on a reference section of a helicopter rotor blade in axial or hovering flight under compressible flow conditions. The aerodynamics of the two-dimensional flow model are formulated using a kernel function approach. By introducing the acceleration potential the governing integral equation for the flow and its attendant downwash boundary condition are developed and solved numerically using a pressure mode assumption and a collocation technique. The compressible aerodynamic theory thus developed is compared analytically with two other existing theories, one incompressible and one compressible, and is shown to agree with these theories provided that the appropriate limit is taken so that the flow models agree. The ratio of blade oscillatory frequency to rotor rotational frequency is shown to be the correlation parameter between the two flow models.
Author

N73-21045 Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).

SOME ASPECTS OF THE DESIGN OF ROTOR-AIRFOIL SHAPES

G. Reichert and S. N. Wagner *In* AGARD Aerodyn. of Rotary Wings Feb. 1973 22 p refs

Analytical studies have shown that performance, stability and control of helicopters can be improved if some characteristics of rotor airfoils could be changed. Starting from given airfoil shapes the characteristics of these airfoils are idealized by changing lift curve slope, maximum lift boundary, and beginning of drag divergence. The influences of these changes on the power required, the stability and control of hingeless rotor helicopters are studied. Furthermore, the desirable characteristics of an airfoil or several airfoils of a rotor are defined using these idealized characteristics and analysing common missions of a given helicopter. Similar studies of a larger field of missions and helicopters could lead to new areas of research and development to design advanced profile shapes of helicopters of the future. Several analytical tools for the design of airfoils are discussed.
Author

N73-21046 Army Air Mobility Research and Development Lab., Moffett Field, Calif.

RECENT DEVELOPMENTS IN ROTOR BLADE STALL

W. J. McCroskey *In* AGARD Aerodyn. of Rotary Wings Feb. 1973 13 p refs

Developments in techniques for analyzing boundary layers

of rotary wings are discussed. The basic effects of rotation and crossflow due to forward flight have been identified and found to be insignificant for most cases of practical interest in helicopter aerodynamics. Within the framework of classical thin boundary theory, unsteady viscous effects are also small. Unsteady viscous-inviscid interaction appears to play an important role in retreating blade stall. The characteristics of retreating blade stall are described based on vortex-like disturbance from the leading edge of the rotor blade. Author

N73-21047 Royal Aircraft Establishment, Farnborough (England). **THE DERIVATION AND VERIFICATION OF A NEW ROTOR PROFILE ON THE BASIS OF FLOW PHENOMENA; AEROFOIL RESEARCH AND FLIGHT TESTS**
H. H. Pearcey, P. G. Wilby, M. J. Riley, and P. Brotherhood *In* AGARD Aerodyn. of Rotary Wings Feb. 1973 18 p refs

An account is given of some of the considerations that governed the derivation of new profiles to be incorporated in the design of the rotor blades for the Lynx helicopter at its inception. The changes relative to the NACA 0012 profile were conservative but were chosen to give consistent and significant all-round improvements to the shock-induced limits on the advancing blade, to the retreating-blade thrust limits and to the loading that could be sustained without shock-wave drag in hover. The conservatism applied especially to the stalling characteristics which play such a dominant part in limiting rotor performance but which are so difficult to predict for the rotor environment. The profiles were derived on the basis of steady flow aerofoil tests, but qualitatively similar improvements have been verified in oscillatory aerofoil tests and in flight. A technique, used in the latter tests, is described for measuring pressure distributions along the blade chord and across the blade wake in the region of the rotor tip in flight. Author

N73-21048 Army Air Mobility Research and Development Lab., Moffett Field, Calif. **THE EFFECT OF PLANFORM SHAPE ON THE TRANSONIC FLOW PAST ROTOR TIPS**
W. F. Ballhaus and F. X. Caradonna *In* AGARD Aerodyn. of Rotary Wings Feb. 1973 12 p refs

A numerical relaxation algorithm capable of calculating the transonic inviscid flow about arbitrary planform rotors has been developed. The essential feature of this method is a transformation in which arbitrary planforms are converted to rectangles and all boundary condition problems are transferred to the equation of motion. Preliminary numerical calculations are presented for blades of various sweeps and profiles. It is seen that three-dimensional effects remove sweep effects and can cause shocks which are locally more severe than would occur in less swept or even unswept planforms. The method presents itself as a means of checking various rotor configurations before any tests are made. Author

N73-21049* National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif. **A SUMMARY OF WIND TUNNEL RESEARCH ON TILT-ROTORS FROM HOVER TO CRUISE FLIGHT**
Ph. Poisson-Quinton and W. L. Cook *In* AGARD Aerodyn. of Rotary Wings Feb. 1973 16 p refs

An experimental research program conducted on a series of tilt rotors designed for a range of blades twist is reported. The test facilities used in the program are identified. The objective of the program was to obtain precise results on the influence of blades twist and aeroelasticity on tilt rotor performance from hover to high speed cruise Mach number to 0.7. Five aluminum rigid rotors and one fiber glass composite rotor were tested. Author

N73-21050 Naval Ship Research and Development Center, Bethesda, Md. **RECENT DEVELOPMENTS IN CIRCULATION CONTROL ROTOR TECHNOLOGY**

Robert Williams *In* AGARD Aerodyn. of Rotary Wings Feb. 1973 19 p refs

Research on the historical concept of circulation control applied to rotor blades is presented. A high speed helicopter application is used to illustrate the potential of this rotor for a major breakthrough in the areas of rotor efficiency, parasite drag and weights leading to a large improvement in aircraft productivity. Details of the hover, transition and high speed cruise performance are presented. Some problems of autorotation, vibrations and blade dynamics are also discussed. Author

N73-21051 Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). **SOME OBJECTIVES IN APPLYING HINGELESS ROTORS TO HELICOPTERS AND V/STOL AIRCRAFTS**
H. B. Huber *In* AGARD Aerodyn. of Rotary Wings Feb. 1973 16 p refs

Some of the aerodynamic, dynamic and aeroelastic problems in rotor design for helicopters and V/STOL-aircraft are discussed. After a short description of the main features of the hingeless rotor concept the most important research and design areas of the system are indicated. Attention is given to the flapping and inplane stiffness of the blade root section, the aerodynamic and dynamic blade design, the rotor hub geometry and the control system flexibility. The aeroelastic characteristics and some important parameter sensitivities are reported. The analytical and experimental studies include control and flight dynamic characteristics, structural loads, damping behaviour and aeroelastic stability. Analytical results are compared with test data. Based on these results some design criteria are provided and recommendations are made for a successful application of hingeless rotor systems on helicopters and tilting prop/rotor aircrafts. Author

N73-21052 SIAI Marchetti S.p.A., Varese (Italy). **AERODYNAMICS OF HELICOPTER COMPONENTS OTHER THAN ROTORS**
Angelo Bosco *In* AGARD Aerodyn. of Rotary Wings Feb. 1973 16 p refs
(Contract DAJA37-72-C-1998)

The effects of parameters other than rotary wings on the performance of helicopters are discussed. Specific examples for the design of the SV-20A winged helicopter are presented. Wind tunnel tests to isolate aerodynamic interferences and to confirm aerodynamic analyses are described. The application of nonrotating component aerodynamics to optimization of the helicopter design is reported. Author

N73-21053* Loughborough Univ. of Technology (England). **FUNDAMENTAL CONSIDERATION OF NOISE RADIATION BY ROTARY WINGS**
Martin V. Lawson *In* AGARD Aerodyn. of Rotary Wings Feb. 1973 18 p refs Sponsored by NASA and Natl. Gas Turbine Estab.

An historical review of progress in understanding of rotor noise is presented. Initial work was principally on propellers, but has many obvious applications to noise from rotary wings. Current understanding of rotor noise radiation is then reviewed in some detail. The principal noise sources appear to be: (1) discrete frequency due to distorted inflow; (2) low frequency broadband due to turbulent inflow, and (3) high frequency broadband due to tip effects. On a helicopter rotor each of these sources seems to be intimately connected with the shed vortex wakes. Tip modifications offer one method for controlling the effects. The implications for the designer are discussed. Rotor subjective noise levels appear to obey a velocity to the eighth power law, independent of thrust. Experiments to rectify some of the present deficiencies in knowledge are suggested. Author

N73-21054 Bogazici Univ., Istanbul (Turkey). **WAKE CHARACTERISTICS OF A TWO DIMENSIONAL ASYMMETRIC AEROFOIL**
Ibrahim Kavrak *In* AGARD Aerodyn. Rotary Wings Feb. 1973 7 p refs

The process by which dipole noise is generated by the turbulent wake behind an airfoil is discussed. The characteristics of the wake are investigated and compared to the drag and lift

coefficients as well as the noise radiated. It is concluded that both the drag coefficient and the generated noise are closely related to the turbulent shear in the separated flow area. The maximum velocity defect is shown to be an important parameter which affects both the performance and the noise intensity.

Author

N73-21055 Societe Nationale Industrielle Aerospatiale, Marseille (France).

MEASURE OF HELICOPTER NOISE DURING FLIGHT (MESURES DE BRUIT D'HELICOPTERES EN VOL)

Fernand D'Ambra, Jean-Pierre Dedieu, and Alain Julienne (ONERA, Chatillon, France) /n AGARD Aerodyn. of Rotary Wings Feb. 1973 15 p refs In FRENCH; ENGLISH summary

Noise measurements have been performed on several helicopters. These tests were aimed toward a complete survey of helicopters' internal and external noise levels in several flight conditions. Data analysis of flyover tests follows conventional aircraft's acoustical certification procedure. Test results are corrected to duplicate nominal flight path and standard atmosphere conditions in several noise units. A statistical analysis of maximum noise levels has been performed and results are presented with their confidence level. The use of the trajectography equipment grants in addition the exact timing of acoustical spectra from which directivity patterns of noise radiated from the complete aircraft in flight and from particular noise sources can be obtained.

Author

N73-21056 Westland Helicopters, Ltd., Yeovil (England).

THE NOISE CHARACTERISTICS OF A LARGE CLEAN ROTOR

John W. Leverton /n AGARD Aerodyn. of Rotary Wings Feb. 1973 14 p refs

A 2-bladed 56-ft diameter rotor was run on a tower in an inverted mode so that the problem of recirculation and the difficulties of measuring noise directivity characteristics could be overcome. This paper outlines the analysis procedure used and presents the detailed results obtained. From a practical point of view rotor noise can be considered to consist of rotational or discrete frequency noise, low frequency broadband noise and high frequency broadband noise. The spectrum characteristics and the directivity patterns of each of these sources have been examined as a function of the blade tip speed, the total rotor thrust and the measurement angle relative to the rotor disc plane. The trends associated with the overall noise, which is dependent on the relative magnitude of the individual sources, have also been studied. These results have been compared, where possible, with the trends given by theoretical and semiempirical prediction methods. Time history traces are also included; these show that even under ideal conditions rotor noise is impulsive in nature.

Author

N73-21057* National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

SOME EFFECTS OF GROOVED RUNWAY CONFIGURATIONS ON AIRCRAFT TIRE BRAKING TRACTION UNDER FLOODED RUNWAY CONDITIONS

Thomas A. Byrdsong Washington Apr. 1973 26 p refs (NASA-TN-D-7215; L-8227) Avail: NTIS HC \$3.00 CSCL 01C

An experimental investigation was conducted to study the effect of grooved runway configurations on aircraft tire braking traction on flooded runway surfaces. The investigation was performed, utilizing size 49 x 17, type VII, aircraft tires with an inflation pressure of 170 lb per square inch at ground speeds up to approximately 120 knots. The results of this investigation indicate that when the runway is flooded, grooved surfaces provide better braking traction than an ungrooved surface and, in general, the level of braking traction was found to improve as the tire bearing pressure was increased because of an increase in the groove area of either the surface or the tire tread. Rounding the groove edges tended to degrade the tire braking capability from that developed on the same groove configuration with sharp edges. Results also indicate that braking friction coefficients for

the test tires and runway surfaces decreased as ground speed was increased because of the hydroplaning effects.

Author

N73-21058* National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

EXPERIMENTAL INVESTIGATION OF THE CORNERING OF A C40 x 14-21 CANTILEVER AIRCRAFT TIRE

Robert C. Dreher and John A. Tanner Washington Apr. 1973 23 p refs

(NASA-TN-D-7203; L-8766) Avail: NTIS HC \$3.00 CSCL 01C

An experimental investigation was conducted at the Langley aircraft landing loads and traction facility to define the cornering characteristics of a size C40 x14-21 aircraft tire of cantilever design. These characteristics, which include the cornering-force and drag-force friction coefficients and self-aligning torque, were obtained for the tire operating on dry, damp, and flooded runway surfaces over a range of yaw angles from 0 deg to 20 deg and at ground speeds of 5 to 100 knots, both with and without braking. The results of this investigation show that the cornering-force and drag-force friction coefficients and self-aligning torque were influenced by the yaw angle, ground speed, brake torque, surface wetness, and the locked-wheel condition.

Author

N73-21059* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

NOISE MEASUREMENTS FOR VARIOUS CONFIGURATIONS OF A MODEL OF A MIXER NOZZLE EXTERNALLY BLOWN FLAP SYSTEM

Jack H. Goodykoontz, Jack M. Wagner, and Noel B. Sargent Washington Apr. 1973 29 p refs

(NASA-TM-X-2776; E-7300) Avail: NTIS HC \$3.00 CSCL 20A

Noise data were taken for variations to a large scale model of an externally blown flap lift augmentation system. The variations included two different mixer nozzles (7 and 8 lobes), two different wing models (2 and 3 flaps), and different lateral distances between the wing chord line and the nozzle centerline. When the seven lobe was used with the trailing flap in the 60 deg position, increasing the wing to nozzle distance had no effect on the sound level. When the eight lobe nozzle was used there was a decrease in sound level. With the 20 deg flap setting the noise level decreased when the distance was increased using either nozzle.

Author

N73-21060* RAND Corp., Santa Monica, Calif.

LOW COST TACTICAL RPVs

R. H. Jacobson Sep. 1972 10 p (P-4902) Avail: NTIS HC \$3.00

The development of low cost remotely piloted vehicles is discussed. The emphasis is placed on development of an unconstrained innovative approach in establishing the logistic and maintenance characteristics which can significantly influence the overall design of remotely piloted vehicles and the required ground support equipment. Methods in which the costs of unmanned flying vehicles can be reduced are proposed. The application of automated production procedures and the use of composite materials are recommended.

Author

N73-21061* National Transportation Safety Board, Washington, D.C.

AIRCRAFT ACCIDENT REPORT: AMERICAN AIRLINES, INCORPORATED; MCDONNELL-DOUGLAS DC-10-10, N103AA, NEAR WINDSOR, ONTARIO, CANADA, 12 JUNE 1972

28 Feb. 1973 44 p

(NTSB-AAR-73-2) Avail: NTIS HC \$4.25

A DC-10-10 was damaged substantially when the aft bulk cargo compartment door separated from the aircraft in flight at approximately 11,750 feet mean sea level. The separation caused rapid decompression, which, in turn, caused failure of the cabin floor over the bulk cargo compartment. The separated door caused minor damage to the fuselage above the door and substantial damage to the leading edge and upper surface of the left horizontal

stabilizer. There were 56 passengers and a crew of 11 aboard the aircraft. Two stewardesses and nine passengers received minor injuries. The probable cause of this accident was the improper engagement of the latching mechanism for the aft bulk cargo compartment door during the preparation of the airplane for flight. The design characteristics of the door latching mechanism permitted the door to be apparently closed when, in fact, the latches were not fully engaged, and the latch lockpins were not in place. Author

N73-21062# National Transportation Safety Board, Washington, D.C.

AIRCRAFT ACCIDENT REPORT: TRANS WORLD AIRLINES, INCORPORATED, BOEING 707-331C, N15712, FLIGHT 604, SAN FRANCISCO, CALIFORNIA, 13 SEPTEMBER 1972

14 Mar. 1973 12 p
(NTSB-AAR-73-4) Avail: NTIS HC \$3.00

On September 13, 1972, a Boeing 707-331C, on a scheduled cargo flight from San Francisco, California, to John F. Kennedy International Airport, Jamaica, New York, crashed into San Francisco Bay following a rejected takeoff. There were no injuries to the three crewmembers, the only occupants on board. The aircraft was substantially damaged. The probable cause of this accident was the initiation of rejected takeoff procedures, beyond V sub 1 speed, with insufficient runway remaining in which to stop the aircraft. The crew action was prompted by the failure of the two right truck rear tires which produced a noticeable aircraft vibration and a reduction in aircraft acceleration. Author

N73-21063# Hydrospace-Challenger, Inc., Rockville, Md.
RESULTS OF NOISE SURVEYS OF SEVENTEEN GENERAL AVIATION TYPE AIRCRAFT Final Report
Damon C. Gray Dec. 1973 74 p
(Contract DOT-FA73WA-3179)
(FAA-EQ-73-1) Avail: NTIS HC \$5.75

Noise levels, in terms of EPNL, PNL, dBA and dBD, are presented for both jet and propeller-driven general aviation type aircraft. The noise levels were derived from measurements taken by the FAA and NASA/LRC at the National Aviation Facilities Experimental Center. Levels derived from actual take-off and constant altitude fly-bys are presented wherever possible. Author

N73-21064# Federal Aviation Administration, Washington, D.C. Office of Environmental Quality
AIRCRAFT SOUND DESCRIPTION SYSTEM: BACKGROUND AND APPLICATION Final Report
J. E. Cruz Mar 1973 60 p refs
(FAA-EQ-73-3) Avail: NTIS HC \$5 00

An objective approach to describing aircraft sound levels for areas in the vicinity of airports called Aircraft Sound Description System (ASDS), suitable for both manual and computer application, is presented. The basic premise of the concept is to state exposure to aircraft sound in terms of the amount of time that sound levels exceed a preselected threshold value. The rationale supporting the selection of this procedure, the selection of the threshold value, as well as some operating time constants, is covered together with two hypothetical applications. Author

N73-21065*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
LF460 DETAIL DESIGN FINAL TECHNICAL REPORT ON AIRCRAFT SUPPORT ACTIVITY Contractor Report, Jun. 1971 - Mar. 1972
Apr. 1973 121 p refs
(Contract NAS2-6056)
(NASA-CR-121146) Avail: NTIS HC \$8.25 CSCL 01C

Various studies and analyses that were performed in support of the V/STOL research transport design effort are discussed. The propulsion system specified for these studies was the LF460/YJ97-GE-100 turboprop lift fan. Strong emphasis was placed on achieving low fan noise while maintaining the high thrust/

weight capability of the high pressure ratio lift fan system. The work was divided into cycle analysis and performance studies, installation and systems support, acoustic analysis and preliminary or conceptual design studies. Author

N73-21066*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
JET EXHAUST NOISE SUPPRESSOR Patent Application
Ronald G. Huff, inventor (to NASA) Filed 9 Mar. 1973 8 p refs
(NASA-Case-LEW-11286-1; US-Patent-Appl-SN-339806) Avail: NTIS HC \$3.00 CSCL 01C

Noise suppression for a jet engine is provided by an annular divergent body attached to an exhaust nozzle. The smallest diameter of the divergent body is larger than the diameter of the exhaust nozzle exit to form an annular step which produces a shock wave in the exhaust as it passes the step. An annular shroud is disposed around the divergent body and causes outside air to pass through voids in the divergent body to mix with the jet exhaust gas. The divergent body includes a plurality of channels with separators between the channels. NASA

N73-21067*# Pennsylvania State Univ., University Park. Acoustics and Noise Control Lab.
DESIGN AND DEVELOPMENT OF THE SPINNING MODE SYNTHESIZER
John M. Seiner and Gerhard Reethof Washington NASA Apr. 1973 57 p refs
(Grant NGL-39-009-121)
(NASA-CR-2260) Avail: NTIS HC \$3.00 CSCL 20A

Design and development of a flexible source of spinning modes which is capable of generating independent spinning waves of controlled complexity and spin speed without the introduction of broad band elements is reported. These features were accomplished through the use of eight commercial loudspeakers located in an equally spaced circular array with diameter of 11 inches and properly phased so that the system could generate a spinning wave. The constructed apparatus was tested in an anechoic environment and found capable of generating a plane, one and two lobed spinning wave of high quality with a sound pressure level of 120 dB and at frequencies ranging from 1500 to 2500 Hz at a distance of 4 ft in the far field. The wave speeds investigated varied from 8000 to 18000 rad/sec which represent supersonic peripheral speeds. Author

N73-21068*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A FLIGHT INVESTIGATION OF THE TRAILING VORTICES GENERATED BY A JUMBO JET TRANSPORT
Harry A. Verstynen, Jr. and R. Earl Dunham, Jr. Washington Apr. 1973 44 p refs
(NASA-TN-D-7172; L-8706) Avail: NTIS HC \$3.00 CSCL 01C

A flight investigation has been conducted to study the velocity and persistence characteristics of the trailing vortices generated by a jumbo jet transport. The investigation showed that the tangential velocities were initially higher for vortices generated with the flaps up and that they persisted for longer distances behind the aircraft than those generated with the flaps down. The core radii with flaps down appeared to be generally larger than those with flaps up. The vertical locations of the vortices behind the generating aircraft varied from several hundred meters below the generating aircraft flight path at long ranges up to, and occasionally above, the flight path at short and moderate ranges. Author

N73-21069*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ELASTOHYDRODYNAMIC PRINCIPLES APPLIED TO THE DESIGN OF HELICOPTER COMPONENTS
Dennis P. Townsend 11 May 1973 11 p refs Presented at 29th Natl. Forum of the Am Helicopter Soc., Washington, D. C., 10-11 May 1973
(NASA-TM-X-68215) Avail: NTIS HC \$3.00 CSCL 01C
Elastohydrodynamic principles affecting the lubrication of

transmission components are presented and discussed. Surface temperature of the transmission bearings and gears affect elasto-hydrodynamic film thickness. Traction forces and sliding as well as the inlet temperature determine surface temperatures. High contact ratio gears cause increased sliding and may run at higher surface temperatures. Component life is a function of the ratio of elasto-hydrodynamic film thickness to composite surface roughness. Lubricant starvation reduces elasto-hydrodynamic film thickness and increases surface temperatures. Methods are presented which allow for the application of elasto-hydrodynamic principles to transmission design in order to increase system life and reliability. Author

N73-21070* # Pratt and Whitney Aircraft, East Hartford, Conn. **HIGH LOADING, LOW SPEED FAN STUDY, 5 Final Report** M. J. Keenan and E. A. Burdall Apr. 1973 143 p refs (Contract NAS3-10483) (NASA-CR-121148, PWA-4517) Avail: NTIS HC \$9.25 CSCL 01C

A low speed, low noise, single stage fan was designed and tested. Design pressure ratio was 1.5 at a rotor tip speed of 1000 ft/sec. No inlet guide vane was used, the rotor stator was spaced and the number of rotor and stator airfoils was selected for low noise. Tests were conducted with uniform and distorted inlet flows. Stall margin of the initial design was too low for practical application. Airfoil slots and boundary layer and endwall devices did not improve stall margin sufficiently. A redesigned stator with reduced loadings increased stall margin, giving a fan efficiency of 0.883, 15% stall margin, and a 1.474 pressure ratio at a specific flow of 41.7 lb/sec sq ft. Casing treatment over rotor tips improved stall margin with distorted inlet flow; vortex generators did not. Blade passing frequency noise increased with rotor relative Mach number. No supersonic fan noise was measured below 105% of design speed. Slotting airfoils, casing treatments, and a reduction of the ratio (number-stators/number-rotors) from $(2n + 16)$ to $(2n + 2)$ had no significant effects on noise. Author

N73-21071* # Systems Control, Inc., Palo Alto, Calif. **MAXIMUM LIKELIHOOD IDENTIFICATION AND OPTIMAL INPUT DESIGN FOR IDENTIFYING AIRCRAFT STABILITY AND CONTROL DERIVATIVES**

David E. Stegner and Raman K. Mehra Washington, NASA Mar. 1973 205 p refs (Contract NAS1-10700) (NASA-CR-2200) Avail: NTIS HC \$3.00 CSCL 01B

A new method of extracting aircraft stability and control derivatives from flight test data is developed based on the maximum likelihood criterion. It is shown that this new method is capable of processing data from both linear and nonlinear models, both with and without process noise and includes output error and equation error methods as special cases. The first application of this method to flight test data is reported for lateral maneuvers of the HL-10 and M2/F3 lifting bodies, including the extraction of stability and control derivatives in the presence of wind gusts. All the problems encountered in this identification study are discussed. Several different methods (including a priori weighting, parameter fixing, and constrained parameter values) for dealing with identifiability and uniqueness problems are introduced and the results given. The method for the design of optimal inputs for identifying the parameters of linear dynamic systems is also given. The criterion used for the optimization is the sensitivity of the system output to the unknown parameters. Several simple examples are first given and then the results of an extensive stability and control derivative identification simulation for a C-8 aircraft are detailed. Author

N73-21072* # National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

SMALL-SCALE NOISE TESTS OF A SLOT NOZZLE WITH V-GUTTER TARGET THRUST REVERSER

James R. Stone and Orlando A. Gutierrez Washington Apr. 1973 64 p refs (NASA-TM-X-2758; E-7307) Avail: NTIS HC \$3.00 CSCL 01C

The noise generated by a 2.26- by 11.43-cm slot nozzle with a V-gutter reverser, as well as some aerodynamic data on flow, thrust-reversal efficiency, and nozzle jet velocity decay, was studied. The experimental data are scaled up to sizes suitable for reversing the wing flow of a 45/400-kg augmentor-wing-type STOL airplane, yielding perceived noise levels well above the 95-PNdB design goal on the 152-m sideline. The reverser, in addition to being noisier than the nozzle alone, also had a more uniform directional distribution and more high frequency noise. The maximum overall sound pressure level and the effective sound power level both varied with the sixth power of nozzle jet velocity. Preliminary experiments indicated possible sideline noise reduction by shielding. Author

N73-21074# Hydrospace Research Corp., San Diego, Calif. **ANALYSIS OF OPERATIONAL NOISE MEASUREMENTS IN TERMS OF SELECTED HUMAN RESPONSE NOISE EVALUATION MEASURES** Final Report, Mar. - Dec. 1971 Carole S. Tanner and Ray E. Glass Dec 1971 71 p refs (Contract DOT-FA71WA-2555) (FAA-RD-71-112) Avail: NTIS HC \$5.75

A comparison between common aircraft noise measures such as composite perceived noise level (PNCL), maximum perceived noise level (PNLM), A-weighted level, D-weighted level and noise exposure level (NEL), and the corresponding effective perceived noise level (EPNL) has been made. Differences between EPNL and each of these measures were computed for the 727, KC-135, 707-320B, and DC-9 aircraft for three take-off and four approach operational procedures. Data is presented in both tabular and plotted form. Author

N73-21076# Defense Documentation Center, Alexandria, Va. **SUPERSONIC TRANSPORTS** Report Bibliography, Oct. 1971 - Dec. 1971

Feb. 1973 172 p refs (AD-755600, DDC-TAS-72-72) Avail: NTIS CSCL 01/3

The bibliography is a compilation of references on Supersonic Transports. Citations are numerically sequenced within each of the following thirteen major headings: I. General and Comprehensive Studies; II. Program Management and Financial Analysis; III. Airport Compatibility, Ground Operations, and Air Traffic Control; IV. Sonic Boom, Aircraft and Engine Noise; V. Aerodynamics; VI. Airframes: Structural Design and Analysis; VII. Airframes Materials and Coatings; VIII. Systems: Electronic and Electrical; IX. Systems: Hydraulic; X. Systems: Environmental and Safety; XI. Systems: Engine Intake and Exhaust; XII. Systems: Engine Fuel, Control and Lubrication, and XIII. Engines. This document supersedes AD-853100 and AD-501950. Corporate Author-Monitoring Agency, Subject, Title, Personal Author, Contract, Report Number, and AD-Number Indexes are included. Author (GRA)

N73-21077# Army Foreign Science and Technology Center, Charlottesville, Va.

MATHEMATICAL SIMULATION OF FLIGHT DYNAMICS

S. I. Zlochevskii and Yu D. Kuznetsov 25 Oct. 1973 11 p refs Transl. into ENGLISH from Vestn. Moscow Univ. (Moscow), no. 2, 1971 p 100-107

(AD-755868, FSTC-HT-23-2129-72) Avail: NTIS CSCL 01/3

The report is devoted to the investigation of equations of aircraft dynamics, their subdivision into two groups of equations and to the construction of an analog-digital complex on this basis. Author (GRA)

N73-21078# Systems Technology, Inc., Hawthorne, Calif. **AN ASSESSMENT OF THE PAPER PILOT - AN ANALYTICAL APPROACH TO THE SPECIFICATION AND EVALUATION OF FLYING QUALITIES** Final Report, Dec. 1970 - Jun. 1972

Gary L. Teper Wright-Patterson AFB, Ohio AFFDL Jun. 1972 130 p refs

(Contract F33615-71-C-1071; AF Proj. 8219) (AD-755367; STI-TR-1006-1; AFFDL-TR-71-174) Avail: NTIS

CSCL 01/2

The Paper Pilot is an approach to flying qualities specification and evaluation based on pilot-vehicle system analysis. A fixed-base simulation program was conducted to test its application in the precision hover task. Pilot ratings and system performance measures and describing functions were obtained. An efficient technique was developed by which pilot model parameters were obtained from the describing function data. This provides a unique data base for a realistic, multi-loop (single-controller, multi-input) task. A comparison of the data with the predictions of the Paper Pilot indicate that the pilot model used should be expanded if improved predictions of pilot and system characteristics are to be obtained. Initial steps in this direction were taken but further developments are desirable.

Author (GRA)

N73-21079# Bureau of Mines, Pittsburgh, Pa. Mining and Safety Research Center.

IGNITION AND FIRE SUPPRESSION IN AEROSPACE VEHICLES (PHASE 2) Technical Report, 1 Dec. 1971 - 30 Jun. 1972

Ralph J. Cato, George H. Martindill, and Joseph M. Kuchta
Wright-Patterson AFB, Ohio AFAPL Dec. 1972 32 p
(Contract F33615-72-M-5008; AF Proj. 3048)
(AD-755362; PMSRC-4178; AFAPL-TR-72-96) Avail: NTIS CSCL 13/12

The effectiveness of Halons 1301 (CF3Br), 1202 (CF2Br2), and 1211 (CF2C1Br) as possible explosion suppressants for aircraft fuel tanks was investigated in ignitions with small charges of an IM-11 incendiary powder (Ba(NO3)2-Mg-Al) and 30-caliber incendiary ammunition. Ignitions with the incendiary powder in a 74-gallon fuel tank indicated that over 8 volume percent Halon 1301 is required to fully quench flame propagations of near-stoichiometric n-pentane-air mixtures and limit the pressure rises to less than 5 psi; such high Halon concentrations were also required under gun firing conditions using the 30-caliber ammunition. The critical Halon requirements for quenching the incendiary ignitions of n-pentane-air mixtures did not appear to differ greatly for the three Halons investigated in this work.

Author (GRA)

N73-21080# Ohio State Univ. Research Foundation, Columbus. **ELECTRICAL CHARGING OF A CYLINDER BY A SEEDED VORTEX** Interim Technical Report

Philip B. Bohl and H. R. Velkoff Oct. 1972 106 p refs
(Contract DA-31-124-ARO(D)-246)
(AD-755282; TR-15; AROD-4942-20-E) Avail: NTIS CSCL 01/3

It is a well-established fact that aircraft, especially helicopters, become electrically charged in particular conditions of flight, such as in the case of flying or hovering near particulate matter. The trailing vortices shed by each rotor tip, in the case of a helicopter, flow downward in a helical path and bathe the surface of the helicopter with the fluid field associated with the vortex. The purpose of this research work was to measure the electrical charging rate of a cylindrical body bathed by the trailing vortex shed by a different airfoil seeded with charged particulate in a subsonic wind tunnel.

Author (GRA)

N73-21081# Hydrospace Research Corp., San Diego, Calif. **MEASUREMENT AND ANALYSIS OF NOISE FROM SEVENTEEN AIRCRAFT IN LEVEL FLIGHT (MILITARY, BUSINESS JET, AND GENERAL AVIATION)** Final Report, Jun. 1970 - Nov. 1971

Carole S. Tanner Nov. 1971 68 p refs
(Contract DOT-FA70WA-2374)
(TR-S-212; FAA-RD-71-98) Avail: NTIS HC \$5.50

Measurements of noise from aircraft level flyers are presented in the form of effective perceived noise level (EPNL) as a function of slant range at the closest point of approach. Seventeen aircraft were investigated (various military, business jets, and general aviation types) and the effort involved acquisition of acoustical, meteorological, aircraft tracking, and aircraft operational data. Microphones were located near the ground in an array normal to the flight track.

Author

N73-21177# Sperry Rand Corp., St. Paul, Minn. Defense Systems Div.

ARTS 3 AUGMENTED TRACKING STUDY Final Report
B. Smulowicz (ARCON Corp.), R. Sittler (ARCON Corp.), M. Wold, G. Kelly, B. Birkholz, and L. Cady Washington FAA Jun. 1972 273 p

(Contract DOT-FA70WA-2289; FAA Proj. 19180)
(PX-6392; FAA-RD-73-27) Avail: NTIS HC \$15.75

The results obtained during investigation of methods for improving aircraft tracking techniques within the ARTS-III system are presented. This study recognizes the current tracking level of the Basic Radar Beacon Tracking Level (RBTL) system as the starting point for development. At this level, both radar and beacon target reports from a common sensor site are available for tracking. The work described by this report is an investigation of new methods for utilizing these target reports as well as optimizing and refining existing methods. In addition to seeking methods for upgrading the tracking function, considerations for improving system performance through integration of the video processing, target detection, and display functions with tracking are also investigated. Numerous alternatives are considered and results of both those which show potential for improvement as well as those which show definite limitations are included.

Author

N73-21182# National Aviation Facilities Experimental Center, Atlantic City, N.J.

TESTS OF THE VEGA AIRCRAFT RADAR ENHANCING SYSTEM (VARES) Final Report, Nov. 1971 - Oct. 1972

Dominick L. Offi Apr. 1973 43 p
(FAA Proj. 022-241-030)
(FAA-RD-73-38; FAA-NA-73-14) Avail: NTIS HC \$4.25

A cross-band radar/beacon system, designed to operate within the constraints of the airport surveillance radar/air traffic control interrogator (ASR/ATCBI) environment was evaluated. The equipment, known as the Vega Aircraft Radar Enhancing System (VARES) was tested to determine technical as well as operational characteristics. The VARES equipment as originally designed was not electrically nor mechanically compatible with the ASR/ATCBI system, nor with the aircraft available. With proper modifications, the system provided an increased radar detection capability. In addition, limited tests indicated evidence of possible interference with the ATC Beacon System.

Author

N73-21189# Illinois Univ., Urbana. Antenna Lab. **ANALYTIC RADAR TARGET MODELING** Final Report, 5 Nov. 1971 - 5 Nov. 1972

R. Mitra, S. W. Lee, and C. A. Chuang Dec. 1972 96 p refs
(Contract DAAH01-72-C-0329)
(AD-755854; UIAL-72-14; UILU-ENG-72-2558) Avail: NTIS CSCL 17/9

The report studies the electromagnetic radar scattering parameters for a complex airborne target at high frequencies. The components of the target are modeled by simple geometrical shapes including ellipsoids, elliptical plates, ogives. Semi-individual components are derived in terms of simple analytical functions. These are subsequently combined, in a consistent manner that takes into consideration the geometrical phase delay and shadowing effect, to yield the total scattered field from the target. Extensive numerical results are presented for the T-33 aircraft and the BQM-34A drone. A comparison of our theoretical computations with experimental data measured by a nanosecond short-pulsed radar reveals reasonably good agreement.

Author (GRA)

N73-21227# Northrop Corp., Palos Verdes Peninsula, Calif. Electronics Div.

LARGE AREA DIGISPLAY SWITCHING PLATE DESIGN, FABRICATION AND TEST Final Technical Report, Apr. 1970 - May 1972

James E. Lang Jan. 1973 87 p
(Contract F30602-70-C-0162)
(AD-755938; RADC-TR-72-332; NORT-72-269) Avail: NTIS CSCL 09/1

A flat, thin CRT, which uses digital switching rather than analog deflection to position a beam, has been successfully demonstrated in a 512 x 512 element, 80 elements per inch format, thus meeting the objective of the program. This display device, the DIGISPLAY, was shown to be capable of scanning at TV rates (60 fields - 30 frames/sec). Operating in a simulated TV raster scan mode, the display has an average spot brightness of approximately 8 to 10 foot-Lamberts, a contrast ratio exceeding 32 to 1, and exhibited 4 discriminable gray levels. The four beam-scanning plates constructed for this program enable the device to be scanned by as many as 32 simultaneous writing beams.

GRA

N73-21248 Georgia Inst. of Tech., Atlanta
THE DEVELOPMENT OF A CONTROLLED LATERAL GUST FACILITY FOR DETERMINING THE TRANSFER FUNCTION OF A LIFTING SURFACE Ph.D. Thesis
 Felton Drew Bartlett, Jr. 1972 100 p
 Avail: Univ. Microfilms Order No. 72-20600

An experimental and analytical investigation is presented to illustrate the feasibility of experimentally generating a uniform simple harmonic lateral disturbance in the test section of a low-speed wind tunnel. The gust field is generated by exciting two flexible walls upstream of the test section with electrodynamic shakers. The development of the gust field, its calibration, and finally its application in determining the transfer function of a lifting surface coupled with a theoretical comparison serves to evaluate the test facility and the complete experimental procedure. A discussion of results and conclusions indicates the usefulness of this facility in determining aircraft response to gust loadings.

Dissert. Abstr.

N73-21259# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany).
[ACTIVITIES OF THE DEUTSCHE FORSCHUNGS- UND VERSUCHSANSTALT FUER LUFT- UND RAUMFAHRT]
 Annual Report, 1971 [JAHRES-BERICHT 1971 DER DFVLR]
 Jul. 1972 497 p refs In GERMAN; ENGLISH summary
 Avail: NTIS HC \$27 00

The main research carried out in individual laboratories and research centers is summarized briefly. Activities reported on are in the following fields: fluid mechanics, flight mechanics, flight control, structural stability, materials, structures, propulsion systems and energy conversion, electronics, atmospheric physics, space environment simulation and aerospace medicine.

ESRO

N73-21260# Illinois Univ., Savoy. Aviation Research Lab.
SYNTHETIC FLIGHT TRAINING REVISITED
 Beverly H. Williges, Stanley N. Roscoe, and Robert C. Williges
 Aug. 1972 45 p refs
 (Contract F44620-70-C-0105; AF Proj. 9778)
 (AD-754957; ARL-72/21/AFOSR-72-10; AFOSR-72-2463TR)
 Avail: NTIS CSCL 01/3

Critical issues in the development and use of synthetic flight trainers are reviewed. Degree of simulation and fidelity of simulation are discussed as key design considerations. Problems of measurement of original learning, transfer, and retention are presented. Both transfer effectiveness and cost effectiveness are described as critical factors in the evaluation of flight trainers. Recent training innovations, such as automatically adaptive training, computer-assisted instruction, cross-adaptive measurement of residual attention, computer graphics, incremental transfer effectiveness measurement, and response surface methodology, are discussed as potential techniques for improving synthetic flight training.

Author

Atlee M. Cunningham, Jr. Feb. 1973 124 p refs
 (Contract NAS1-11565)

(NASA-CR-112264) Avail: NTIS HC \$8.25 CSCL 20D

A study was conducted to investigate the feasibility of using combined subsonic and supersonic linear theory as a means for solving unsteady transonic flow problems in an economical and yet realistic manner. With some modification, existing linear theory methods are combined into a single program and a simple algorithm is derived for determining interference between lifting surface elements of different Mach number. The method is applied to a wide variety of problems for which measured unsteady pressure distributions and Mach number distributions are available. By comparing theory and experiment, the transonic method solutions show a significant improvement over uniform flow solutions. It is concluded that with these refinements the method will provide a means for performing realistic transonic flutter and dynamic response analyses at costs which are compatible with current linear theory based solutions.

Author

N73-21308# Kansas Univ./Center for Research, Inc., Lawrence.
VARIATIONS IN THE DETECTABILITY OF MAJOR AIRPORTS IN NORTHEASTERN KANSAS AND NORTHWESTERN MISSOURI

Stanley A. Morain, Principal Investigator, Jerry C. Coiner, and Donald L. Williams 6 Jan. 1973 2 p ERTS

(Contract NAS5-21822)

(E73-10471; NASA-CR-131281) Avail: NTIS HC \$3.00 CSCL 01E

The author has identified the following significant results. Six major airports are located within the ERTS-1 imagery. Runways at four of the airports are readily detectable. Runways at the other two airports are not detectable and the locations must be inferred by other means. This variation is attributed to variation in runway surface composition.

N73-21382# Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.

EXTREMES OF LOW ATMOSPHERIC DENSITY NEAR THE GROUND FOR ELEVATIONS UP TO 15,000 FEET FOR MIL-STD-210B Air Force Surveys in Geophysics

Rene V. Cormier 6 Dec. 1972 23 p refs

(AF Proj. 8624)

(AD-755791; AFCRL-72-0711; AFCRL-AFSIG-251) Avail: NTIS CSCL 04/1

Atmospheric density, especially low values thereof, is important to aircraft takeoff and landing operations. Such extremes must be considered in aircraft design and are therefore to be included in MIL-STD-210B. This document provides environmental design criteria to designers of military equipment, and requires for the most extreme area and month, values of low density that are equalled or surpassed during, 1, 5, 10, and 20 percent of the time for ground elevations up to 15,000 feet. Typical temperatures accompanying these values, needed for engine power calculations, are also required. This report provides these densities and temperatures. In addition, empirical equations, being used by the USAF Environmental Technical Applications Center, for estimating extremes of low density near the ground, are evaluated.

Author (GRA)

N73-21400# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany) Inst fuer Flugfuehrung.

ASSESSMENT OF COCKPIT DISPLAYS [WIRKSAMKEIT-SUNTERSUCHUNGEN VON ANZEIGEN FUER DIE FLUGFUEHRUNG]

Ralf Beyer 1973 32 p refs In GERMAN; ENGLISH summary (DLR-FB-73-03) Avail: NTIS HC \$3.75; DFVLR, Porz, West Ger.: 9,50 DM

A limited survey of some methods for assessment and evaluation of new and predominantly electronic display techniques is given. Particular emphasis is laid on control technology, experimental psychology, physiology, and subjective rating. The survey is supported by results drawn from various experiments.

ESRO

N73-21272# General Dynamics/Fort Worth, Tex. Convair Aerospace Div.
THE APPLICATION OF GENERAL AERODYNAMIC LIFTING SURFACE ELEMENTS TO PROBLEMS IN UNSTEADY TRANSONIC FLOW

N73-21403# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.

TRUE AIRSPEED SENSOR FOR V/STOL AIRCRAFT

Technical Report, 1 Jul. 1970 - 31 Mar. 1972

K. W. McElreath Dec. 1972 37 p refs

(AF Proj. 643A)

(AD-755374; AFFDL-TR-72-131) Avail. NTIS CSCL 01/4

One factor which has hindered the development of an effective low-speed flight control capability for helicopters and other V/STOL aircraft is the lack of an accurate airspeed sensor which will operate at speeds below 40 knots. One device which does meet this requirement is an advanced electronic true airspeed sensor developed by J-Tec Associates of Cedar Rapids, Iowa. Under the USAF Flight Dynamics Laboratory's Advanced Development Program 643A, 'Tactical Airlift Technology,' a J-Tec Associates true airspeed sensor has been evaluated for use by low-speed aircraft, using a Sikorsky CH-3E helicopter as a test bed. The results of the wind-tunnel and flight testing conducted at Wright-Patterson AFB showed that the sensor has excellent characteristics particularly in the low-speed flight regime, where it maintained its accuracy even at high yaw and pitch angles.

Author (GRA)

N73-21417# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Munich (West Germany). Inst. fuer Flugtrieb- und Schmierstoffe.

SPECTROSCOPIC ANALYSIS OF METAL WEAR BASED ON TESTS OF AIRCRAFT TURBINE ENGINE OILS [UEBER DIE SPEKTROSKOPISCHE ANALYSE VON METALLABRIEB ANHAND VON OELUNTERSUCHUNGEN AUS FLUGTRIEBWERKEN]

Eilhard Jantzen; 28 Nov. 1972 56 p refs In GERMAN; ENGLISH summary

(DLR-FB-73-06) Avail. NTIS HC \$5.00, DFVLR, Porz, West Ger. 28.20 DM

Spectroscopic, photometric, and microscopic analyses were carried out to investigate metallic wear particles in 11 JT3D turbojet engines of a Boeing 707, with an aim to predicting engine damage. Emission and atom absorption spectrographs were used, and 9 elements were quantitatively detected, of which the quantities of iron, magnesium and silicon were in some cases more than 1 ppm, with a tendency to increase. Simultaneous light transmittance measurements show the influence of oil change, larger oil filling quantities and progressive oil consumption. Raster electron microscopy of abrasion particles was used to determine type, form, and size distribution of particles. ESRO

N73-21522# Rutgers Univ. New Brunswick, N.J. Center for Transportation Studies

COMPARISON OF MOBILE SOURCE EMISSIONS FROM AIRCRAFT, AUTOMOBILES, BUSES, TRUCKS, RAILROADS, AND ELECTRIC TRAINS (PROJECT EAGLE) Final Report, Mar. 1972 - Dec. 1972

Cooper Bright, Toivo Lamminen, Kenneth Hanko, James Mullaly, Robert Helfand, Richard Heller, Craig Pasco, Yvet Heving Hsu, Michael Tomaszewicz, Forest Markowitz et al Dec. 1972 448 p refs

(Contract DOT-FA72WA-2877)

(FAA-EQ-73-2) Avail NTIS HC \$24.50

Mobile source emissions from aircraft, automobiles, buses, trucks, railroads, and electric trains within the continental United States during the period 1940-1980 were compared. This included air pollution created by operations of air carriers and military and general aviation aircraft. The pollutants considered for all these modes of transportation were carbon monoxide, hydrocarbons and nitrogen oxides and, in addition, for electric trains, pollutant values for sulfur oxides and particulates. It was demonstrated that for the period 1940-1980 public carriers including air transportation showed significantly less air pollution than autos both in grams per passenger mile and total tons. For the same period, aircraft showed less air pollution than buses and railroads both in grams per passenger mile and total tons. This comparison of mobile source emissions pollution from aircraft, autos, buses, trucks, railroads and electric trains provides

information required by planning agencies and legislative bodies in providing support for mass transit projects to assist in reducing air pollution and conserving dwindling petroleum resources. It was concluded that by developing aircraft suitable for operating intraurban mass air transportation in competition with automobiles would make possible drastic reduction in air pollution. Author

N73-21526# National Environmental Satellite Service, Washington, D.C.

STRATOSPHERIC PHOTOCHEMISTRY OF OZONE AND SST POLLUTION: AN INTRODUCTION AND SURVEY OF SELECTED DEVELOPMENTS SINCE 1965

Martin S Longmire Mar. 1973 33 p refs

(NOAA-TM-NESS-47) Avail NTIS HC \$3.75

A review of current thinking on the stratospheric photochemistry of ozone is presented. The study is related to current plans for monitoring the stratosphere for climatic change and for determining other long-range effects arising from natural or human activities. Ozone and atomic oxygen are treated together as odd oxygen because they are converted into each other in the stratosphere through very rapid reactions. The reactions or chains of reactions considered most significant in determining stratospheric ozone are discussed in detail. It is contended that the reactions involving nitrogen oxides dominate those that destroy odd oxygen. The discussion is restricted to ozone photochemistry. A list of stratospheric constituents whose distributions should be monitored globally is also presented, together with a suggested order of priority of observation.

Author

N73-21533# Air Weather Service, Scott AFB, Ill.

AIR WEATHER SERVICE WEATHER-MODIFICATION PROGRAM, FY 1972 Annual Report

Herbert S Appleman, Ted S Cress, Robert I Sax, and Klaus M. Weickmann Dec 1972 20 p refs

(AD-755659; AWS-TR-249; AR-5) Avail. NTIS CSCL 04/2

The annual report of the weather-modification activities of the Air Weather Service covers the projects, their operation and results, undertaken during FY 1972. Its primary purpose is to inform AWS field personnel of the progress in weather modification made during the year. Details of the projects are only briefly discussed as such details are published elsewhere, if warranted. Cold flake, cold wand, cold clear, cool view, and the Elmendorf ground-based propane system are the activities covered by this report.

Author (GRA)

N73-21554# Electromagnetic Compatibility Analysis Center, Annapolis, Md.

IN-BAND COMPATIBILITY ANALYSIS OF THE RTCA-PROPOSED MICROWAVE LANDING GUIDANCE SYSTEM (LGS) AND CANDIDATE SYSTEMS

Robert A. Frazier Jul. 1972 232 p refs Prepared in cooperation with IIT Res. Inst., Annapolis

(Contracts DOT-FA70WAI-175; F19628-71-C-0221; AF Proj. 649E)

(ECAC-PR-72-069; FAA-RD-72-62) Avail: NTIS HC \$13.75

The electromagnetic compatibility among the proposed next generation microwave landing guidance system (LGS) and several existing microwave landing guidance systems proposed as interim candidates was analyzed. The angle data localizer and glideslope portions of the systems were deployed in an FAA-predicted high density 1980 environment and the possibility of compatible operation was assessed with the assistance of a computer analysis. The compatibility among the systems DME functions was analyzed using frequency/distance considerations. The EMC between the landing guidance systems and other in-band domestic systems and between the LGS and a foreign microwave enroute guidance satellite system (DIOSCURES) were analyzed using frequency/distance considerations.

Author

N73-21556# Ohio Univ., Athens. Dept of Electrical Engineering. **ALL-WEATHER, LOW-LEVEL NAVIGATION AND IMPLEMENTATION OF A ONE-WAY RANGING, RANGE-RANGE**

NAVIGATION SYSTEM Final Semiannual Report, Apr. - Oct. 1972

Nov. 1972 192 p refs
(Contracts DAAB07-68-C-0084; DAAB07-71-C-0156)
(AD-755205, ECOM-0084-F, SAR-6) Avail: NTIS CSCL 17/7

The report is a synopsis of a five-year effort of research and development activities into low-level, all-weather aircraft navigation. Various disciplines supporting radio navigation research were pursued in this work and reflected in the report which include computer simulation, communications, electronics, electromagnetics, digital computer technology, control theory, and mathematics. The scope of the work included tradeoff analysis among competing ideas, optimization of system parameters, alleviation of critical implementation problems, invention of new and/or improved structures for radio navigation purposes, and the synthesis of conceptual ideas which were subsequently simulated, analyzed, implemented in prototype form and experimentally evaluated. Author (GRA)

N73-21557# Mitre Corp., Bedford, Mass.
A NORTH ATLANTIC AIR TRAFFIC ANALYSIS PROGRAM
R. H. Reck Dec. 1972 58 p refs
(Contract F19628-71-C-0002; AF Proj. 4150)
(AD-755910; MTR-2389; ESD-TR-72-328) Avail: NTIS CSCL 01/2

A computer program to analyze air traffic in the North Atlantic Ocean is described. Three program options allow the user to obtain a bird's-eye view of the zone traffic at a specified instant of time, determine the flights which pass through a specified geographic box, and determine the time order and latitude of flights crossing a specified longitude. Typical results showing the instantaneous airborne count, amount of traffic passing through a geographic zone, and number of flights per hour versus time are given for two days in 1972. Data was extracted from the Airline Guide. Author (GRA)

N73-21673*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
ANALYSIS OF NOISE PRODUCED BY AN ORDERLY STRUCTURE OF TURBULENT JETS
Jay C. Hardin Washington Apr. 1973 31 p refs
(NASA-TN-D-7242; L-8843) Avail: NTIS HC \$3.00 CSCL 20A

The orderly structure which has been observed recently by numerous researchers within the transition region of subsonic turbulent jets is analyzed to reveal its noise-producing potential. For a circular jet, this structure is modeled as a train of toroidal vortex rings which are formed near the jet exit and propagate downstream. The noise produced by the model is evaluated from a reformulation of Lighthill's expression for the far-field acoustic density, which emphasizes the importance of the vorticity within the turbulent flow field. It is shown that the noise production occurs mainly close to the jet exit and depends primarily upon temporal changes in the toroidal radii. The analysis suggests that the process of formation of this regular structure may also be an important contribution of the high-frequency jet noise. These results may be helpful in the understanding of jet-noise generation and in new approaches to jet-noise suppression. Author

N73-21691*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
EFFECT OF INLET-AIR HUMIDITY ON THE FORMATION OF OXIDES OF NITROGEN IN A GAS-TURBINE COMBUSTOR
Nicholas R. Marchionna Mar. 1973 25 p refs
(NASA-TM-X-68209; E-7391) Avail: NTIS HC \$3.25 CSCL 21E

Tests were conducted to determine the effect of inlet-air humidity on the formation of oxides of nitrogen from a gas-turbine combustor. Combustor inlet-air temperature ranged from 450 F to 1050 F. The tests were run at a constant pressure of 6 atmospheres and reference Mach number of 0.065. The NO sub x emission index was found to decrease with increasing

inlet-air humidity at a constant exponential rate of 19 percent per mass percent water vapor in the air. This decrease of NO sub x emission index with increasing humidity was found to be independent of inlet-air temperature. Author

N73-21692*# Naval Air Propulsion Test Center, Trenton, N.J.
ROTOR BURST PROTECTION PROGRAM: STATISTICS ON AIRCRAFT GAS TURBINE ENGINE FAILURES THAT OCCURRED IN COMMERCIAL AVIATION DURING 1971
R. A. Delucia and G. J. Mangano Feb. 1973 11 p Sponsored by NASA
(NASA-CR-131525, NAPTC-PE-12) Avail: NTIS HC \$3.00 CSCL 21E

A program to develop criteria for the design of devices that will be used on aircraft to protect passengers and the aircraft structure from the lethal and devastating fragments generated by the disintegration of a gas turbine engine rotor is discussed. Statistics on gas rotor turbine failures that have occurred in commercial aviation in 1971 are presented. It is shown that 124 rotor failures occurred and 35 of these were uncontained. This figure is considered significantly high to justify continuation of the development program. Author

N73-21693*# LTV Aerospace Corp., Dallas, Tex. Vought Systems Div.
ANALYSIS OF INLET FLOW DISTORTION AND TURBULENCE EFFECTS ON COMPRESSOR STABILITY
H. C. Melick 31 Mar. 1973 225 p refs
(Contract NAS2-6901)
(NASA-CR-114577; TR-2-57110/3R-3071) Avail: NTIS HC \$13.25 CSCL 21E

The effect of steady state circumferential total pressure distortion on the loss in compressor stall pressure ratio has been established by analytical techniques. Full scale engine and compressor/fan component test data were used to provide direct evaluation of the analysis. Specifically, since a circumferential total pressure distortion in an inlet system will result in unsteady flow in the coordinate system of the rotor blades, analysis of this type distortion must be performed from an unsteady aerodynamic point of view. By application of the fundamental aerothermodynamic laws to the inlet/compressor system, parameters important in the design of such a system for compatible operation have been identified. A time constant, directly related to the compressor rotor chord, was found to be significant, indicating compressor sensitivity to circumferential distortion is directly dependent on the rotor chord. Author

N73-21695*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
AN ADVERSE EFFECT OF FILM COOLING ON THE SUCTION SURFACE OF A TURBINE VANE
Herbert J. Gladden, James W. Gauntner, Frederick C. Yeh, and Daniel J. Gauntner [1973] 8 p refs
(NASA-TM-X-68210; E-7392) Avail: NTIS HC \$3.00 CSCL 21E

A J-75 size turbine vane with film cooling holes on the suction surface near the leading edge was tested with and without film cooling flow in a four-vane cascade. Results show that the cooling effectiveness on the aft portion of the vane suction surface can decrease with the addition of film cooling near the leading edge. Apparently the film cooling air flow caused a laminar or transitional boundary layer to become a transitional or turbulent boundary layer. The vane was tested at a gas temperature and pressure of 1260 K (1800 F) and 22.7 newtons per square centimeter (33 psia), a coolant temperature of 280 K (50 F), film cooling flow ratios from 0.0 to 0.026, and backside midchord cooling flow ratios of 0.007 and 0.035. Author

N73-21845*# Hydronautics, Inc., Laurel, Md.
HIGH FREQUENCY FATIGUE TESTING OF UDIMET 700 AT 1400 F
Andrew F. Conn and S. Lee Rudy Jun. 1972 35 p refs
(Contract NAS3-14335)
(NASA-CR-120958; TR-7150-1) Avail: NTIS HC \$3.75 CSCL 20K

N73-21862

An investigation pertaining to the development of life prediction methods for materials subjected to high temperature creep/fatigue conditions is presented. High frequency (13.4 kHz) fatigue data were measured at 1400 F on specimens of the nickel-based alloy Udimet 700. Tests were conducted on the virgin material, as well as on specimens which had received prior exposures to high temperature, fatigue, and creep. Author

N73-21862*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

EFFECT OF PREMIXING ON NITRIC OXIDE FORMATION
David N. Anderson 1973 14 p refs Proposed for presentation at 75th Natl. Meeting of the Am. Inst. of Chem. Eng., Detroit, Mich., 3-6 June 1973
(NASA-TM-X-68220; E-7418) Avail: NTIS HC \$3.00 CSCL 21B

Emissions from a simple 10-cm (4-in.) diameter tube combustor burning a premixed, gaseous propane/air mixture were measured. Inlet conditions included a temperature of 590 K (600 F), pressure of 5.5 atm, and reference velocity of 23 m/s (75 ft/s) for a range of equivalence ratios from the lean limit to slightly richer than stoichiometric. A nitric oxide emission index of 1 g NO₂/kg fuel was measured for an equivalence ratio of 0.57. Author

N73-21863# Sandia Labs., Livermore, Calif
TURBULENT HEAT TRANSFER AND PRESSURE ON LEADING EDGES OF FINS MOUNTED ON A CONE.
H. W. Coleman and E. C. Lemmon Dec. 1972 70 p refs
(Contract AT(29-1)-789)
(SCL-RR-72-0308) Avail: NTIS

As a result of an extensive experimental program, a technique was developed for predicting shock shapes, pressures, and turbulent heat transfer rates on the leading edge of a fin, swept wing, antenna, or similar highly swept protuberance near its intersection with a high velocity vehicle. Comparison of predictions with data indicates good agreement. While pressures in the intersection region are higher than infinite swept cylinder theory predictions, heat transfer rates can be either significantly greater or less than theoretical values depending on local flow conditions and geometry. Author

N73-21878 Laboratorium fuer Betriebsfestigkeit, Darmstadt (West Germany).
[INSTITUTE PUBLICATIONS, REPORT 5, FROM THE LABORATORY FOR SERVICEABILITY CONTROL OPERATIONAL LIFE AND DURABILITY OF MATERIALS AND STRUCTURES SUBJECTED TO LOADS] [INSTITUTSVER-OEFFENTLICHUNGEN, HEFT 5]
Apr. 1972 158 p refs In GERMAN
Copyright. Avail: Issuing Activity

Management, operation, and instrumentation of the institute are briefly outlined and current research projects are discussed. Scientific and experimental work centered on structural damage problems, reliability engineering, quality control measures, and fatigue design procedures for transport vehicles. Transl. by G.G.

N73-21882# National Research Council of Canada, Ottawa (Ontario).
QUARTERLY BULLETIN OF THE DIVISION OF MECHANICAL ENGINEERING AND THE NATIONAL AERONAUTICAL ESTABLISHMENT, 1 OCTOBER - 31 DECEMBER 1972.
Dec. 1972 103 p refs
(DME/NAE-1972(4)) Avail: NTIS HC \$7.25

Current studies are reported which include the following headings: (1) A description of the NAE T-33 turbulence research aircraft, instrumentation and data analysis; (2) Stationary gas turbine icing problems; (3) The role of plastic deformation in metal powder coaction. D.L.G.

N73-21890# Air Force Systems Command, Washington, D.C
PROCEEDINGS OF AIR FORCE SYSTEMS COMMAND 1972

SCIENCE AND ENGINEERING SYMPOSIUM, VOLUME 1
19 Oct. 1972 549 p refs Conf. held at San Antonio, Tex., 17-19 Oct. 1972
(AD-753071; AFSC-TR-72-005-Vol-1) Avail: NTIS CSCL 05/2

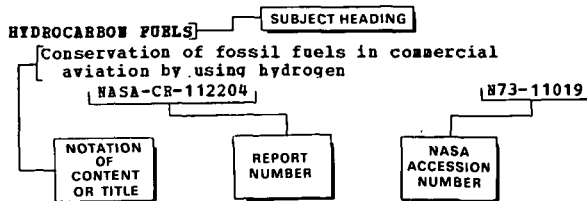
The report is a collection of the unclassified papers presented at the 1972 AFSC Science and Engineering Symposium in San Antonio, Texas. The papers cover a wide variety of technical subjects representing outstanding achievements by AFSC scientists and engineers. Author (GRA)

N73-21894# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div
THE COMBAT USE AND COMBAT EFFECTIVENESS OF FIGHTER-INTERCEPTORS
V. H. Durov 31 Jul. 1972 301 p refs Transl. into ENGLISH of the Book "Boevoe Primenenie i Boyevaya Effektivnost Istrebiteley-Perekhvatchikov" Moscow, Voennoye Izd-vo. Min. Oborony SSSR, 1972 p 1-279
(AD-751512; FTD-MT-24-1158-72) Avail: NTIS CSCL 15/3

The methods are dealt with for evaluating the surface guidance and homing of interceptors and rockets, calculation of interception lines and approach trajectories of an interceptor and a target, and determination of the zones of possible attacks and launches, the combat efficiency, and the combat readiness of a single interceptor as well as a group of planes. Modern mathematical methods are used for solving problems of the combat use of fighter-interceptors. The book is intended for specialists in Air Force units, AA aviation, for students at aviation schools, and also for workers in the aviation industry. Author (GRA)

SUBJECT INDEX

Typical Subject Index Listing



The subject heading is a key to the subject content of the document. The Notation of Content (NOC), rather than the title of the document, is usually used to provide a more exact description of the subject matter. (In some cases AIAA uses the title in lieu of an NOC.) The report number helps to indicate the type of document cited (e.g., NASA report, translation, NASA contractor report). The accession number is located beneath and to the right of the Notation of Content, e.g., N73-11019. Under any one subject heading, the accession numbers are arranged in sequence with the AIAA accession numbers appearing first.

A

- A-7 AIRCRAFT**
A-7 aircraft airborne, ground, and shipboard inertial navigator alignment methodology
N73-20710
- AC GENERATORS**
Investigation of new elements and equipment configurations in stable-frequency, alternating-current, electrical power supply systems employing primary power plants consisting of engines with varying rotational speed
A73-26785
- ACCELERATED LIFE TESTS**
Test plan for extending service life of E-2A arresting gear
[AD-754752] N73-20284
- ACCELERATION (PHYSICS)**
Collection and processing of gust load data obtained from counting accelerometers mounted at center of gravity of various aircraft
[AGARD-R-605] N73-20023
- ACCELEROMETERS**
Collection and processing of gust load data obtained from counting accelerometers mounted at center of gravity of various aircraft
[AGARD-R-605] N73-20023
- ACCESS TIME**
Airport access and ground travel modes
[PB-212814] N73-20990
- ACOUSTIC DUCTS**
Design of noise source for simulating supersonic spinning modes in duct acoustics
[NASA-CR-2260] N73-21067
- ACOUSTIC MEASUREMENTS**
A single number rating for effective noise reduction.
A73-25000
- Seismic measurement data from Cornish cottage during Concorde sonic boom flight, using moving coil geophones
A73-26292
- Acoustic and fluid dynamic tests of multilobed discharge silencers scale models, noting optimum jet noise attenuation configuration
A73-27390
- Flow and acoustic characteristics determined for subsonic and supersonic jets and supersonic suppressors
[NASA-CR-131297] N73-20006
- Analysis of noise sources in jet aircraft based on measurement of infrared emission
[NASA-TT-P-14851] N73-20020
- Evaluation of acoustic properties of conventional wind tunnels for analyzing aerodynamically generated noise
[NASA-CR-114575] N73-20277
- Acoustic measurement methods for evaluating aircraft noise pollution in urban areas
[PB-212875] N73-20757
- Analysis of acoustic properties of jet engine malfunction as means for detecting jet engine burnthrough - Vol. 1
[FAA-RD-72-149-VOL-1] N73-20825
- Noise spectrum characteristics and directivity patterns for rotary wings as function of blade tip speed, total rotor thrust, and angle of rotor disc plane
N73-21056
- Acoustic measurements of aerodynamic noise generated by externally blown flap lift augmentation system for various aerodynamic configurations
[NASA-TN-X-2776] N73-21059
- Development of system for analyzing aircraft sound levels for areas in vicinity of airports
[FAA-EQ-73-3] N73-21064
- Analysis of common aircraft noise measures in terms of selected human response for jet transport aircraft
[FAA-RD-71-112] N73-21074
- Measurement and analysis of aircraft noise generated by general aviation aircraft during level flyovers
[TR-S-212] N73-21081
- Analysis of transition region of subsonic turbulent jets to determine noise producing potential based on far field acoustic density
[NASA-TN-D-7242] N73-21573
- ACOUSTIC PROPERTIES**
Evaluation of acoustic properties of conventional wind tunnels for analyzing aerodynamically generated noise
[NASA-CR-114575] N73-20277
- Generation of aerodynamic noise by turbulent wake behind rotary wing airfoil and relationship to drag and lift coefficients
N73-21054
- Analysis of helicopter internal and external noise levels for various flight conditions and timing of acoustical spectra
N73-21055
- Noise spectrum characteristics and directivity patterns for rotary wings as function of blade tip speed, total rotor thrust, and angle of rotor disc plane
N73-21056
- Development of system for analyzing aircraft sound levels for areas in vicinity of airports
[FAA-EQ-73-3] N73-21064
- Analysis of common aircraft noise measures in terms of selected human response for jet transport aircraft
[FAA-RD-71-112] N73-21074
- Analysis of transition region of subsonic turbulent jets to determine noise producing potential based on far field acoustic density
[NASA-TN-D-7242] N73-21573
- ACOUSTIC SCATTERING**
Theory of sound scattering by turbulence applied to scattering cross section calculation for turbulent jet flow and wind, discussing jet noise reduction
A73-26496

ACOUSTIC SIMULATION

SUBJECT INDEX

ACOUSTIC SIMULATION

- Optimal and preferred listening levels for speech in aircraft acoustical environments. A73-25387
- ACTUATORS**
- Design and evaluation of miniature control surface actuation systems for aeroelastic models. [AIAA PAPER 73-323] A73-25553
- Hydraulic powered integrated actuator package /IAP/ for V/STOL aircraft flight control, noting advantages in system weight, mechanical complexity and power loss reduction A73-26271
- ADAPTIVE CONTROL**
- Development and use of synthetic flight trainers based on degree and fidelity of simulation as key design considerations [AD-754957] N73-21260
- ADHESIVE TESTS**
- Non-destructive testing of adhesive bonding. A73-26299
- ADHESIVE BONDING**
- Non-destructive testing of adhesive bonding. A73-26299
- AERODYNAMIC CHARACTERISTICS**
- Aeroelastic effects on flying wing aircraft aerodynamic stability characteristics, using elementary beam-rod differential equations and aerodynamic strip theory [AIAA PAPER 73-397] A73-25526
- An exploratory investigation of the unsteady aerodynamic response of a two-dimensional airfoil at high reduced frequency. [AIAA PAPER 73-309] A73-25540
- Calculation of unsteady transonic aerodynamics for oscillating wings with thickness. [AIAA PAPER 73-316] A73-25547
- An investigation of unsteady aerodynamics on an oscillating airfoil. [AIAA PAPER 73-318] A73-25549
- Analysis of the aerodynamic characteristics of wing-lift augmentation devices. II A73-25796
- Aerodynamic characteristics of torus shaped cascades involved in flame stabilization process of reheat devices for jet engines A73-26595
- Analysis of the aerodynamic characteristics of wing lift augmentation devices A73-26824
- Wind tunnel tests to determine effects of nozzle geometry and upper surface blowing on aerodynamic characteristics of 14 percent thick airfoil [NASA-CR-114560] N73-19998
- Method for computing lifting pressure distribution on wing with partial span, swept control surfaces [NASA-TN-D-7251] N73-19999
- Characteristics of system for providing yaw control of vehicles at high supersonic and hypersonic speeds by deflecting flaps mounted on upper wing surface [NASA-CASE-LAR-11140-1] N73-20008
- Wind tunnel tests to determine low speed aerodynamic characteristics of large scale V/STOL transport models with lift fan lift-cruise fan propulsion system [NASA-TN-X-62231] N73-20014
- Flight test of X-22 aircraft to determine longitudinal stability requirements of short takeoff aircraft during terminal area operations [AD-754840] N73-20029
- Application of parafoil equations of motion to predict flight performance of powered parafoil flight vehicle [AD-754907] N73-20034
- Annotated bibliography of aerodynamic configurations and characteristics of short takeoff aircraft [AD-754500] N73-20037
- Aerodynamic performance of core-engine turbine stator vane tested in two-dimensional cascade of 10 vanes and in single-vane tunnel [NASA-TN-X-2766] N73-20823
- Analysis of optimum pressure distribution on multi-element airfoils to obtain conditions for maximum lift coefficient N73-20996
- Development of method for estimating normal force, axial force, and pitching moment coefficients for slender bodies of varying cross section equipped with lifting surfaces [NASA-TN-D-7228] N73-20998
- Minimum weight design of supersonic aircraft wing with finite element modeling to meet strength, stability, frequency, and flutter requirements N73-21003
- Comparisons between analog and numerical methods for studying response of an aircraft [PUBL-97] N73-21007
- Presentation of helicopter level flight performance as power coefficient compared with tip speed or advance ratio for range of thrust coefficients N73-21014
- Flight tests of XH-51 helicopter to determine effects of gyroscope and control spring modifications on stability and control N73-21015
- Discussion of speed record establishment by SA-341 helicopter to include aircraft preparation procedures and requirements for successful completion N73-21018
- Review of tilting rotor technology and comparison of tilting rotor performance with standard rotary wings N73-21027
- Proceedings of conference on fluid dynamics of rotary wings and aerodynamic characteristics of rotary wing systems [AGARD-CP-111] N73-21031
- Analytical and experimental techniques to define geometry of vortex field of hovering rotary wing and effect on rotor performance N73-21032
- Wind tunnel tests of rotary wing to determine retreating blade stall at several preset parameters and effect of reverse flow area N73-21037
- Improvements in basic rotary wing design and tests to determine effects on helicopter performance N73-21038
- Aerodynamic characteristics of rotary wings under axial flow conditions and development of numerical analysis techniques N73-21039
- Development of method for predicting performance of heavily loaded propellers and rotors in steady hovering flight N73-21040
- Analysis of unsteady aerodynamic environment of rotary wings and research projects to improve understanding of rotor unsteady airfoils N73-21041
- Analysis of unsteady aerodynamic loading on reference section of helicopter rotor blade in axial or hovering flight under compressible flow conditions N73-21044
- Developments in techniques for analyzing boundary layer characteristics of rotary wings based on unsteady viscous-inviscid interaction N73-21046
- Development of concept of circulation control applied to rotary wings to show effects on hover, transition, and high speed cruise performance N73-21050
- Wind tunnel tests to determine effects of nonrotating components on helicopter performance and application for helicopter design optimization N73-21052
- AERODYNAMIC COEFFICIENTS**
- Development and applications of supersonic unsteady consistent aerodynamics for interfering parallel wings. [AIAA PAPER 73-317] A73-25548
- Correction for change in fluid flow curvature about a lift-generating airfoil in a two-dimensional test section with perforated walls A73-25864
- A note on the lift coefficient of a thin jet-flapped airfoil. A73-27171

SUBJECT INDEX

AERODYNAMIC INTERFERENCE

- Experimental tests on scale models of conical variable geometry propulsion nozzle with short petals for fighter aircraft, discussing aerodynamic and thrust coefficients
A73-27388
- Analysis of optimum pressure distribution on multi-element airfoils to obtain conditions for maximum lift coefficient
N73-20996
- Presentation of helicopter level flight performance as power coefficient compared with tip speed or advance ratio for range of thrust coefficients
N73-21014
- AERODYNAMIC CONFIGURATIONS**
- Light motorized glider-type aircraft design, development and flight testing, discussing aerodynamic configuration, structural design and performance characteristics
A73-27732
- Performance tests of axial flow transonic compressor stage with multiple circular arc blades to determine effects of blade shape on efficiency and stall margin
[NASA-TM-X-2731]
N73-19995
- Method for computing lifting pressure distribution on wing with partial span, swept control surfaces
[NASA-TN-D-7251]
N73-19999
- Annotated bibliography of aerodynamic configurations and characteristics of short takeoff aircraft
[AD-754500]
N73-20037
- Design of airfoil sections for low Reynolds numbers based on requirement to achieve transition upstream of major adverse pressure gradient
N73-20995
- Wind tunnel tests to determine aerodynamic characteristics of full scale H-126 aircraft, using jet flap principle
[NASA-TN-D-7252]
N73-20997
- Development of method for estimating normal force, axial force, and pitching moment coefficients for slender bodies of varying cross section equipped with lifting surfaces
[NASA-TN-D-7228]
N73-20998
- Minimum weight design of supersonic aircraft wing with finite element modeling to meet strength, stability, frequency, and flutter requirements
N73-21003
- Flight tests of Westland Scout helicopter fitted with reduced scale version of rigid rotor to determine airworthiness and handling characteristics
N73-21017
- Survey of problems encountered in prediction of structural design loads and aeroelastic stability margins during development of rotary wing aircraft
N73-21020
- Aerodynamic characteristics of circulation controlled rotor and fundamental problems of stopped rotor aircraft
N73-21024
- Development of jet-flap rotor and application to heavy helicopter and stoppable rotor designs
N73-21025
- Review of tilting rotor technology and comparison of tilting rotor performance with standard rotary wings
N73-21027
- Development of advancing blade concept rotary wing and wind tunnel tests of full scale model
N73-21029
- Proceedings of conference on fluid dynamics of rotary wings and aerodynamic characteristics of rotary wing systems
[AGARD-CP-111]
N73-21031
- Aerodynamic characteristics of rotary wings under axial flow conditions and development of numerical analysis techniques
N73-21039
- Analysis of unsteady aerodynamic environment of rotary wings and research projects to improve understanding of rotor unsteady airfoils
N73-21041
- Effect of rotary wing airfoil modifications on performance, stability, and control of helicopters
N73-21045
- Development of technique for rotor blade design and measurement of pressure distributions along the blade chord and across blade wake near rotor tip in flight
N73-21047
- Development of algorithm for calculating inviscid flow about arbitrary planform rotors and application to analyzing various rotary wing configurations
N73-21048
- Wind tunnel tests to determine effects of blade twist and aeroelasticity on tilt rotor performance from hover to mach number 0.7
N73-21049
- Development of concept of circulation control applied to rotary wings to show effects on hover, transition, and high speed cruise performance
N73-21050
- Aerodynamic, dynamic, and aeroelastic problems in rotary wing design for helicopters and V/STOL aircraft with application to hingeless rotor systems
N73-21051
- Wind tunnel tests to determine effects of nonrotating components on helicopter performance and application for helicopter design optimization
N73-21052
- Acoustic measurements of aerodynamic noise generated by externally blown flap lift augmentation system for various aerodynamic configurations
[NASA-TM-X-2776]
N73-21059
- Design, development, and production of low cost remotely piloted vehicles based on innovative approach for aircraft engineering procedures
[P-4902]
N73-21060
- Application of maximum likelihood criterion and optimal input design for analyzing flight test data to obtain aircraft stability and control derivatives
[NASA-CR-2200]
N73-21071
- Bibliography of supersonic transport aircraft data to include program management, systems engineering, aircraft structures, and operational considerations
[AD-755600]
N73-21076
- Development of computer program and algorithm for determining interference between lifting surface elements at various Mach numbers
[NASA-CR-112264]
N73-21272
- AERODYNAMIC DRAG**
- Lift and drag at off-design Mach numbers of conically cambered wings with subsonic leading edges and supersonic trailing edge
A73-27927
- AERODYNAMIC FORCES**
- Collection and processing of gust load data obtained from counting accelerometers mounted at center of gravity of various aircraft
[AGARD-R-605]
N73-20023
- Numerical analysis of ideal and real gas equations for application to lift generated by helicopter rotors
[AD-754420]
N73-20026
- Development of method for estimating normal force, axial force, and pitching moment coefficients for slender bodies of varying cross section equipped with lifting surfaces
[NASA-TN-D-7228]
N73-20998
- Calculation and measurement of aerodynamic forces on oscillating airfoil with and without aerodynamic stalling
N73-21042
- Influence of various aerodynamic forces on rectangular wing performance with harmonic movement parallel to sieve flow movement
N73-21043
- AERODYNAMIC HEATING**
- Development of methods for protecting aircraft compartments from aerodynamic heating effects
[AD-754606]
N73-20036
- AERODYNAMIC INTERFERENCE**
- Flutter of pairs of aerodynamically interfering delta wings.
[AIAA PAPER 73-314]
A73-25545

AERODYNAMIC LOADS

SUBJECT INDEX

AERODYNAMIC LOADS

- Analysis of point vortex approximation of vortex sheet in two space dimensions and application to vortex sheet induced by elliptically loaded wing [AD-755007] N73-20335
- Tables of reports giving comparative theoretical and experimental aerodynamic loading data relevant to zero- and low-frequency aeroelastic problems [ARC-R/M-3708] N73-21000
- Survey of problems encountered in prediction of structural design loads and aeroelastic stability margins during development of rotary wing aircraft N73-21020
- Analysis of unsteady aerodynamic loading on reference section of helicopter rotor blade in axial or hovering flight under compressible flow conditions N73-21044

AERODYNAMIC NOISE

- Noise radiated from a turbulent boundary layer. A73-24979
- Sound directivity pattern radiated from small airfoils. A73-24980
- Noise intensity in the field of subsonic turbulent jets A73-25738
- Application of gas dynamics equations to determine magnitude of pressure rise due to sonic boom in stratified atmosphere [NASA-TN-D-7105] N73-20010
- Analysis of basic acoustic characteristics and noise reduction potential of upper surface of blown flap [NASA-CR-112246] N73-20017
- Evaluation of acoustic properties of conventional wind tunnels for analyzing aerodynamically generated noise [NASA-CR-114575] N73-20277
- Analysis of aerodynamic noise produced by rotary wings and methods for noise reduction based on shed vortex wakes and blade tip modification N73-21053
- Generation of aerodynamic noise by turbulent wake behind rotary wing airfoil and relationship to drag and lift coefficients N73-21054
- Analysis of helicopter internal and external noise levels for various flight conditions and timing of acoustical spectra N73-21055
- Noise spectrum characteristics and directivity patterns for rotary wings as function of blade tip speed, total rotor thrust, and angle of rotor disc plane N73-21056
- Acoustic measurements of aerodynamic noise generated by externally blown flap lift augmentation system for various aerodynamic configurations [NASA-TN-X-2776] N73-21059
- Design of V/STOL research transport aircraft to achieve low fan noise with high thrust/weight capability of high pressure ratio lift fan system [NASA-CR-121146] N73-21065
- Analysis of transition region of subsonic turbulent jets to determine noise producing potential based on far field acoustic density [NASA-TN-D-7242] N73-21573
- AERODYNAMIC STABILITY**
- Aeroelastic effects on flying wing aircraft aerodynamic stability characteristics, using elementary beam-rod differential equations and aerodynamic strip theory [AIAA PAPER 73-397] A73-25526
- Analysis of whirl stability boundaries and aerodynamic characteristics of tilting rotors N73-21004
- Analytical and experimental techniques to define geometry of vortex field of hovering rotary wing and effect on rotor performance N73-21032
- AERODYNAMIC STALLING**
- Analysis of stall flutter of a helicopter rotor blade. [AIAA PAPER 73-403] A73-25532

- Calculation and measurement of aerodynamic forces on oscillating airfoil with and without aerodynamic stalling N73-21042
- AERODYNAMICS**
- Effect of wing span loading on wing trailing vortices [AD-754055] N73-20003
- AEROELASTICITY**
- The effect of servomechanical control and stability systems on the flutter behavior of aircraft A73-25349
- Aeroelastic structural weight optimization under strength and flutter constraints, using finite element and displacement methods to describe equations of motion in matrix form [AIAA PAPER 73-389] A73-25518
- Aeroelastic effects on flying wing aircraft aerodynamic stability characteristics, using elementary beam-rod differential equations and aerodynamic strip theory [AIAA PAPER 73-397] A73-25526
- Aeroelastic dynamic response to shock induced flow separation, analyzing wing buffet components at high Mach number subsonic flow [AIAA PAPER 73-308] A73-25539
- An investigation of unsteady aerodynamics on an oscillating airfoil. [AIAA PAPER 73-318] A73-25549
- Design and evaluation of miniature control surface actuation systems for aeroelastic models. [AIAA PAPER 73-323] A73-25553
- The state of the art in aeroelasticity of aerospace vehicles in Japan. [AIAA PAPER 73-331] A73-25560
- Tables of reports giving comparative theoretical and experimental aerodynamic loading data relevant to zero- and low-frequency aeroelastic problems [ARC-R/M-3708] N73-21000
- Effect of elastic flapping of rotor blades on stability and control of helicopter equipped with hingeless rotor system N73-21016
- Wind tunnel tests to determine effects of blade twist and aeroelasticity on tilt rotor performance from hover to mach number 0.7 N73-21049
- AERONAUTICAL ENGINEERING**
- Existing position and future prospects of wind tunnels in European research [AGARD-AR-60] N73-20269
- History of German aeronautical development during the first half of the century N73-20956
- AERONAUTICS**
- Radio Technical Commission for Aeronautics, Annual Assembly Meeting, Washington, D.C., November 9, 10, 1972, Proceedings. A73-27360
- Technical and scientific contributions of German aeronautical societies to aerospace sciences N73-20957
- AERONOMY**
- Stratospheric chemical reactions and perturbations caused by supersonic aircraft exhaust [PB-213111] N73-20464
- Survey on aeronomic dynamics of photochemical reactions caused by supersonic aircraft exhaust [PB-213126] N73-20466
- AEROSPACE SCIENCES**
- Technical and scientific contributions of German aeronautical societies to aerospace sciences N73-20957
- German cooperation with AGARD research in aerospace sciences N73-20958
- German cooperation in international aeronautical research N73-20959
- Organization, management, and research activities at National Institute for Aerospace Research of the Netherlands N73-20960
- History and organization of German Society for Aerospace Research N73-20961

SUBJECT INDEX

AIR TRAFFIC CONTROL

Management models for large research institute considering aerospace sciences N73-20968

Proceedings of conference on research and development projects conducted by US Air Force Research and Development Command [AD-753071] N73-21890

AEROSPACE SYSTEMS
Aerospace systems evaluation and optimization via systems analysis, discussing capability, dependability and availability and cost A73-27384

AEROSPACE VEHICLES
The state of the art in aeroelasticity of aerospace vehicles in Japan. [AIAA PAPER 73-331] A73-25560
Book on aerospace vehicles science covering airfoils, aircrafts, fuel systems, structural weight, instrumentation, taxiing, towing and federal aviation regulations A73-27054
Development of structural optimization algorithm used with large finite element program based on displacement method of structural analysis N73-21005

AEROTHERMODYNAMICS
Development of methods for protecting aircraft compartments from aerodynamic heating effects [AD-754606] N73-20036
Analysis of requirements, instruments, and procedures for measurement of aircraft temperatures up to Mach 2.3 and altitudes up to 80,000 feet [AGARD-AG-160-VOL-2] N73-20499

AFTERBODIES
Effect of plume-induced boundary layer separation on afterbody during powered supersonic flight [AD-754640] N73-20326

AGING (MATERIALS)
Thermal resistance and aging properties of polybenzimidazoles, polyimides and polyamides-imides used for Mach 3 aircraft radomes A73-25291

AIR CARGO
Cargo air transport means selection procedure, suggesting methods for economic evaluation of time savings A73-27066

AIR COOLING
Influence of the turbine air cooling system on the characteristics of a turbojet engine during regulation of the latter A73-27091

AIR DEFENSE
German book on national airspace protection against foreign aircraft intrusion in peacetime covering sovereign rights according to international law, conventions and treaties A73-26257
Combat use and combat effectiveness of fighter-interceptors [AD-751512] N73-21894

AIR FLOW
Effect of inlet-air humidity on formation of oxides of nitrogen from a gas turbine combustor under various air inlet temperature conditions [NASA-TM-X-68209] N73-21691

AIR JETS
Control technology for air cushion passenger vehicle N73-20969

AIR NAVIGATION
Determination of the turn start point coordinates for modern commercial aircraft A73-26723
A new approach to Doppler-inertial navigation /Doppler Beam Sampling/. A73-27162
Satellite systems for mobile communications and surveillance; Proceedings of the International Conference, London, England, March 13-15, 1973. A73-27652
Development and evaluation of discrete address beacon system for air traffic control applications [FAA-RD-73-12] N73-20184
Analysis of synchronized discrete address beacon system for improved air traffic control capability [SD-PB-01] N73-20189

Application of loran/inertial hybrid system and Kalman filter algorithm to fixed feedback gain N73-20701
Life cycle cost analysis of inertial navigation systems for aircraft and air to surface missiles N73-20717
Analysis of interaction of major elements of Oceanic Air Traffic Control System to determine minimum longitudinal and lateral separation distances [FAA-RD-73-8] N73-20719
Analysis of improved signal processing techniques for low frequency, one-way ranging for aircraft radio navigation [AD-754031] N73-20727
Functional error analysis and simulation of air traffic control system to support concepts evaluation program [PB-213148] N73-20730
Development of navigation system design factors through computerized simulation for application to loran/inertial hybrid system [AD-754548] N73-20731

AIR PIRACY
German book - International air traffic conventions: Air piracy - Concept, facts, protective measures. A73-25570

AIR POLLUTION
Gas turbine engine exhaust pollutants consisting of unburned hydrocarbons, nitric oxide, carbon dioxide, nitrogen dioxide and carbon monoxide A73-27934
Alternate fuels to reduce aircraft exhaust pollutants [AD-755151] N73-20815
Comparison of air pollution from aircraft, automobiles, buses, trucks, railroads, and electric trains in US from 1940-1980 [FAA-EQ-73-2] N73-21522
Stratospheric photochemical reactions of ozone in relation to climatology and supersonic transport pollution [NOAA-TM-NESS-47] N73-21526

AIR TO-SURFACE MISSILES
Life cycle cost analysis of inertial navigation systems for aircraft and air to surface missiles N73-20717

AIR TRAFFIC
Data acquisition process to plan and engineer air traffic system, considering design aspects and piecemeal evolution A73-27362
Status of funded improvements to the National Aviation System and planned improvements not yet funded. A73-27363
Improvements in the use of FAA resources for system performance assurance. A73-27364
Development of procedures for accurately estimating annual air traffic levels at airports without tower control [SCI-2-2040] N73-20722

AIR TRAFFIC CONTROL
Airport computerized departure control for check-in, load control, cargo and catering operations, discussing load optimization and passenger acceptance control /LOPAC/ system A73-25210
An optimal control approach to terminal area air traffic control. A73-25786
Signal processing in the Air Traffic Control Radar Beacon System. A73-27165
National aviation system improvement via cost effectiveness, considering FAA facilities and equipment program, ATC automation and terminal aids A73-27365
Potential applications of acoustic matched filters to air-traffic control systems. A73-27572
The use of satellites for aircraft communications and air traffic control. A73-27666

AIR TRANSPORTATION

SUBJECT INDEX

- Characteristics of operational airport surveillance radars and methods for improving performance to meet air route surveillance requirements
[ATC-14] N73-20183
- Development and evaluation of discrete address beacon system for air traffic control applications
[FAA-RD-73-12] N73-20184
- Analysis of synchronized discrete address beacon system for improved air traffic control capability
[SD-FR-01] N73-20189
- Development of statistical methods for estimating annual operations at non-tower airports and establishment of standardized estimation procedure
[SCI-2040] N73-20278
- Analysis of interaction of major elements of Oceanic Air Traffic Control System to determine minimum longitudinal and lateral separation distances
[FAA-RD-73-8] N73-20719
- Research and development projects conducted by Federal Aviation Administration to improve air traffic control and flight safety
[FAA-EH-73-2] N73-20720
- Functional error analysis and simulation of air traffic control system to support concepts evaluation program
[PB-213148] N73-20730
- Development and evaluation of aircraft tracking techniques based on radar and beacon target reports from common sensor site
[PX-6392] N73-21177
- Development and evaluation of cross-band radar/beacon system for operation with airport surveillance radar/air traffic control beacon interrogator system
[FAA-RD-73-38] N73-21182
- Development of computer program to analyze air traffic in North Atlantic to show zone traffic at specified instants
[AD-755910] N73-21557
- AIR TRANSPORTATION**
- Dusseldorf airport passenger terminal facilities project, considering handling capacity, building and wide bodied jet traffic requirements
A73-25206
- Malmo-Sturup airport facilities layout, discussing passenger terminal, lounges, baggage and cargo handling, ATC school, etc
A73-25207
- Regularization of the legal status of international air charter services.
A73-26349
- Cargo air transport means selection procedure, suggesting methods for economic evaluation of time savings
A73-27066
- Methodologies for the analysis of transport requirements with particular regard to the aeronautic case
A73-27070
- AIRBORNE EQUIPMENT**
- Airborne IR 32 cm observatory, discussing atmospheric transmission and guiding methods to overcome aircraft instability effects
A73-26503
- AIRCRAFT**
- Comparison of air pollution from aircraft, automobiles, buses, trucks, railroads, and electric trains in US from 1940-1980
[FAA-EQ-73-2] N73-21522
- AIRCRAFT ACCIDENT INVESTIGATION**
- Aircraft design and reliability analysis method based on accidents occurrence investigation by Franco-British airworthiness authorities, noting applicability to Concorde aircraft
A73-26589
- AIRCRAFT ACCIDENTS**
- Statistical analysis of aircraft accidents occurring in US civil aviation during calendar year 1971
[NTSB-BA-73-1] N73-20015
- Inflight incident involving separation of cargo compartment door on DC-10 aircraft near Windsor, Ontario, Canada on 12 June, 1972
[NTSB-AAR-73-2] N73-21061
- Aircraft accident involving Boeing 707 aircraft at San Francisco, California airport following rejected takeoff on 13 Sept. 1972
[NTSB-AAR-73-4] N73-21062
- AIRCRAFT ANTENNAS**
- Flush mountable elliptically polarized low silhouette blade antenna for aircraft, describing polarization and radiation characteristics
A73-27043
- Factors relating to the choice of antenna characteristics for the aircraft terminal in an aeronautical satellite communications/surveillance system.
A73-27654
- The disc antenna - A possible L-band aircraft antenna.
A73-27655
- A radiating element giving circularly polarised radiation over a large solid angle.
A73-27656
- AIRCRAFT CARRIERS**
- Test plan for extending service life of E-2A arresting gear
[AD-754752] N73-20284
- Laboratory hook bounce test for E-2A arresting gear A-frame
[AD-754753] N73-20285
- Hook bounce test of C-2A aircraft arresting gear A-frame
[AD-754077] N73-20288
- Test plan for extending life of C-2A arresting hook A-frame to 3000 arrested landings
[AD-754076] N73-20289
- AIRCRAFT COMMUNICATION**
- Satellite systems for mobile communications and surveillance; Proceedings of the International Conference, London, England, March 13-15, 1973.
A73-27652
- Factors relating to the choice of antenna characteristics for the aircraft terminal in an aeronautical satellite communications/surveillance system.
A73-27654
- The provision of ground station facilities for an aeronautical satellite system.
A73-27658
- The use of satellites for aircraft communications and air traffic control.
A73-27666
- Factors affecting the frequency chosen for aircraft to satellite communications.
A73-27667
- Message organisation in the ground segment of an aeronautical satellite system.
A73-27668
- Satellite communication channels assignment to ships and aircraft, considering automated digital calling method for ship-to-shore communication
A73-27670
- Satellite communication systems for long haul air transport operations, discussing political, operational/technical and economic problems
A73-27671
- Balloon-aircraft ranging, data, and voice experiment.
A73-27680
- AIRCRAFT COMPARTMENTS**
- Optimal and preferred listening levels for speech in aircraft acoustical environments.
A73-25387
- Application of normal bivariate distributions and anthropometric correlations for design of workspaces in aircraft
[AD-754780] N73-20468
- Inflight incident involving separation of cargo compartment door on DC-10 aircraft near Windsor, Ontario, Canada on 12 June, 1972
[NTSB-AAR-73-2] N73-21061
- AIRCRAFT CONFIGURATIONS**
- Active flutter suppression - B-52 controls configured vehicle.
[ATAA PAPER 73-322] A73-25552
- Critique of paper on supersonic aircraft configuration with zero wave drag, discussing tubular outer structure and convergent-divergent inner duct
A73-25798

SUBJECT INDEX

AIRCRAFT EQUIPMENT

- Analysis of integrated airframe and engine configuration for hypersonic transport at 70,000 feet altitude and Mach 6.0
[NASA-CR-112300] N73-20022
- Analysis of requirements, instruments, and procedures for measurement of aircraft temperatures up to Mach 2.3 and altitudes up to 80,000 feet
[AGARD-AG-160-VOL-2] N73-20499
- Proceedings of conference on rotary wing aircraft developments to include operational experience, flight tests, and evaluation of structural concepts
[AGARD-CP-121] N73-21008
- AIRCRAFT CONTROL**
- The effect of servomechanical control and stability systems on the flutter behavior of aircraft A73-25349
- Active flutter suppression - B-52 controls configured vehicle.
[AIAA PAPER 73-322] A73-25552
- Iliushin 62 aircraft horizontal stabilizer structural design and control, discussing mounting hardware and electrically driven servomechanism A73-25795
- Advanced flight control systems - Power-by-wire and fly-by-wire. A73-26272
- Practical quadratic optimal control for systems with large parameter variations. A73-27166
- Response-optimum control of the angular and torsional oscillations of an elastic flying wing. A73-27459
- Aircraft and spacecraft hand controllers for yaw, pitch, and roll
[NASA-CASE-MSC-12394-1] N73-20041
- Situational display system of cathode ray tubes to assist pilot in aircraft control
[NASA-CASE-ERC-10350] N73-20474
- Application of maximum likelihood criterion and optimal input design for analyzing flight test data to obtain aircraft stability and control derivatives
[NASA-CR-2200] N73-21071
- AIRCRAFT DESIGN**
- Varying-temperature test installation for the interior design of the Concorde A73-25103
- Aircraft design philosophies and structural integrity considerations for reliability without major NDT and maintenance, proposing research program for future computerized design A73-25128
- Military aircraft radome design technology developments in Sweden, discussing use of glass fiber reinforced plastics, manufacturing method, computerized optimization and measurement techniques A73-25300
- Taylor series algorithms for computerized structural design and reanalysis of modified structures, applying to aircraft fuselage midsection
[AIAA PAPER 73-338] A73-25478
- Application of computer-aided aircraft design in a multidisciplinary environment.
[AIAA PAPER 73-353] A73-25490
- Preliminary design of aircraft structures to meet structural integrity requirements.
[AIAA PAPER 73-374] A73-25506
- An automated procedure for computing flutter eigenvalues.
[AIAA PAPER 73-393] A73-25522
- Russian book on airplane and helicopter design and stability covering selection of wing/rotor configuration and power plant, subsystem design, strength, reliability, lifetime, etc A73-26256
- Hydraulic powered integrated actuator package /IAP/ for V/STOL aircraft flight control, noting advantages in system weight, mechanical complexity and power loss reduction A73-26271
- Optimization of aircraft structures with multiple stiffness requirements. A73-26298
- Aircraft design and reliability analysis method based on accidents occurrence investigation by Franco-British airworthiness authorities, noting applicability to Concorde aircraft A73-26589
- Transport aircraft maintenance program, discussing safety and reliability correlation with design A73-26591
- Aircraft design parameters optimization based on criterion function representing overall deviation for specifications with application to subsonic passenger aircraft A73-27095
- Augmentor wing design and performance tests for multimission XPV-12 V/STOL prototype aircraft A73-27731
- Light motorized glider-type aircraft design, development and flight testing, discussing aerodynamic configuration, structural design and performance characteristics A73-27732
- Application of normal bivariate distributions and anthropometric correlations for design of workspaces in aircraft
[AD-754780] N73-20468
- Structural concepts of rotary wing system capabilities to show changes in design of specific vertical takeoff aircraft components N73-21021
- Development and application of composite materials for vertical takeoff aircraft airframes and effect on improved aircraft performance N73-21023
- Design, development, and production of low cost remotely piloted vehicles based on innovative approach for aircraft engineering procedures
[P-4902] N73-21060
- Design of V/STOL research transport aircraft to achieve low fan noise with high thrust/weight capability of high pressure ratio lift fan system
[NASA-CR-121146] N73-21065
- Atmospheric density extremes up to 15,000 feet for design of military aircraft
[AD-755791] N73-21382
- AIRCRAFT ENGINES**
- Twin-engined Anglo-French Lynx helicopter main rotor head, blade and drive train with conformal gearing, discussing design and material features A73-25790
- A modern mechanical laboratory for the support of aircraft engine design A73-27385
- Condition monitoring - A new technology for aircraft engine maintenance A73-27389
- Analysis of integrated airframe and engine configuration for hypersonic transport at 70,000 feet altitude and Mach 6.0
[NASA-CR-112300] N73-20022
- Analysis of formation of carbon deposits on jet engines and effect on reliability, efficiency, and service life
[AD-754607] N73-20837
- Analysis of gas turbine engine rotor failures as basis for conducting program to provide equipment for protection of passengers and aircraft structures from damage
[NASA-CR-131525] N73-21692
- AIRCRAFT EQUIPMENT**
- Fabrication and physical, mechanical and electrical properties of inorganic composite material for aircraft radomes A73-25288
- Thermal resistance and aging properties of polybenzimidazoles, polyimides and polyamides-imides used for Mach 3 aircraft radomes A73-25291
- Airliner radomes erosion by atmospheric precipitation, water penetration, icing, bird and stone impact and lightning A73-25297
- Numerical analysis of aircraft shock absorber operation to show initial charging, motion, and force parameters during static and dynamic compression of landing gear
[AD-754609] N73-20031
- Design and performance of advanced auxiliary power system for fighter aircraft
[AD-754903] N73-20049

AIRCRAFT FUEL SYSTEMS

SUBJECT INDEX

- Analysis of synchronized discrete address beacon system for improved air traffic control capability [SD-FR-01] N73-20189
- Manual on electromagnetic compatibility and interference between aircraft weapon systems [AD-754411] N73-20263
- Structural concepts of rotary wing system capabilities to show changes in design of specific vertical takeoff aircraft components N73-21021
- Bibliography of supersonic transport aircraft data to include program management, systems engineering, aircraft structures, and operational considerations [AD-755600] N73-21076
- Development of halogenated hydrocarbon materials for use as fire and ignition suppressants for aircraft fuel tanks subjected to incendiary ammunition [AD-755362] N73-21079
- AIRCRAFT FUEL SYSTEMS**
- Book on aerospace vehicles science covering airfoils, aircrafts, fuel systems, structural weight, instrumentation, taxiing, towing and federal aviation regulations A73-27054
- Some causes for the appearance of the 'extraneous noise' defect in transfer pumps of aircraft fuel systems A73-27094
- Alternate fuels to reduce aircraft exhaust pollutants [AD-755151] N73-20815
- AIRCRAFT HAZARDS**
- Aquaplaning prevention during take-off and landing, discussing friction loss factors, aircraft tires and runway surface treatment by antiskid overlays and grooving A73-25209
- Study on the limit efficiency of lightning conductors on aircraft radomes. A73-25303
- Electrostatic charge induction on aircraft due to charged atmosphere and friction effects, noting lightning protection, fuel container shielding and charge removal methods A73-26722
- Probability of aircraft being struck by lightning [NLL-M-22800-(5828.4F)] N73-20656
- AIRCRAFT HYDRAULIC SYSTEMS**
- Effects of trapped air on operation of aircraft hydraulic systems and methods for removing air contamination [NLL-NEL-TT-2420-(6075.461)] N73-20005
- AIRCRAFT INSTRUMENTS**
- Design of control and display panels using computer algorithms. A73-25180
- Utilization of the Doppler effect to measure the drift angle and the ground speed of an aircraft A73-25797
- A description of the NAE T-33 turbulence research aircraft, instrumentation and data analysis. A73-26269
- On the estimation of the directional spectrum of surface gravity waves from a programmed aircraft altimeter. A73-26347
- Cockpit instrument display systems visibility and reliability requirements, discussing various illumination methods in terms of power consumption, cost and human factors engineering A73-26825
- Book on aerospace vehicles science covering airfoils, aircrafts, fuel systems, structural weight, instrumentation, taxiing, towing and federal aviation regulations A73-27054
- AIRCRAFT LANDING**
- Display system for monitoring automatically controlled STOL landing glide paths, discussing computer controlled simulation A73-25440
- An optimal control approach to terminal area air traffic control. A73-25786
- Vibrations of an Euler beam with a system of discrete masses, springs, and dashpots. A73-25788
- Evaluation of glide paths for landing a VTOL airplane using linear regulator theory. A73-27154
- Flight test of X-22 aircraft to determine longitudinal stability requirements of short takeoff aircraft during terminal area operations [AD-754840] N73-20029
- Analysis of procedures and problems involved in operating helicopters from decks of ships N73-21010
- Analysis of effect of grooved runway configurations on aircraft tire braking traction on flooded runway surfaces [NASA-TN-D-7215] N73-21057
- Analysis of electromagnetic compatibility of microwave landing guidance system and candidate interim systems [ECAC-PR-72-069] N73-21554
- AIRCRAFT MAINTENANCE**
- Transport aircraft maintenance program, discussing safety and reliability correlation with design A73-26591
- Prediction for a park of helicopters of the same type A73-27077
- Condition monitoring - A new technology for aircraft engine maintenance A73-27389
- Improvements in military helicopter flight test techniques to provide data for safety, maintainability, and reliability N73-21013
- AIRCRAFT NOISE**
- A single number rating for effective noise reduction. A73-25000
- A comparative study of augmentor wing, ejector nozzle and power jet flap low noise STOL concepts. A73-25385
- European contribution to structural response to noise. [AIAA PAPER 73-332] A73-25561
- Airport noise control and minimization for community and airline industry interests by technology application and legal-political approaches A73-26350
- Variations in the sound field of a STOL aircraft as a function of wing-flap deflection A73-26592
- Some causes for the appearance of the 'extraneous noise' defect in transfer pumps of aircraft fuel systems A73-27094
- Acoustic measurement methods for evaluating aircraft noise pollution in urban areas [PB-212875] N73-20757
- Guidelines for urban control of aircraft noise pollution [PB-213020] N73-20759
- Noise level surveys of seventeen general aviation aircraft including jet and propeller driven types [FAA-EQ-73-1] N73-21063
- Development of system for analyzing aircraft sound levels for areas in vicinity of airports [FAA-EQ-73-3] N73-21064
- Measurement and analysis of aircraft noise generated by general aviation aircraft during level flyovers [TR-S-212] N73-21081
- AIRCRAFT PARTS**
- Design and manufacture of structure components made of fiber-reinforced materials A73-25417
- Numerical procedure for determining optimal member sizes of aircraft structural components with weight minimization and flutter speed lower bound [AIAA PAPER 73-391] A73-25520
- Phenomenological approach to low-cycle fatigue fracture of a typical aircraft full scale component static test. [AIAA PAPER 73-324] A73-25554
- Aerospace component failure due to corrosion fatigue in aluminum wing attachment spar, helicopter rotor blade, landing gear cylinder and engine bearings A73-25803

SUBJECT INDEX

AIRFOIL PROFILES

- Stress corrosion cracking and corrosion fatigue for hydraulic aluminum pressure cylinders used for landing gear, stabilizers and aircraft systems A73-25827
- Fretting fatigue in titanium helicopter components. A73-25837
- Reliability and operational safety of mechanical helicopter transmission boxes N73-21012
- AIRCRAFT PERFORMANCE**
- A comparative study of augmentor wing, ejector nozzle and power jet flap low noise STOL concepts. A73-25385
- Light motorized glider-type aircraft design, development and flight testing, discussing aerodynamic configuration, structural design and performance characteristics A73-27732
- Evaluation of energy maneuverability procedures in aircraft flight path optimization and performance estimation [AD-754909] N73-20035
- Wind tunnel tests to determine aerodynamic characteristics of full scale H-126 aircraft using jet flap principle [NASA-TN-D-7252] N73-20997
- Bibliography of supersonic transport aircraft data to include program management, systems engineering, aircraft structures, and operational considerations [AD-755600] N73-21076
- Analysis of equations of aircraft dynamics and development of analog-digital simulation capability [AD-755868] N73-21077
- Development of pilot model parameters to provide data base for multiloop, single controller, multi-input analysis of aircraft performance [AD-755367] N73-21078
- AIRCRAFT PILOTS**
- Airline pilots problems in terms of job security, working conditions, management relations, public relations, flight safety due to noise abatement rules, etc A73-27599
- AIRCRAFT PRODUCTION**
- Reliability and quality control of production engineering computer programs. [AIAA PAPER 73-356] A73-25493
- AIRCRAFT RELIABILITY**
- Aircraft design philosophies and structural integrity considerations for reliability without major NDT and maintenance, proposing research program for future computerized design A73-25128
- Aircraft design and reliability analysis method based on accidents occurrence investigation by Franco-British airworthiness authorities, noting applicability to Concorde aircraft A73-26589
- Transport aircraft maintenance program, discussing safety and reliability correlation with design A73-26591
- Prediction for a park of helicopters of the same type A73-27077
- AIRCRAFT SAFETY**
- Aircraft design and reliability analysis method based on accidents occurrence investigation by Franco-British airworthiness authorities, noting applicability to Concorde aircraft A73-26589
- Transport aircraft maintenance program, discussing safety and reliability correlation with design A73-26591
- Development of halogenated hydrocarbon materials for use as fire and ignition suppressants for aircraft fuel tanks subjected to incendiary ammunition [AD-755362] N73-21079
- AIRCRAFT SPECIFICATIONS**
- Aircraft design parameters optimization based on criterial function representing overall deviation for specifications with application to subsonic passenger aircraft A73-27095
- AIRCRAFT STABILITY**
- Airborne IR 32 cm observatory, discussing atmospheric transmission and guiding methods to overcome aircraft instability effects A73-26503
- Flight-mechanics analysis of various flight conditions of conventional aircraft. VII - Mechanical foundations: Dynamic equations of motion of the translational motion of a rigid body A73-26725
- Solid body on elastic supports as model for helicopter stability and nonlinear oscillations analysis A73-27791
- AIRCRAFT STRUCTURES**
- Test rails possibilities for rain erosion phenomena study on aircraft or missile structures A73-25296
- Design and manufacture of structure components made of fiber-reinforced materials A73-25417
- Preliminary design of aircraft structures to meet structural integrity requirements. [AIAA PAPER 73-374] A73-25506
- Parametric studies of the wing flutter behavior of a STOL transport. [AIAA PAPER 73-394] A73-25523
- Optimization of aircraft structures with multiple stiffness requirements. A73-26298
- In-flight flutter testing methods for determining aircraft structure natural frequencies and vibration damping ratios with air flow A73-26593
- An-2R aircraft conversion to flying test bed for feasibility studies of jet engine use in agricultural aircraft, describing structural design modifications A73-26823
- Book on aerospace vehicles science covering airfoils, aircrafts, fuel systems, structural weight, instrumentation, taxiing, towing and federal aviation regulations A73-27054
- Certain fatigue phenomena in aeronautical structures with stiffened shells A73-27394
- Research projects in structural reliability engineering for transport vehicles N73-21878
- AIRCRAFT TIRES**
- Aquaplaning prevention during take-off and landing, discussing friction loss factors, aircraft tires and runway surface treatment by antiskid overlays and grooving A73-25209
- Technique for determining mechanical properties of full-size aircraft tires from tests conducted with small-scale model tires [NASA-CR-2220] N73-21006
- Analysis of effect of grooved runway configurations on aircraft tire braking traction on flooded runway surfaces [NASA-TN-D-7215] N73-21057
- Performance tests to determine cornering characteristics of cantilever aircraft tire on dry, damp, and flooded runway surfaces over range of yaw angles [NASA-TN-D-7203] N73-21058
- AIRCRAFT WAKES**
- Aerodynamics of wake vortices. A73-26385
- Chemically reacting wave of aircraft flying at subsonic and supersonic velocity in upper troposphere and stratosphere [AD-754918] N73-20447
- Flight investigation to determine velocity and persistence characteristics of trailing vortices generated by jumbo jet transport [NASA-TN-D-7172] N73-21068
- AIRFOIL PROFILES**
- Potential flow past axisymmetric ring wing profiles via singularity method, applying source and vortex distributions to curved thick profiles A73-25348
- Higher order numerical solution of the integral equation for the two-dimensional Neumann problem. A73-25434

AIRFOILS

SUBJECT INDEX

- Vibration and local edge buckling of thermally stressed, wedge airfoil cantilever wings. [AIAA PAPER 73-327] A73-25557
- A linearized potential flow theory for airfoils with spoilers. A73-25853
- Minimum weight design of supersonic aircraft wing with finite element modeling to meet strength, stability, frequency, and flutter requirements N73-21003
- AIRFOILS**
- Sound directivity pattern radiated from small airfoils. A73-24980
- An exploratory investigation of the unsteady aerodynamic response of a two-dimensional airfoil at high reduced frequency. [AIAA PAPER 73-309] A73-25540
- An investigation of unsteady aerodynamics on an oscillating airfoil. [AIAA PAPER 73-318] A73-25549
- Correction for change in fluid flow curvature about a lift-generating airfoil in a two-dimensional test section with perforated walls A73-25864
- Book on aerospace vehicles science covering airfoils, aircrafts, fuel systems, structural weight, instrumentation, taxiing, towing and federal aviation regulations A73-27054
- Wind tunnel tests to determine effects of nozzle geometry and upper surface blowing on aerodynamic characteristics of 14 percent thick airfoil [NASA-CR-114560] N73-19998
- Design of airfoil sections for low Reynolds numbers based on requirement to achieve transition upstream of major adverse pressure gradient N73-20995
- Analysis of optimum pressure distribution on multi-element airfoils to obtain conditions for maximum lift coefficient N73-20996
- Calculation and measurement of aerodynamic forces on oscillating airfoil with and without aerodynamic stalling N73-21042
- Effect of rotary wing airfoil modifications on performance, stability, and control of helicopters N73-21045
- Development of algorithm for calculating inviscid flow about arbitrary planform rotors and application to analyzing various rotary wing configurations N73-21048
- Generation of aerodynamic noise by turbulent wake behind rotary wing airfoil and relationship to drag and lift coefficients N73-21054
- AIRFRAME MATERIALS**
- Design and manufacture of structure components made of fiber-reinforced materials A73-25417
- X2048, a high strength, high toughness alloy for aircraft applications. [AIAA PAPER 73-385] A73-25514
- AIRFRAMES**
- Fabrication of L-1011 aircraft panels to compare costs and service performance characteristics of FRD-49 and fiberglass [NASA-CR-112250] N73-20018
- Fatigue damage of helicopter rotary wing structures - bibliographies [AD-754062] N73-20027
- Development of methods for protecting aircraft compartments from aerodynamic heating effects [AD-754606] N73-20036
- Development of beryllium-copper bearings for use with stainless steel shafts under high bearing stress levels imposed by airframes [AD-754759] N73-20540
- Theories, numerical methods, and computer programs for determining inviscid three dimensional flow around spherically-capped smooth bodies and wings at supersonic speeds [AD-753696] N73-21002
- Development of structural optimization algorithms used with large finite element program based on displacement method of structural analysis N73-21005
- Development and application of composite materials for vertical takeoff aircraft airframes and effect on improved aircraft performance N73-21023
- AIRLINE OPERATIONS**
- Malmo-Sturup airport facilities layout, discussing passenger terminal, lounges, baggage and cargo handling, ATC school, etc A73-25207
- Ireland commercial airports at Dublin, Shannon and Cork, discussing management, terminal facilities and operations A73-25208
- Airport computerized departure control for check-in, load control, cargo and catering operations, discussing load optimization and passenger acceptance control /LOPAC/ system A73-25210
- Regularization of the legal status of international air charter services. A73-26349
- Airport noise control and minimization for community and airline industry interests by technology application and legal-political approaches A73-26350
- Prediction for a park of helicopters of the same type A73-27077
- Satellite communication systems for long haul air transport operations, discussing political, operational/technical and economic problems A73-27671
- Analysis of factors involving commercial application of short takeoff aircraft for short haul airline operations [NASA-TN-X-62239] N73-20016
- House hearings on air passenger fees, related taxation, and government regulation of commercial airline operations N73-20970
- Development of computer program to analyze air traffic in North Atlantic to show zone traffic at specified instants [AD-755910] N73-21557
- AIRPORT BEACONS**
- Comparison tests of strobe and incandescent beacons to determine suitability as replacement for standard rotating airport beacon [FAA-WA-73-1] N73-20182
- AIRPORT LIGHTS**
- Comparison tests of strobe and incandescent beacons to determine suitability as replacement for standard rotating airport beacon [FAA-WA-73-1] N73-20182
- AIRPORT PLANNING**
- Dusseldorf airport passenger terminal facilities project, considering handling capacity, building and wide bodied jet traffic requirements A73-25206
- Malmo-Sturup airport facilities layout, discussing passenger terminal, lounges, baggage and cargo handling, ATC school, etc A73-25207
- Ireland commercial airports at Dublin, Shannon and Cork, discussing management, terminal facilities and operations A73-25208
- Regional airport systems study for San Francisco bay area, discussing commercial and general aviation future needs, environmental and economic aspects and alternative options A73-26125
- Airport noise control and minimization for community and airline industry interests by technology application and legal-political approaches A73-26350
- General aviation requirements within National Aviation System, discussing basic services, facilities, federal spending and R and D A73-27361

SUBJECT INDEX

ARCTIC REGIONS

- An appraisal of the funding provisions of the Airport and Airways Development Act of 1970 to implement system improvements. A73-27366
- Airport and Airway Development Act trust fund surplus, discussing expenditure policy determination and incentive plan provisions to expedite improvements A73-27367
- Analysis of technical and economic feasibility of constructing offshore airport in New York Metropolitan area [FAA-BD-73-45] N73-20280
- AIRPORTS**
- Criteria on jet blast velocities and effects during operation of commercial aircraft and recommended procedures to reduce adverse impact [AC-150/5325-6A] N73-20271
- Development of statistical methods for estimating annual operations at non-tower airports and establishment of standardized estimation procedure [SCI-2040] N73-20278
- Development of procedures for accurately estimating annual air traffic levels at airports without tower control [SCI-2-2040] N73-20722
- Airport access and ground travel modes [PB-212814] N73-20990
- Development of system for analyzing aircraft sound levels for areas in vicinity of airports [FAA-EQ-73-3] N73-21064
- Detection and identification of major airports in northeastern Kansas and northwestern Missouri [E73-10471] N73-21308
- AIRSPACE**
- German book on national airspace protection against foreign aircraft intrusion in peacetime covering sovereign rights according to international law, conventions and treaties A73-26257
- AIRSPEED**
- True airspeed sensor for V/STOL aircraft with increased accuracy below 40 knots [AD-755374] N73-21403
- ALGORITHMS**
- Design of control and display panels using computer algorithms. A73-25180
- Taylor series algorithms for computerized structural design and reanalysis of modified structures, applying to aircraft fuselage midsection [AIAA PAPER 73-338] A73-25478
- Application of loran/inertial hybrid system and Kalman filter algorithm to fixed feedback gain N73-20701
- Development of structural optimization algorithm used with large finite element program based on displacement method of structural analysis N73-21005
- ALIGNMENT**
- Parameters of single-axis floated gyroscopes when used in inertial systems requiring rapid gyrocompassing for alignment N73-20709
- A-7 aircraft airborne, ground, and shipboard inertial navigator alignment methodology N73-20710
- ALL-WEATHER AIR NAVIGATION**
- Research projects to develop all-weather, low level navigation systems based on one way ranging, range-range navigation techniques [AD-755205] N73-21556
- ALUMINUM ALLOYS**
- I2048, a high strength, high toughness alloy for aircraft applications. [AIAA PAPER 73-385] A73-25514
- Aircraft structures' aluminum alloys fatigue crack growth rate relationship to cracking mode, stress ratio, cyclic frequency and corrosive environment severity A73-25826
- AN-2 AIRCRAFT**
- An-2E aircraft conversion to flying test bed for feasibility studies of jet engine use in agricultural aircraft, describing structural design modifications A73-26823
- ANALOG COMPUTERS**
- Application of equations of motion to develop analog computer simulation of helicopter rotor system [AD-754547] N73-20024
- ANGLE OF ATTACK**
- Correction for change in fluid flow curvature about a lift-generating airfoil in a two-dimensional test section with perforated walls A73-25864
- Researches on the two-dimensional retarded cascade. III - Cascade performances at high inlet angles. A73-26338
- Researches on the two-dimensional retarded cascade. IV - Determination of blade elements at retarded blade row. A73-26339
- ANTENNA DESIGN**
- Factors relating to the choice of antenna characteristics for the aircraft terminal in an aeronautical satellite communications/surveillance system. A73-27654
- The disc antenna - A possible L-band aircraft antenna. A73-27655
- A radiating element giving circularly polarized radiation over a large solid angle. A73-27656
- ANTENNA RADIATION PATTERNS**
- Aircraft and missile radomes technology in France, discussing materials, antenna radiation pattern calculation, computer programming for transmission and angular aberrations, and raindrop erosion tests A73-25301
- First order effects of terrain on the radiation pattern of a non-directional LF beacon. A73-26204
- Flush mountable elliptically polarized low silhouette blade antenna for aircraft, describing polarization and radiation characteristics A73-27043
- ANTI-FRICTION BEARINGS**
- Development of beryllium-copper bearings for use with stainless steel shafts under high bearing stress levels imposed by airframes [AD-754759] N73-20540
- ANTISKID DEVICES**
- Aquaplaning prevention during take-off and landing, discussing friction loss factors, aircraft tires and runway surface treatment by antiskid overlays and grooving A73-25209
- APPROACH CONTROL**
- Display system for monitoring automatically controlled STOL landing glide paths, discussing computer controlled simulation A73-25440
- An optimal control approach to terminal area air traffic control. A73-25786
- Evaluation of glide paths for landing a VTOL airplane using linear regulator theory. A73-27154
- APPROACH INDICATORS**
- Analysis of electromagnetic compatibility of microwave landing guidance system and candidate interim systems [ECAC-PR-72-069] N73-21554
- APPROPRIATIONS**
- Airport and Airway Development Act trust fund surplus, discussing expenditure policy determination and incentive plan provisions to expedite improvements A73-27367
- APPROXIMATION**
- Higher order numerical solution of the integral equation for the two-dimensional Neumann problem. A73-25434
- ARCTIC REGIONS**
- Technology assessment for long year-round transportation in Arctic [AD-754381] N73-20296

ARMED FORCES (FOREIGN)

SUBJECT INDEX

ARMED FORCES (FOREIGN)
Operational performance of helicopters in French Army
N73-21011

ARMED FORCES (UNITED STATES)
Air force radio communication and navigation system development planning
[AD-754930] N73-20207

ARRESTING GEAR
Test plan for extending service life of E-2A arresting gear
[AD-754752] N73-20284
Laboratory hook bounce test for E-2A arresting gear A-frame
[AD-754753] N73-20285
Hook bounce test of C-2A aircraft arresting gear A-frame
[AD-754077] N73-20288
Test plan for extending life of C-2A arresting hook A-frame to 3000 arrested landings
[AD-754076] N73-20289

ASTRONOMICAL TELESCOPES
Airborne IR 32 cm observatory, discussing atmospheric transmission and guiding methods to overcome aircraft instability effects
A73-26503

ASYMPTOTIC METHODS
A note on the lift coefficient of a thin jet-flapped airfoil.
A73-27171

ATLANTIC OCEAN
Development of computer program to analyze air traffic in North Atlantic to show zone traffic at specified instants
[AD-755910] N73-21557

ATMOSPHERIC ATTENUATION
Factors affecting the frequency chosen for aircraft to satellite communications.
A73-27667

ATMOSPHERIC DENSITY
Numerical analysis of ideal and real gas equations for application to lift generated by helicopter rotors
[AD-754420] N73-20026
Atmospheric density extremes up to 15,000 feet for design of military aircraft
[AD-755791] N73-21382

ATMOSPHERIC MODELS
Atmospheric models for fluid dynamic and chemical impacts of supersonic aircraft on climatology
[PB-212819] N73-20473

ATMOSPHERIC OPTICS
Airborne IR 32 cm observatory, discussing atmospheric transmission and guiding methods to overcome aircraft instability effects
A73-26503

ATMOSPHERIC PHYSICS
U.S., UK and French research programs on conditions encountered by civil aviation and supersonic transports in stratosphere
A73-26594

ATMOSPHERIC TURBULENCE
A description of the NAE T-33 turbulence research aircraft, instrumentation and data analysis.
A73-26269
Russian monograph on turbulence in free atmosphere covering measurement and statistical techniques, tropospheric and stratospheric disturbances, wind pulsations, effects on aircraft flights, etc
A73-27134
Response-optimum control of the angular and torsional oscillations of an elastic flying wing.
A73-27459
Analysis of gust alleviation system for short takeoff aircraft for improved performance under random turbulence conditions
[NASA-TN-D-7201] N73-20013
Instrumentation and data handling process of NAE T-33 turbulence research aircraft, stationary gas turbine icing problems, and role of plastic deformation in metal powder compaction
[DRE/NAE-1972(4)] N73-21882

ATTACK AIRCRAFT
Application of cluster rotation to improvement of existing platforms in strike aircraft
N73-20704

AUDITORY PERCEPTION
Optimal and preferred listening levels for speech in aircraft acoustical environments.
A73-25387

AUTOMATIC CONTROL
Problems in constructing aerodynamically active elements - Converters of input and output signals in automatic control systems
A73-26769
National aviation system improvement via cost effectiveness, considering FAA facilities and equipment program, ATC automation and terminal aids
A73-27365

AUXILIARY POWER SOURCES
Design and performance of advanced auxiliary power system for fighter aircraft
[AD-754903] N73-20049

AVIONICS
On the improvement in survivability for avionics equipment.
A73-27158
Radio Technical Commission for Aeronautics, Annual Assembly Meeting, Washington, D.C., November 9, 10, 1972, Proceedings.
A73-27360
Analysis of synchronized discrete address beacon system for improved air traffic control capability
[SD-FR-01] N73-20189

AXIAL FLOW
Aerodynamic characteristics of rotary wings under axial flow conditions and development of numerical analysis techniques
N73-21039

AXIAL FLOW TURBINES
Performance tests of axial flow transonic compressor stage with multiple circular arc blades to determine effects of blade shape on efficiency and stall margin
[NASA-TN-X-2731] N73-19995
Application of momentum theory to determine performance limits of propellers, and lifting rotors with axes parallel to undisturbed flow
[AD-754072] N73-20025

AXISYMMETRIC BODIES
Potential flow past axisymmetric ring wing profiles via singularity method, applying source and vortex distributions to curved thick profiles
A73-25348

B

B-52 AIRCRAFT
Active flutter suppression - B-52 controls configured vehicle.
[AIAA PAPER 73-322] A73-25552

B-70 AIRCRAFT
Mountain waves and CAT encountered by the XB-70 in the stratosphere.
A73-25785

BACKGROUND NOISE
Optimal and preferred listening levels for speech in aircraft acoustical environments.
A73-25387

BALL BEARINGS
Effect of ovality of radial thrust bearing balls on axial vibration of rapidly rotating rotor of engine
[AD-754615] N73-20546

BALLOON SOUNDING
Balloon-aircraft ranging, data, and voice experiment.
A73-27680

BEAMS (SUPPORTS)
Vibrations of an Euler beam with a system of discrete masses, springs, and dashpots.
A73-25788

BERYLLIUM ALLOYS
Development of beryllium-copper bearings for use with stainless steel shafts under high bearing stress levels imposed by airframes
[AD-754759] N73-20540

BIAS
Parallel-redundant flight control systems, discussing sensor bias and combined control computer input effects on controllability and steady state modal response
A73-25783

BIBLIOGRAPHIES

- Annotated bibliography of aerodynamic configurations and characteristics of short takeoff aircraft
[AD-754500] N73-20037
- Tables of reports giving comparative theoretical and experimental aerodynamic loading data relevant to zero- and low-frequency aeroelastic problems
[ARC-R/H-3708] N73-21000

BIOTECHNOLOGY

- Proceedings of conference on manual control to show interplay between man and machine and application of control theory in medicine and psychology
[NASA-CR-131244] N73-20028

BLADE TIPS

- Synthesis of helicopter rotor tips for less noise.
A73-24981
- Development of rotary wings with cold, hot, and mixed cycle tip jet propulsion systems and application for torque-free rotor drive system
N73-21026
- Procedures for measuring velocity distribution through helicopter rotor blade tip vortex using single full scale rotor blade
N73-21034

BLAST DEFLECTORS

- Criteria on jet blast velocities and effects during operation of commercial aircraft and recommended procedures to reduce adverse impact
[AC-150/5325-6A] N73-20271

BLUFF BODIES

- Research facility for studying noise generated by bluff body flow interaction inside ducted fuel combustion system
[AD-754094] N73-20286

BODY KINEMATICS

- Flight-mechanics analysis of various flight conditions of conventional aircraft. VII - Mechanical foundations: Dynamic equations of motion of the translational motion of a rigid body
A73-26725

BOEING 707 AIRCRAFT

- Aircraft accident involving Boeing 707 aircraft at San Francisco, California airport following rejected takeoff on 13 Sept. 1972
[NTSB-AAR-73-4] N73-21062

BOUNDARY LAYER FLOW

- Wind tunnel tests to determine effects of nozzle geometry and upper surface blowing on aerodynamic characteristics of 14 percent thick airfoil
[NASA-CR-114560] N73-19998
- Developments in techniques for analyzing boundary layer characteristics of rotary wings based on unsteady viscous-inviscid interaction
N73-21046

BOUNDARY LAYER SEPARATION

- Analysis of stall flutter of a helicopter rotor blade.
[AIAA PAPER 73-403] A73-25532
- Effect of plume-induced boundary layer separation on afterbody during powered supersonic flight
[AD-754640] N73-20326

BRAKING

- Analysis of effect of grooved runway configurations on aircraft tire braking traction on flooded runway surfaces
[NASA-TN-D-7215] N73-21057

BUCKLING

- Vibration and local edge buckling of thermally stressed, wedge airfoil cantilever wings.
[AIAA PAPER 73-327] A73-25557
- Certain fatigue phenomena in aeronautical structures with stiffened shells
A73-27394

BUDGETING

- Status of funded improvements to the National Aviation System and planned improvements not yet funded.
A73-27363

BUFFETING

- Aeroelastic dynamic response to shock induced flow separation, analyzing wing buffet components at high Mach number subsonic flow
[AIAA PAPER 73-308] A73-25539

- Buffeting pressures on a swept wing in transonic flight - Comparison of model and full scale measurements.
[AIAA PAPER 73-311] A73-25542

BUILDINGS

- Reduction of ILS errors caused by building reflections.
A73-25784

BURNTHROUGH (FAILURE)

- Analysis of acoustic properties of jet engine malfunction as means for detecting jet engine burnthrough - Vol. 1
[FAA-RD-72-149-VOL-1] N73-20825

C

C-2 AIRCRAFT

- Hook bounce test of C-2A aircraft arresting gear A-frame
[AD-754077] N73-20288

CAMBERED WINGS

- Lift and drag at off-design Mach numbers of conically cambered wings with subsonic leading edges and supersonic trailing edge
A73-27927

CANTILEVER PLATES

- Stability of elastic bending and torsion of uniform cantilevered rotor blades in hover.
[AIAA PAPER 73-405] A73-25534

CARBON

- Analysis formation of carbon deposits on jet engines and effect on reliability, efficiency, and service life
[AD-754607] N73-20837

CARBON FIBERS

- Temperature sensitivity of cfrp honey-comb structures under holographic ndt.
A73-27036

CARGO AIRCRAFT

- Development and characteristics of dual cargo hook system for use on military transport helicopters
N73-21022

CASCADE FLOW

- Researches on the two-dimensional retarded cascade. III - Cascade performances at high inlet angles.
A73-26338

- Researches on the two-dimensional retarded cascade. IV - Determination of blade elements at retarded blade row.
A73-26339

- Graphic-interactive analysis of the velocity field around blade cascades for turbomachines
A73-27387

CASCADE WIND TUNNELS

- Application of certain generalized data from wind-tunnel tests with plane subsonic compressor cascades to the calculation of the characteristic flow regimes in supersonic cascades
A73-27480

- Aerodynamic performance of core-engine turbine stator vane tested in two-dimensional cascade of 10 vanes and in single-vane tunnel
[NASA-TN-X-2766] N73-20823

CASCADES

- Aerodynamic characteristics of torus shaped cascades involved in flame stabilization process of reheat devices for jet engines
A73-26595

CATHODE RAY TUBES

- Situational display system of cathode ray tubes to assist pilot in aircraft control
[NASA-CASE-ERC-10350] N73-20474
- Development and characteristics of flat, thin, cathode ray tube with digital switching for beam deflection and positioning
[AD-755938] N73-21227

CENTRIFUGAL COMPRESSORS

- Theory on blades of axial, mixed, and radial turbomachines by inverse method.
A73-26340

- Performance tests of low-pressure-ratio centrifugal compressor with four different diffuser configurations
[NASA-TN-D-7237] N73-19997

- Design and fabrication of backswept impeller vane island diffuser, and advanced-concepts compressor rig
[NASA-CR-120942] N73-20531

CENTRIFUGAL FORCE

SUBJECT INDEX

CENTRIFUGAL FORCE

Deformation equations of a propeller blade and the orthogonality characteristics of its normal mode shapes of vibration

A73-27085

CHANNELS (DATA TRANSMISSION)

Message organisation in the ground segment of an aeronautical satellite system.

A73-27668

CHEMICAL PROPERTIES

Hydrodynamic and chemical properties of stratospheric aircraft wake

[PB-213114]

N73-20465

CHEMICAL REACTIONS

Atmospheric models for fluid dynamic and chemical impacts of supersonic aircraft on climatology

[PB-212819]

N73-20473

CIRCUIT PROTECTION

Study on the limit efficiency of lightning conductors on aircraft radomes.

A73-25303

CIRCULAR POLARIZATION

A radiating element giving circularly polarised radiation over a large solid angle.

A73-27656

CIVIL AVIATION

Regional airport systems study for San Francisco bay area, discussing commercial and general aviation future needs, environmental and economic aspects and alternative options

A73-26125

Regularization of the legal status of international air charter services.

A73-26349

U.S., UK and French research programs on conditions encountered by civil aviation and supersonic transports in stratosphere

A73-26594

General aviation requirements within National Aviation System, discussing basic services, facilities, federal spending and R and D

A73-27361

An appraisal of the funding provisions of the Airport and Airways Development Act of 1970 to implement system improvements.

A73-27366

Airport and Airway Development Act trust fund surplus, discussing expenditure policy determination and incentive plan provisions to expedite improvements

A73-27367

Airline pilots problems in terms of job security, working conditions, management relations, public relations, flight safety due to noise abatement rules, etc

A73-27599

The provision of ground station facilities for an aeronautical satellite system.

A73-27658

Statistical analysis of aircraft accidents occurring in US civil aviation during calendar year 1971

[NTSB-BA-73-11]

N73-20015

CLEAR AIR TURBULENCE

Mountain waves and CAT encountered by the XB-70 in the stratosphere.

A73-25785

CLIMATE

Atmospheric models for fluid dynamic and chemical impacts of supersonic aircraft on climatology

[PB-212819]

N73-20473

CLIMATOLOGY

U.S., UK and French research programs on conditions encountered by civil aviation and supersonic transports in stratosphere

A73-26594

Stratospheric photochemical reactions of ozone in relation to climatology and supersonic transport pollution

[NOAA-TM-NESS-47]

N73-21526

COBALT ALLOYS

Analysis of KC-135 flight samples of Star-J Satellite solidified in near-zero gravity

[NASA-CR-124179]

N73-20610

COCKPIT SIMULATORS

Comparative evaluation of cockpit displays considering human factors and aircraft control data

[NASA-TT-F-14846]

N73-20019

COCKPITS

Cockpit instrument display systems visibility and reliability requirements, discussing various illumination methods in terms of power consumption, cost and human factors engineering

A73-26825

Application of normal bivariate distributions and anthropometric correlations for design of workspaces in aircraft

[AD-754780]

N73-20468

Cockpit display evaluation methods

[DLR-PB-73-03]

N73-21400

COHESION

Non-destructive testing of adhesive bonding.

A73-26299

COLLISION AVOIDANCE

Analysis of interaction of major elements of Oceanic Air Traffic Control System to determine minimum longitudinal and lateral separation distances

[FAA-RD-73-8]

N73-20719

COMBAT

Combat use and combat effectiveness of fighter-interceptors

[AD-751512]

N73-21894

COMBUSTION CHAMBERS

Effects of pre-vaporized fuel on exhaust emissions of an experimental gas turbine combustor.

A73-26420

Research facility for studying noise generated by bluff body flow interaction inside ducted fuel combustion system

[AD-754094]

N73-20286

COMBUSTION EFFICIENCY

Analysis formation of carbon deposits on jet engines and effect on reliability, efficiency, and service life

[AD-754607]

N73-20837

COMBUSTION PRODUCTS

Analysis formation of carbon deposits on jet engines and effect on reliability, efficiency, and service life

[AD-754607]

N73-20837

Effect of inlet-air humidity on formation of oxides of nitrogen from a gas turbine combustor under various air inlet temperature conditions

[NASA-TM-X-68209]

N73-21691

COMMERCIAL AIRCRAFT

Ireland commercial airports at Dublin, Shannon and Cork, discussing management, terminal facilities and operations

A73-25208

Determination of the turn start point coordinates for modern commercial aircraft

A73-26723

Design of perforated tube uniform distribution of fire extinguishing agent into commercial air transport compartments

[FAA-NA-73-3]

N73-20009

Analysis of factors involving commercial application of short takeoff aircraft for short haul airline operations

[NASA-TM-X-62239]

N73-20016

House hearings on air passenger fees, related taxation, and government regulation of commercial airline operations.

N73-20970

COMMUNICATION EQUIPMENT

Doppler compensated communication system for locating supersonic transport position

[NASA-CASE-GSC-10087-4]

N73-20174

COMMUNICATION SATELLITES

Satellite systems for mobile communications and surveillance; Proceedings of the International Conference, London, England, March 13-15, 1973.

A73-27652

Factors relating to the choice of antenna characteristics for the aircraft terminal in an aeronautical satellite communications/surveillance system.

A73-27654

The use of satellites for aircraft communications and air traffic control.

A73-27666

Factors affecting the frequency chosen for aircraft to satellite communications.

A73-27667

SUBJECT INDEX

CONICAL BODIES

- Message organization in the ground segment of an aeronautical satellite system. A73-27668
- COMPONENT RELIABILITY**
Reliability analysis of helicopter mechanical transmission components and reduction gearboxes A73-26596
- COMPOSITE MATERIALS**
Fabrication and physical, mechanical and electrical properties of inorganic composite material for aircraft radomes A73-25288
Development and application of composite materials for vertical takeoff aircraft airframes and effect on improved aircraft performance N73-21023
- COMPOSITE STRUCTURES**
Fabrication of L-1011 aircraft panels to compare costs and service performance characteristics of FRD-49 and fiberglass [NASA-CR-112250] N73-20018
- COMPOUND HELICOPTERS**
Development program of medium range winged design helicopter, describing wing-fuselage structure, propulsion and power transmission systems and combustion, electrical and hydraulic plants A73-27383
- COMPRESSIBLE FLOW**
Unsteady subsonic compressible flow around finite thickness wings. [AIAA PAPER 73-313] A73-25544
- COMPRESSIBLE FLUIDS**
Nonstationary flow downwash behind a delta wing during supersonic motion A73-25046
- COMPRESSOR BLADES**
Researches on the two-dimensional retarded cascade. III - Cascade performances at high inlet angles. A73-26338
Researches on the two-dimensional retarded cascade. IV - Determination of blade elements at retarded blade row. A73-26339
Performance tests of axial flow transonic compressor stage with multiple circular arc blades to determine effects of blade shape on efficiency and stall margin [NASA-TN-X-2731] N73-19995
- COMPRESSOR ROTORS**
Design and aerodynamic performance of low speed fan stage for low noise turboengine [NASA-CR-121148] N73-21070
- COMPUTER DESIGN**
Research activities of electronic laboratory in development of inertial navigation systems to include applications for space missions and commercial aviation N73-20686
- COMPUTER GRAPHICS**
Eigenvalue problem and stiffness optimization procedure for incremental flutter analysis, describing method use in computer graphics mode [AIAA PAPER 73-392] A73-25521
Graphic-interactive analysis of the velocity field around blade cascades for turbomachines A73-27387
- COMPUTER PROGRAMS**
Application of computer-aided aircraft design in a multidisciplinary environment. [AIAA PAPER 73-353] A73-25490
Reliability and quality control of production engineering computer programs. [AIAA PAPER 73-356] A73-25493
Theories, numerical methods, and computer programs for determining inviscid three dimensional flow around spherically-capped smooth bodies and wings at supersonic speeds [AD-753696] N73-21002
Development of computer program to analyze air traffic in North Atlantic to show zone traffic at specified instants [AD-755910] N73-21557
- COMPUTER TECHNIQUES**
Airport computerized departure control for check-in, load control, cargo and catering operations, discussing load optimization and passenger acceptance control /LOPAC/ system A73-25210
- Parallel-redundant flight control systems, discussing sensor bias and combined control computer input effects on controllability and steady state modal response A73-25783
- COMPUTERIZED DESIGN**
Aircraft design philosophies and structural integrity considerations for reliability without major NDT and maintenance, proposing research program for future computerized design A73-25128
Design of control and display panels using computer algorithms. A73-25180
Military aircraft radome design technology developments in Sweden, discussing use of glass fiber reinforced plastics, manufacturing method, computerized optimization and measurement techniques. A73-25300
Taylor series algorithms for computerized structural design and reanalysis of modified structures, applying to aircraft fuselage midsection [AIAA PAPER 73-338] A73-25478
Application of computer-aided aircraft design in a multidisciplinary environment. [AIAA PAPER 73-353] A73-25490
An automated procedure for computing flutter eigenvalues. [AIAA PAPER 73-393] A73-25522
- COMPUTERIZED SIMULATION**
Application of equations of motion to develop analog computer simulation of helicopter rotor system [AD-754547] N73-20024
Functional error analysis and simulation of air traffic control system to support concepts evaluation program [PB-213148] N73-20730
Computerized simulation of aircraft as radar target [AD-755854] N73-21189
- CONCORDE AIRCRAFT**
Varying-temperature test installation for the interior design of the Concorde A73-25103
Seismic measurement data from Cornish cottage during Concorde sonic boom flight, using moving coil geophones A73-26292
Aircraft design and reliability analysis method based on accidents occurrence investigation by Franco-British airworthiness authorities, noting applicability to Concorde aircraft A73-26589
- CONFERENCES**
Radio Technical Commission for Aeronautics, Annual Assembly Meeting, Washington, D.C., November 9, 10, 1972, Proceedings. A73-27360
Satellite systems for mobile communications and surveillance; Proceedings of the International Conference, London, England, March 13-15, 1973. A73-27652
Proceedings of conference on manual control to show interplay between man and machine and application of control theory in medicine and psychology [NASA-CR-131244] N73-20028
Proceedings of conference on rotary wing aircraft developments to include operational experience, flight tests, and evaluation of structural concepts [AGARD-CP-121] N73-21008
Proceedings of conference on fluid dynamics of rotary wings and aerodynamic characteristics of rotary wing systems [AGARD-CP-111] N73-21031
- CONGRESS**
House hearings on air passenger fees, related taxation, and government regulation of commercial airline operations N73-20970
- CONICAL BODIES**
Supersonic gas flow past the leeward side of a conical wing A73-26439

CONICAL CAMBER

SUBJECT INDEX

CONICAL CAMBER

Lift and drag at off-design Mach numbers of conically cambered wings with subsonic leading edges and supersonic trailing edge
A73-27927

CONICAL NOZZLES

Experimental tests on scale models of conical variable geometry propulsion nozzle with short petals for fighter aircraft, discussing aerodynamic and thrust coefficients
A73-27388

CONSTRUCTION MATERIALS

Aircraft structures aluminum alloys fatigue crack growth rate relationship to cracking mode, stress ratio, cyclic frequency and corrosive environment severity
A73-25826

A new method for the study of the phenomenon of dynamic instability of thin-walled bars used in the construction of aeroplanes, ships and bridges.
A73-27063

CONTROL BOARDS

Design of control and display panels using computer algorithms.
A73-25180

CONTROL EQUIPMENT

Advanced flight control systems - Power-by-wire and fly-by-wire.
A73-26272

CONTROL SURFACES

Active flutter suppression - B-52 controls configured vehicle.
[AIAA PAPER 73-322] A73-25552

Design and evaluation of miniature control surface actuation systems for aeroelastic models.
[AIAA PAPER 73-323] A73-25553

The theoretical and experimental methods used in France for flutter prediction.
[AIAA PAPER 73-329] A73-25558

Method for computing lifting pressure distribution on wing with partial span, swept control surfaces
[NASA-TN-D-7251] A73-19999

Characteristics of system for providing yaw control of vehicles at high supersonic and hypersonic speeds by deflecting flaps mounted on upper wing surface
[NASA-CASE-LAR-11140-1] A73-20008

CONTROL THEORY

Practical quadratic optimal control for systems with large parameter variations.
A73-27166

Synthesis of searchless self-adjusting systems based on the root locus method. I.
A73-27460

CONTROLLABILITY

Parallel-redundant flight control systems, discussing sensor bias and combined control computer input effects on controllability and steady state modal response
A73-25783

Control technology for air cushion passenger vehicle
A73-20969

CONTROLLERS

Aircraft and spacecraft hand controllers for yaw, pitch, and roll
[NASA-CASE-HSC-12394-1] A73-20041

COOLING

Turbine blades cooling effectiveness for engines gas temperature energy gain compensation
A73-27090

COOLING SYSTEMS

Influence of the turbine air cooling system on the characteristics of a turbojet engine during regulation of the latter
A73-27091

Development of methods for protecting aircraft compartments from aerodynamic heating effects
[AD-754606] A73-20036

CORROSION TESTS

Aircraft structures aluminum alloys fatigue crack growth rate relationship to cracking mode, stress ratio, cyclic frequency and corrosive environment severity
A73-25826

COST ANALYSIS

Improvements in the use of FAA resources for system performance assurance.
A73-27364

Life cycle cost analysis of inertial navigation systems for aircraft and air to surface missiles
A73-20717

COST EFFECTIVENESS

Radio Technical Commission for Aeronautics, Annual Assembly Meeting, Washington, D.C., November 9, 10, 1972, Proceedings.
A73-27360

National aviation system improvement via cost effectiveness, considering FAA facilities and equipment program, ATC automation and terminal aids
A73-27365

COST REDUCTION

Design, development, and production of low cost remotely piloted vehicles based on innovative approach for aircraft engineering procedures [P-4902]
A73-21060

CRACK PROPAGATION

Aircraft structures aluminum alloys fatigue crack growth rate relationship to cracking mode, stress ratio, cyclic frequency and corrosive environment severity
A73-25826

CREEP ANALYSIS

Creep analysis of a thin-walled wing on the basis of the plate analogy
A73-27086

CREEP TESTS

Method of life prediction for nickel-based Udimet alloy by high temperature creep/fatigue testing [NASA-CR-120958]
A73-21845

CRITICAL POINT

Prediction of height-velocity boundaries for rotorcraft by application of optimization techniques.
A73-27175

CROSS FLOW

Performance characteristics of a model VTOL lift fan in crossflow.
A73-25782

CUMULATIVE DAMAGE

Phenomenological approach to low-cycle fatigue fracture of a typical aircraft full scale component static test.
[AIAA PAPER 73-324] A73-25554

CYCLIC LOADS

Aircraft structures aluminum alloys fatigue crack growth rate relationship to cracking mode, stress ratio, cyclic frequency and corrosive environment severity
A73-25826

D

DATA ACQUISITION

Methodologies for the analysis of transport requirements with particular regard to the aeronautic case
A73-27070

Data acquisition process to plan and engineer air traffic system, considering design aspects and piecemeal evolution
A73-27362

DATA MANAGEMENT

Message organization in the ground segment of an aeronautical satellite system.
A73-27668

DATA REDUCTION

A description of the NAE T-33 turbulence research aircraft, instrumentation and data analysis.
A73-26269

DATA TRANSMISSION

The use of satellites for aircraft communications and air traffic control.
A73-27666

Balloon-aircraft ranging, data, and voice experiment.
A73-27680

DC 10 AIRCRAFT

Inflight incident involving separation of cargo compartment door on DC-10 aircraft near Windsor, Ontario, Canada on 12 June, 1972
[NTSB-AAR-73-2] A73-21061

- DECISION MAKING**
Regional airport systems study for San Francisco bay area, discussing commercial and general aviation future needs, environmental and economic aspects and alternative options
A73-26125
- DEGREES OF FREEDOM**
Sensitivity of rotor blade vibration characteristics to torsional oscillations.
[AIAA PAPER 73-404] A73-25533
- DELTA WINGS**
Nonstationary flow downwash behind a delta wing during supersonic motion
A73-25046
Flutter of pairs of aerodynamically interfering delta wings.
[AIAA PAPER 73-314] A73-25545
Supersonic gas flow past the leeward side of a conical wing
A73-26439
Supersonic flow around a delta wing, taking into account flow separation at the leading edges
A73-27098
- DEMAND (ECONOMICS)**
Methodologies for the analysis of transport requirements, with particular regard to the aeronautic case
A73-27070
- DEPOSITS**
Chemistry of deposits and their precursors in jet turbine fuel systems
[AD-754459] N73-20816
- DIFFERENTIAL INTERFEROMETRY**
The application of holography to sonic boom investigations.
A73-26633
- DIFFUSERS**
Performance tests of low-pressure-ratio centrifugal compressor with four different diffuser configurations
[NASA-TN-D-7237] N73-19997
- DIGITAL FILTERS**
Microprogrammed digital filters for strapdown guidance application.
A73-27168
- DIGITAL SYSTEMS**
Digital flight director for precise aircraft control
[AD-754028] N73-20726
Development and characteristics of flat, thin, cathode ray tube with digital switching for beam deflection and positioning
[AD-755938] N73-21227
Research projects to develop all-weather, low level navigation systems based on one way ranging, range-range navigation techniques
[AD-755205] N73-21556
- DIGITAL TECHNIQUES**
Satellite communication channels assignment to ships and aircraft, considering automated digital calling method for ship-to-shore communication
A73-27670
- DIPOLE ANTENNAS**
A radiating element giving circularly polarised radiation over a large solid angle.
A73-27656
- DIPOLERS**
Sound directivity pattern radiated from small airfoils.
A73-24980
- DIRECTIONAL ANTENNAS**
The disc antenna - A possible L-band aircraft antenna.
A73-27655
- DIRECTIVITY**
Sound directivity pattern radiated from small airfoils.
A73-24980
- DISINTEGRATION**
Analysis of gas turbine engine rotor failures as basis for conducting program to provide equipment for protection of passengers and aircraft structures from damage
[NASA-CR-131525] N73-21692
- DISKS (SHAPES)**
The disc antenna - A possible L-band aircraft antenna.
A73-27655
- DISPERSING**
Air Force heating system for fog dispersal
[AD-754900] N73-20675
- DISPLAY DEVICES**
Design of control and display panels using computer algorithms.
A73-25180
Display system for monitoring automatically controlled STOL landing glide paths, discussing computer controlled simulation
A73-25440
Cockpit instrument display systems visibility and reliability requirements, discussing various illumination methods in terms of power consumption, cost and human factors engineering
A73-26825
Comparative evaluation of cockpit displays considering human factors and aircraft control data
[NASA-TT-P-14846] N73-20019
Proceedings of conference on manual control to show interplay between man and machine and application of control theory in medicine and psychology
[NASA-CR-131244] N73-20028
Situational display system of cathode ray tubes to assist pilot in aircraft control
[NASA-CASE-ERC-10350] N73-20474
Development and characteristics of flat, thin, cathode ray tube with digital switching for beam deflection and positioning
[AD-755938] N73-21227
Cockpit display evaluation methods
[DLR-FB-73-03] N73-21400
- DIVERGENT NOZZLES**
Shrouded divergent body attached to exhaust nozzle for jet noise suppression
[NASA-CASE-LEW-11286-1] N73-21066
Aerodynamic tests and noise levels of slot nozzle with V gutter reverser for STOL
[NASA-TN-X-2758] N73-21072
- DOPPLER EFFECT**
Doppler compensated communication system for locating supersonic transport position
[NASA-CASE-GSC-10087-4] N73-20174
- DOPPLER NAVIGATION**
A new approach to Doppler-inertial navigation /Doppler Beam Sampling/.
A73-27162
- DOPPLER RADAR**
Utilization of the Doppler effect to measure the drift angle and the ground speed of an aircraft
A73-25797
- DOWNWASH**
Nonstationary flow downwash behind a delta wing during supersonic motion
A73-25046
Development of actuator disc theory for predicting time-averaged downwash distribution and response characteristics of helicopter rotors in forward flight
N73-21033
Analysis of unsteady aerodynamic loading on reference section of helicopter rotor blade in axial or hovering flight under compressible flow conditions
N73-21044
- DRAG CHUTES**
Parawing-drag chute system operation on wind shear energy to maintain payload flight altitude
A73-25787
- DRIFT**
Utilization of the Doppler effect to measure the drift angle and the ground speed of an aircraft
A73-25797
- DRONE AIRCRAFT**
Computerized simulation of aircraft as radar target
[AD-755854] N73-21189
- DYNAMIC MODELS**
Solid body on elastic supports as model for helicopter stability and nonlinear oscillations analysis
A73-27791
- DYNAMIC RESPONSE**
Sensitivity of rotor blade vibration characteristics to torsional oscillations.
[AIAA PAPER 73-404] A73-25533

DYNAMIC STABILITY

SUBJECT INDEX

The spatial correlation method and a time-varying flexible structure.
[AIAA PAPER 73-406] A73-25535

Aeroelastic dynamic response to shock induced flow separation, analyzing wing buffet components at high Mach number subsonic flow
[AIAA PAPER 73-308] A73-25539

An exploratory investigation of the unsteady aerodynamic response of a two-dimensional airfoil at high reduced frequency.
[AIAA PAPER 73-309] A73-25540

Vibrations of an Euler beam with a system of discrete masses, springs, and dashpots.
A73-25788

Response-optimum control of the angular and torsional oscillations of an elastic flying wing.
A73-27459

DYNAMIC STABILITY
A new method for the study of the phenomenon of dynamic instability of thin-walled bars used in the construction of aeroplanes, ships and bridges.
A73-27063

DYNAMIC STRUCTURAL ANALYSIS
The state of the art in aeroelasticity of aerospace vehicles in Japan.
[AIAA PAPER 73-331] A73-25560

E

E-2 AIRCRAFT
Test plan for extending service life of E-2A arresting gear
[AD-754752] N73-20284

EAR PROTECTORS
A single number rating for effective noise reduction.
A73-25000

ECONOMIC FACTORS
Cargo air transport means selection procedure, suggesting methods for economic evaluation of time savings
A73-27066

EFFECTIVE PERCEIVED NOISE LEVELS
Noise level surveys of seventeen general aviation aircraft including jet and propeller driven types
[FAA-EQ-73-1] N73-21063

Aerodynamic tests and noise levels of slot nozzle with V gutter reverser for STOL
[NASA-TN-X-2758] N73-21072

Analysis of common aircraft noise measures in terms of selected human response for jet transport aircraft
[FAA-RD-71-112] N73-21074

EIGENVALUES
Eigenvalue problem and stiffness optimization procedure for incremental flutter analysis, describing method use in computer graphics mode
[AIAA PAPER 73-392] A73-25521

An automated procedure for computing flutter eigenvalues.
[AIAA PAPER 73-393] A73-25522

ELASTIC BARS
A new method for the study of the phenomenon of dynamic instability of thin-walled bars used in the construction of aeroplanes, ships and bridges.
A73-27063

ELASTIC BENDING
Stability of elastic bending and torsion of uniform cantilevered rotor blades in hover.
[AIAA PAPER 73-405] A73-25534

ELASTIC DEFORMATION
Deformation equations of a propeller blade and the orthogonality characteristics of its normal mode shapes of vibration
A73-27085

ELASTIC SYSTEMS
Solid body on elastic supports as model for helicopter stability and nonlinear oscillations analysis
A73-27791

ELASTOHYDRODYNAMICS
Analysis of parameters and elastohydrodynamic principles affecting lubrication of transmission components with application to helicopter mechanical drive systems
[NASA-TN-X-68215] N73-21069

ELECTRIC FIELDS
Analysis of electrical charge generated by helicopter rotor operating near particulate matter with seeded vortex
[AD-755282] N73-21080

ELECTRIC MOTORS
Investigation of new elements and equipment configurations in stable-frequency, alternating-current, electrical power supply systems employing primary power plants consisting of engines with varying rotational speed
A73-26785

ELECTRIC POWER SUPPLIES
Investigation of new elements and equipment configurations in stable-frequency, alternating-current, electrical power supply systems employing primary power plants consisting of engines with varying rotational speed
A73-26785

ELECTRIC POWER TRANSMISSION
Advanced flight control systems - Power-by-wire and fly-by-wire.
A73-26272

ELECTRICAL PROPERTIES
Fabrication and physical, mechanical and electrical properties of inorganic composite material for aircraft radomes
A73-25288

ELECTROACOUSTIC TRANSDUCERS
Potential applications of acoustic matched filters to air-traffic control systems.
A73-27572

ELECTROMAGNETIC COMPATIBILITY
Electromagnetic compatibility of avionic weapon system
[AD-754412] N73-20262

Manual on electromagnetic compatibility and interference between aircraft weapon systems
[AD-754411] N73-20263

Analysis of electromagnetic compatibility of microwave landing guidance system and candidate interim systems
[ECAC-PR-72-069] N73-21554

ELECTROMAGNETIC INTERFERENCE
Manual on electromagnetic compatibility and interference between aircraft weapon systems
[AD-754411] N73-20263

ELECTRON BEAMS
Development and characteristics of flat, thin, cathode ray tube with digital switching for beam deflection and positioning
[AD-755938] N73-21227

ELECTRONIC EQUIPMENT
Research activities of electronic laboratory in development of inertial navigation systems to include applications for space missions and commercial aviation
N73-20686

ELECTRONIC EQUIPMENT TESTS
Development and evaluation of cross-band radar/beacon system for operation with airport surveillance radar/air traffic control beacon interrogator system
[FAA-RD-73-38] N73-21182

ELECTROSTATIC CHARGE
Electrostatic charge induction on aircraft due to charged atmosphere and friction effects, noting lightning protection, fuel container shielding and charge removal methods
A73-26722

Analysis of electrical charge generated by helicopter rotor operating near particulate matter with seeded vortex
[AD-755282] N73-21080

ELECTROSTATIC GYROSCOPES
Development of electrostatic gyro systems
N73-20698

ELECTROSTATIC SHIELDING
Electrostatic charge induction on aircraft due to charged atmosphere and friction effects, noting lightning protection, fuel container shielding and charge removal methods
A73-26722

ELLIPTICAL POLARIZATION

Flush mountable elliptically polarized low silhouette blade antenna for aircraft, describing polarization and radiation characteristics
A73-27043

EMERGENCIES

Aircraft accident involving Boeing 707 aircraft at San Francisco, California airport following rejected takeoff on 13 Sept. 1972
[NTSB-AR-73-4] N73-21062

ENERGY CONVERSION

Parawing-drag chute system operation on wind shear energy to maintain payload flight altitude
A73-25787

ENGINE DESIGN

A reappraisal of design methods for inward flow radial gas turbines.
A73-26370

Analysis of the operational parameters of a bypass turbojet
A73-27069

A modern mechanical laboratory for the support of aircraft engine design
A73-27385

ENGINE FAILURE

Prediction of height-velocity boundaries for rotorcraft by application of optimization techniques.
A73-27175

Performance tests on J-52 turbojet engines to determine acceptable compressor stall margin
[AD-755152] N73-20832

ENGINE INLETS

Effect of inlet-air humidity on formation of oxides of nitrogen from a gas turbine combustor under various air inlet temperature conditions
[NASA-TM-X-68209] N73-21691

ENGINE MONITORING INSTRUMENTS

Condition monitoring - A new technology for aircraft engine maintenance
A73-27389

ENGINE NOISE

A single number rating for effective noise reduction.
A73-25000

ENGINE TESTS

An-2R aircraft conversion to flying test bed for feasibility studies of jet engine use in agricultural aircraft, describing structural design modifications
A73-26823

ENVIRONMENTAL CONTROL

Airport noise control and minimization for community and airline industry interests by technology application and legal-political approaches
A73-26350

Guidelines for urban control of aircraft noise pollution
[PB-213020] N73-20759

EQUATIONS OF MOTION

Flight-mechanics analysis of various flight conditions of conventional aircraft. VII - Mechanical foundations: Dynamic equations of motion of the translational motion of a rigid body
A73-26725

Application of parafoil equations of motion to predict flight performance of powered parafoil flight vehicle
[AD-754907] N73-20034

Analysis of equations of aircraft dynamics and development of analog-digital simulation capability
[AD-755868] N73-21077

ERROR CORRECTING DEVICES

Reduction of ILS errors caused by building reflections.
A73-25784

EUROPE

Existing position and future prospects of wind tunnels in European research
[AGARD-AR-60] N73-20269

EXHAUST GASES

Effects of pre vaporized fuel on exhaust emissions of an experimental gas turbine combustor.
A73-26424

Gas turbine engine exhaust pollutants consisting of unburned hydrocarbons, nitric oxide, carbon dioxide, nitrogen dioxide and carbon monoxide
A73-27934

Chemically reacting wave of aircraft flying at subsonic and supersonic velocity in upper troposphere and stratosphere
[AD-754918] N73-20447

Stratospheric chemical reactions and perturbations caused by supersonic aircraft exhaust
[PB-213111] N73-20464

Survey on aeronomic dynamics of photochemical reactions caused by supersonic aircraft exhaust
[PB-213126] N73-20466

Alternate fuels to reduce aircraft exhaust pollutants
[AD-755151] N73-20815

Reduction of jet engine noise due to turbulent mixing of exhaust gases with ambient atmosphere
[NASA-CASE-ARC-10712-1] N73-20826

EXHAUST NOZZLES

Shrouded divergent body attached to exhaust nozzle for jet noise suppression
[NASA-CASE-LEW-11286-1] N73-21066

EXTERNALLY BLOWN FLAPS

Analysis of basic acoustic characteristics and noise reduction potential of upper surface of blown flap
[NASA-CR-112246] N73-20017

Acoustic measurements of aerodynamic noise generated by externally blown flap lift augmentation system for various aerodynamic configurations
[NASA-TM-X-2776] N73-21059

F**F-4 AIRCRAFT**

Evaluation of energy maneuverability procedures in aircraft flight path optimization and performance estimation
[AD-754909] N73-20035

FABRICS

Recent developments in commercial fire resistant fibrous materials.
A73-26419

FAILURE ANALYSIS

Analysis of acoustic properties of jet engine malfunction as means for detecting jet engine burnthrough - Vol. 1
[FAA-RD-72-149-VOL-1] N73-20825

Inflight incident involving separation of cargo compartment door on DC-10 aircraft near Windsor, Ontario, Canada on 12 June, 1972
[NTSB-AR-73-2] N73-21061

FATIGUE LIFE

Fretting fatigue in titanium helicopter components.
A73-25837

Ti alloy coating and surface treatment to prolong fatigue life by eliminating fretting damage, discussing design parameters selection, screening and strength tests and performance evaluation
A73-25838

Certain fatigue phenomena in aeronautical structures with stiffened shells
A73-27394

FATIGUE TESTS

Varying-temperature test installation for the interior design of the Concorde
A73-25103

Phenomenological approach to low-cycle fatigue fracture of a typical aircraft full scale component static test.
[AIAA PAPER 73-324] A73-25554

Fatigue and impact tests on composite propeller blades made of glass- and carbon fiber reinforced plastics, noting comparison with measured vibratory strains
A73-26881

Fatigue damage of helicopter rotary wing structures - bibliographies
[AD-754062] N73-20027

Method of life prediction for nickel-based Udimet alloy by high temperature creep/fatigue testing
[NASA-CR-120958] N73-21845

FEDERAL BUDGETS

SUBJECT INDEX

FEDERAL BUDGETS

Airport and Airway Development Act trust fund surplus, discussing expenditure policy determination and incentive plan provisions to expedite improvements
A73-27367

FEEDBACK CONTROL
Advanced flight control systems - Power-by-wire and fly-by-wire.
A73-26272

Evaluation of glide paths for landing a VTOL airplane using linear regulator theory.
A73-27154

Practical quadratic optimal control for systems with large parameter variations.
A73-27166

Synthesis of searchless self-adjusting systems based on the root locus method. I.
A73-27460

Application of loran/inertial hybrid system and Kalman filter algorithm to fixed feedback gain
N73-20701

FIBERS
Recent developments in commercial fire resistant fibrous materials.
A73-26419

FIGHTER AIRCRAFT
Preliminary design of aircraft structures to meet structural integrity requirements.
[AIAA PAPER 73-374] A73-25506

Experimental tests on scale models of conical variable geometry propulsion nozzle with short petals for fighter aircraft, discussing aerodynamic and thrust coefficients
A73-27388

Combat use and combat effectiveness of fighter-interceptors
[AD-751512] N73-21894

FILM COOLING
Adverse effect of film cooling on suction surface of turbine blade
[NASA-TN-X-69210] N73-21695

FINANCIAL MANAGEMENT
Status of funded improvements to the National Aviation System and planned improvements not yet funded.
A73-27363

An appraisal of the funding provisions of the Airport and Airways Development Act of 1970 to implement system improvements.
A73-27366

FINITE ELEMENT METHOD
Aeroelastic structural weight optimization under strength and flutter constraints, using finite element and displacement methods to describe equations of motion in matrix form
[AIAA PAPER 73-389] A73-25518

Contribution to the theory of the finite element method applied to the overall stress analysis of a fuselage
A73-27084

FINS
Turbulent heat transfer to a fin leading edge - Flight test results.
A73-26405

Turbulent heat transfer and pressure on leading edge of fin, swept wing, or antenna
[SCL-RR-72-0308] N73-21863

FIRE EXTINGUISHERS
Design of perforated tube uniform distribution of fire extinguishing agent into commercial air transport compartments
[FAA-NA-73-3] N73-20009

FIRE PREVENTION
Development of haloogenated hydrocarbon materials for use as fire and ignition suppressants for aircraft fuel tanks subjected to incendiary ammunition
[AD-755362] N73-21079

FIREPROOFING
Recent developments in commercial fire resistant fibrous materials.
A73-26419

FLAME STABILITY
Aerodynamic characteristics of torus shaped cascades involved in flame stabilization process of reheat devices for jet engines
A73-26595

FLAMMABILITY

Recent developments in commercial fire resistant fibrous materials.
A73-26419

FLAT PLATES
Noise reduction for subsonic fluid flow over flat plate via interposition of secondary fluid layer at trailing edge
A73-25386

FLEXIBLE WINGS
The spatial correlation method and a time-varying flexible structure.
[AIAA PAPER 73-406] A73-25535

FLIGHT
Discussion of speed record establishment by SA-341 helicopter to include aircraft preparation procedures and requirements for successful completion
N73-21018

FLIGHT ALTITUDE
Parawing-drag chute system operation on wind shear energy to maintain payload flight altitude
A73-25787

FLIGHT CHARACTERISTICS
Helicopter flight performance in tactical environment
N73-21009

Flight characteristics and performance of Fenestron type helicopter tail rotor
N73-21028

Analysis of equations of aircraft dynamics and development of analog-digital simulation capability
[AD-755868] N73-21077

FLIGHT CONTROL
Parallel-redundant flight control systems, discussing sensor bias and combined control computer input effects on controllability and steady state modal response
A73-25783

Hydraulic powered integrated actuator package /IAP/ for V/STOL aircraft flight control, noting advantages in system weight, mechanical complexity and power loss reduction
A73-26271

Advanced flight control systems - Power-by-wire and fly-by-wire.
A73-26272

Practical quadratic optimal control for systems with large parameter variations.
A73-27166

Characteristics of system for providing yaw control of vehicles at high supersonic and hypersonic speeds by deflecting flaps mounted on upper wing surface
[NASA-CASE-LAR-11140-1] N73-20008

Proceedings of conference on manual control to show interplay between man and machine and application of control theory in medicine and psychology
[NASA-CR-131244] N73-20028

Design of hydrofluidic flight control system for helicopter stabilization
[AD-754602] N73-20032

Contributions of quality inertial system to vehicle flight control
N73-20700

Digital flight director for precise aircraft control
[AD-754028] N73-20726

Bibliography of supersonic transport aircraft data to include program management, systems engineering, aircraft structures, and operational considerations
[AD-755600] N73-21076

FLIGHT MECHANICS
Flight-mechanics analysis of various flight conditions of conventional aircraft. VII - Mechanical foundations: Dynamic equations of motion of the translational motion of a rigid body
A73-26725

FLIGHT OPTIMIZATION
Airport computerized departure control for check-in, load control, cargo and catering operations, discussing load optimization and passenger acceptance control /LOPAC/ system
A73-25210

SUBJECT INDEX

FLUTTER ANALYSIS

FLIGHT PATHS

An optimal control approach to terminal area air traffic control. A73-25786
 Determination of the turn start point coordinates for modern commercial aircraft A73-26723
 Evaluation of energy maneuverability procedures in aircraft flight path optimization and performance estimation [AD-754909] N73-20035

FLIGHT SAFETY

Research and development projects of Federal Aviation Administration to provide improved weather data acquisition and distribution [FAA-ED-15-1] N73-20662
 Analysis of interaction of major elements of Oceanic Air Traffic Control System to determine minimum longitudinal and lateral separation distances [FAA-RD-73-8] N73-20719
 Research and development projects conducted by Federal Aviation Administration to improve air traffic control and flight safety [FAA-EM-73-2] N73-20720
 Functional error analysis and simulation of air traffic control system to support concepts evaluation program [PB-213148] N73-20730

FLIGHT SIMULATORS

Evaluation of helicopter handling qualities based on ground-based piloted flight simulator tests N73-21030
 Analysis of equations of aircraft dynamics and development of analog-digital simulation capability [AD-755868] N73-21077
 Development and use of synthetic flight trainers based on degree and fidelity of simulation as key design considerations [AD-754957] N73-21260

FLIGHT TESTS

Turbulent heat transfer to a fin leading edge - Flight test results. A73-26405
 Application of parafoil equations of motion to predict flight performance of powered parafoil flight vehicle [AD-754907] N73-20034
 Scale effect on swept wings at subsonic speed on basis of pressure distribution measured in flight and on wind tunnel super VC 10 model [ARC-R/E-3707] N73-20999
 Analysis of procedures and problems involved in operating helicopters from decks of ships N73-21010
 Improvements in military helicopter flight test techniques to provide data for safety, maintainability, and reliability N73-21013
 Flight tests of XH-51 helicopter to determine effects of gyroscope and control spring modifications on stability and control N73-21015
 Application of maximum likelihood criterion and optimal input design for analyzing flight test data to obtain aircraft stability and control derivatives [NASA-CR-2200] N73-21071
 Development of pilot model parameters to provide data base for multiloop, single controller, multi-input analysis of aircraft performance [AD-755367] N73-21078

FLOW CHARACTERISTICS

Theory on blades of axial, mixed, and radial turbo-machines by inverse method. A73-26340
 Application of certain generalized data from wind-tunnel tests with plane subsonic compressor cascades to the calculation of the characteristic flow regimes in supersonic cascades A73-27480
 Procedures for calculating velocity potential and pressure distribution of planforms oscillating harmonically in supersonic flow [FOK-X-440] N73-19994

Design of airfoil sections for low Reynolds numbers based on requirement to achieve transition upstream of major adverse pressure gradient N73-20995
 Wind tunnel tests of rotary wing to determine retreating blade stall at several preset parameters and effect of reverse flow area N73-21037
 Aerodynamic characteristics of rotary wings under axial flow conditions and development of numerical analysis techniques N73-21039

Effect of steady state circumferential total pressure distortion on loss in compressor stall pressure ratio [NASA-CR-114577] N73-21693

FLOW DEFLECTION

Supersonic gas flow past the leeward side of a conical wing A73-26439

FLOW DISTORTION

Performance characteristics of a model VTOL lift fan in crossflow. A73-25782

FLOW DISTRIBUTION

Nonstationary flow downwash behind a delta wing during supersonic motion A73-25046

Analysis of basic acoustic characteristics and noise reduction potential of upper surface of blown flap [NASA-CR-112246] N73-20017

Development of procedure for determining geometry and strength distribution of vortex wake generated by single-bladed hovering helicopter rotor N73-21035

FLOW EQUATIONS

Development of method for solving three dimensional, incompressible laminar and turbulent boundary layer problems for swept infinite cylinders and small cross flow [AD-754440] N73-20004

FLOW GEOMETRY

A reappraisal of design methods for inward flow radial gas turbines. A73-26370

FLOW MEASUREMENT

Problems in constructing aerodynamically active elements - Converters of input and output signals in automatic control systems A73-26769

Three component wake velocity measurements of full scale OH-13 helicopter rotary wing during hovering flight [AD-754644] N73-20030

FLOW THEORY

A linearized potential flow theory for airfoils with spoilers. A73-25853

FLOW VISUALIZATION

An investigation of unsteady aerodynamics on an oscillating airfoil. [AIAA PAPER 73-318] A73-25549

FLUID AMPLIFIERS

Design of hydrofluidic flight control system for helicopter stabilization [AD-754602] N73-20032

FLUID DYNAMICS

Atmospheric models for fluid dynamic and chemical impacts of supersonic aircraft on climatology [PB-212819] N73-20473

FLUID FLOW

Noise reduction for subsonic fluid flow over flat plate via interposition of secondary fluid layer at trailing edge A73-25386

FLUIDICS

Problems in constructing aerodynamically active elements - Converters of input and output signals in automatic control systems A73-26769

FLUTTER ANALYSIS

The effect of servomechanical control and stability systems on the flutter behavior of aircraft A73-25349

- Gradient optimization of structural weight for specified flutter speed.
[AIAA PAPER 73-390] A73-25519
- Numerical procedure for determining optimal member sizes of aircraft structural components with weight minimization and flutter speed lower bound
[AIAA PAPER 73-391] A73-25520
- Eigenvalue problem and stiffness optimization procedure for incremental flutter analysis, describing method use in computer graphics mode
[AIAA PAPER 73-392] A73-25521
- An automated procedure for computing flutter eigenvalues.
[AIAA PAPER 73-393] A73-25522
- Parametric studies of the wing flutter behavior of a STOL transport.
[AIAA PAPER 73-394] A73-25523
- Analysis of stall flutter of a helicopter rotor blade.
[AIAA PAPER 73-403] A73-25532
- Flutter of pairs of aerodynamically interfering delta wings.
[AIAA PAPER 73-314] A73-25545
- Active flutter suppression - B-52 controls configured vehicle.
[AIAA PAPER 73-322] A73-25552
- The theoretical and experimental methods used in France for flutter prediction.
[AIAA PAPER 73-329] A73-25558
- Flutter technology in the United Kingdom - A survey.
[AIAA PAPER 73-330] A73-25559
- The state of the art in aeroelasticity of aerospace vehicles in Japan.
[AIAA PAPER 73-331] A73-25560
- In-flight flutter testing methods for determining aircraft structure natural frequencies and vibration damping ratios with air flow
A73-26593
- FLY BY WIRE CONTROL**
Advanced flight control systems - Power-by-wire and fly-by-wire.
A73-26272
- FLYING PLATFORMS**
An-2R aircraft conversion to flying test bed for feasibility studies of jet engine use in agricultural aircraft, describing structural design modifications
A73-26823
- FOG**
Air Force heating system for fog dispersal
[AD-754900] N73-20675
Air Weather Service fog dispersal and weather modification program
[AD-755659] N73-21533
- FRACTURE MECHANICS**
Preliminary design of aircraft structures to meet structural integrity requirements.
[AIAA PAPER 73-374] A73-25506
- FRACTURE STRENGTH**
X2048, a high strength, high toughness alloy for aircraft applications.
[AIAA PAPER 73-385] A73-25514
- FREE ATMOSPHERE**
Russian monograph on turbulence in free atmosphere covering measurement and statistical techniques, tropospheric and stratospheric disturbances, wind pulsations, effects on aircraft flights, etc
A73-27134
- FREQUENCY ASSIGNMENT**
Factors affecting the frequency chosen for aircraft to satellite communications.
A73-27667
Satellite communication channels assignment to ships and aircraft, considering automated digital calling method for ship-to-shore communication
A73-27670
- FREQUENCY STABILITY**
Investigation of new elements and equipment configurations in stable-frequency, alternating-current, electrical power supply systems employing primary power plants consisting of engines with varying rotational speed
A73-26785
- FRETTING**
Fretting fatigue in titanium helicopter components.
A73-25837
- FRETTING CORROSION**
Ti alloy coating and surface treatment to prolong fatigue life by eliminating fretting damage, discussing design parameters selection, screening and strength tests and performance evaluation
A73-25838
- FRICTION DRAG**
Friction effect on lift of airfoil section with slotted flap
[DLR-FB-73-04] N73-21001
- FUEL COMBUSTION**
Gas turbine engine exhaust pollutants consisting of unburned hydrocarbons, nitric oxide, carbon dioxide, nitrogen dioxide and carbon monoxide.
A73-27934
Effect on nitric oxide emissions of using premixed prevaporized fuel/air in turbojet combustors
[NASA-TN-X-68220] N73-21862
- FUEL INJECTION**
Gas turbine nozzle geometry of two phase flow fuel injectors
[AD-754051] N73-20831
- FUEL PUMPS**
Some causes for the appearance of the 'extraneous noise' defect in transfer pumps of aircraft fuel systems.
A73-27094
- FUEL SYSTEMS**
Chemistry of deposits and their precursors in jet turbine fuel systems
[AD-754459] N73-20816
- FUEL TANKS**
Development of halogenated hydrocarbon materials for use as fire and ignition suppressants for aircraft fuel tanks subjected to incendiary ammunition
[AD-755362] N73-21079
- FUEL-AIR RATIO**
Effect on nitric oxide emissions of using premixed prevaporized fuel/air in turbojet combustors
[NASA-TN-X-68220] N73-21862
- FULL SCALE TESTS**
Buffeting pressures on a swept wing in transonic flight - Comparison of model and full scale measurements.
[AIAA PAPER 73-311] A73-25542
Phenomenological approach to low-cycle fatigue fracture of a typical aircraft full scale component static test.
[AIAA PAPER 73-324] A73-25554
- FUSELAGES**
Taylor series algorithms for computerized structural design and reanalysis of modified structures, applying to aircraft fuselage midsection
[AIAA PAPER 73-338] A73-25478
Contribution to the theory of the finite element method applied to the overall stress analysis of a fuselage.
A73-27084
- G**
- GAS DYNAMICS**
Application of gas dynamics equations to determine magnitude of pressure rise due to sonic boom in stratified atmosphere
[NASA-TN-D-7105] N73-20010
- GAS FLOW**
Supersonic gas flow past the leeward side of a conical wing
A73-26439
- GAS MIXTURES**
Effect on nitric oxide emissions of using premixed prevaporized fuel/air in turbojet combustors
[NASA-TN-X-68220] N73-21862
- GAS TURBINE ENGINES**
A reappraisal of design methods for inward flow radial gas turbines.
A73-26370
Gas-turbine processes with interrupted expansion and interrupted compression.
A73-26371
Turbine blades cooling effectiveness for engines gas temperature energy gain compensation
A73-27090

SUBJECT INDEX

HARMONIC OSCILLATION

- Influence of the turbine air cooling system on the characteristics of a turbojet engine during regulation of the latter
A73-27091
- Gas turbine engine exhaust pollutants consisting of unburned hydrocarbons, nitric oxide, carbon dioxide, nitrogen dioxide and carbon monoxide
A73-27934
- Effect of ovality of radial thrust bearing balls on axial vibration of rapidly rotating rotor of engine
[AD-754615] N73-20546
- Effect of inlet-air humidity on formation of oxides of nitrogen from a gas turbine combustor under various air inlet temperature conditions
[NASA-TN-X-68209] N73-21691
- GAS TURBINES**
Effects of prevaporized fuel on exhaust emissions of an experimental gas turbine combustor.
A73-26424
- A modern mechanical laboratory for the support of aircraft engine design
A73-27385
- Design and performance of advanced auxiliary power system for fighter aircraft
[AD-754903] N73-20049
- Chemistry of deposits and their precursors in jet turbine fuel systems
[AD-754459] N73-20816
- Gas turbine nozzle geometry of two phase flow fuel injectors
[AD-754051] N73-20831
- GASOLINE**
Alternate fuels to reduce aircraft exhaust pollutants
[AD-755151] N73-20815
- GEARS**
Reliability analysis of helicopter mechanical transmission components and reduction gearboxes
A73-26596
- GENERAL AVIATION AIRCRAFT**
General aviation requirements within National Aviation System, discussing basic services, facilities, federal spending and R and D
A73-27361
- Statistical analysis of aircraft accidents occurring in US civil aviation during calendar year 1971
[NTSB-BA-73-1] N73-20015
- Noise level surveys of seventeen general aviation aircraft including jet and propeller driven types
[FAA-EQ-73-1] N73-21063
- Measurement and analysis of aircraft noise generated by general aviation aircraft during level flyovers
[TR-S-212] N73-21081
- GERMANY**
History of German aeronautical development during the first half of the century
N73-20956
- Technical and scientific contributions of German aeronautical societies to aerospace sciences
N73-20957
- German cooperation with AGARD research in aerospace sciences
N73-20958
- German cooperation in international aeronautical research
N73-20959
- History and organization of German Society for Aerospace Research
N73-20961
- GLASS FIBERS**
Fabrication of L-1011 aircraft panels to compare costs and service performance characteristics of FRD-49 and fiberglass
[NASA-CR-112250] N73-20018
- GLIDE PATHS**
Display system for monitoring automatically controlled STOL landing glide paths, discussing computer controlled simulation
A73-25440
- Evaluation of glide paths for landing a VTOL airplane using linear regulator theory.
A73-27154
- GOVERNMENT/INDUSTRY RELATIONS**
An appraisal of the funding provisions of the Airport and Airways Development Act of 1970 to implement system improvements.
A73-27366
- Airport and Airway Development Act trust fund surplus, discussing expenditure policy determination and incentive plan provisions to expedite improvements
A73-27367
- GRAVITY WAVES**
On the estimation of the directional spectrum of surface gravity waves from a programmed aircraft altimeter.
A73-26347
- GROUND EFFECT MACHINES**
Control technology for air cushion passenger vehicle
N73-20969
- GROUND SPEED**
Utilization of the Doppler effect to measure the drift angle and the ground speed of an aircraft
A73-25797
- GROUND STATIONS**
The provision of ground station facilities for an aeronautical satellite system.
A73-27658
- Balloon-aircraft ranging, data, and voice experiment.
A73-27680
- GROUND SUPPORT EQUIPMENT**
Simple mathematical models of mechanical systems for ground support equipment, airborne launcher, vibration isolation design
[AD-754537] N73-20283
- GROUND-AIR-GROUND COMMUNICATIONS**
Satellite communication channels assignment to ships and aircraft, considering automated digital calling method for ship-to-shore communication
A73-27670
- Satellite communication systems for long haul air transport operations, discussing political, operational/technical and economic problems
A73-27671
- GUST ALLEVIATORS**
Analysis of gust alleviation system for short takeoff aircraft for improved performance under random turbulence conditions
[NASA-TN-D-7201] N73-20013
- GUST LOADS**
Analysis of gust alleviation system for short takeoff aircraft for improved performance under random turbulence conditions
[NASA-TN-D-7201] N73-20013
- Collection and processing of gust load data obtained from counting accelerometers mounted at center of gravity of various aircraft
[AGARD-R-605] N73-20023
- GYROSCOPES**
Parameters of single-axis floated gyroscopes when used in inertial systems requiring rapid gyrocompassing for alignment
N73-20709
- H**
- H-126 AIRCRAFT**
Wind tunnel tests to determine aerodynamic characteristics of full scale H-126 aircraft using jet flap principle
[NASA-TN-D-7252] N73-20997
- HALOGENS**
Development of haloogenated hydrocarbon materials for use as fire and ignition suppressants for aircraft fuel tanks subjected to incendiary ammunition
[AD-755362] N73-21079
- HARMONIC MOTION**
Influence of various aerodynamic forces on rectangular wing performance with harmonic movement parallel to sieve flow movement
N73-21043
- HARMONIC OSCILLATION**
Calculation of unsteady transonic aerodynamics for oscillating wings with thickness.
[AIAA PAPER 73-316] A73-25547

HEATING EQUIPMENT

SUBJECT INDEX

- Procedures for calculating velocity potential and pressure distribution of planforms oscillating harmonically in supersonic flow
[FOR-X-440] N73-19994
- HEATING EQUIPMENT**
Air Force heating system for fog dispersal
[AD-754900] N73-20675
- HELICOPTER CONTROL**
Flight tests of XH-51 helicopter to determine effects of gyroscope and control spring modifications on stability and control N73-21015
Effect of elastic flapping of rotor blades on stability and control of helicopter equipped with hingeless rotor system N73-21016
Flight characteristics and performance of Fenestron type helicopter tail rotor N73-21028
Evaluation of helicopter handling qualities based on ground-based piloted flight simulator tests N73-21030
Effect of rotary wing airfoil modifications on performance, stability, and control of helicopters N73-21045
- HELICOPTER DESIGN**
Noise control modification to HH-43B helicopter for 50 percent reduction in forward flight octave band sound pressure level signature A73-25383
Sensitivity of rotor blade vibration characteristics to torsional oscillations.
[AIAA PAPER 73-404] A73-25533
Twin-engined Anglo-French Lynx helicopter main rotor head, blade and drive train with conformal gearing, discussing design and material features A73-25790
Pretting fatigue in titanium helicopter components. A73-25837
Russian book on airplane and helicopter design and stability covering selection of wing/rotor/ configuration and power plant, subsystem design, strength, reliability, lifetime, etc A73-26256
Development program of medium range winged design helicopter, describing wing-fuselage structure, propulsion and power transmission systems and combustion, electrical and hydraulic plants A73-27383
Proceedings of conference on rotary wing aircraft developments to include operational experience, flight tests, and evaluation of structural concepts
[AGARD-CP-121] N73-21008
Flight tests of Westland Scout helicopter fitted with reduced scale version of rigid rotor to determine airworthiness and handling characteristics N73-21017
Survey of problems encountered in prediction of structural design loads and aeroelastic stability margins during development of rotary wing aircraft N73-21020
Aerodynamic characteristics of circulation controlled rotor and fundamental problems of stopped rotor aircraft N73-21024
Wind tunnel tests to determine effects of nonrotating components on helicopter performance and application for helicopter design optimization N73-21052
- HELICOPTER PERFORMANCE**
Reliability analysis of helicopter mechanical transmission components and reduction gearboxes A73-26596
Solid body on elastic supports as model for helicopter stability and nonlinear oscillations analysis A73-27791
Helicopter flight performance in tactical environment N73-21009
Analysis of procedures and problems involved in operating helicopters from decks of ships N73-21010
Operational performance of helicopters in French Army N73-21011
- Presentation of helicopter level flight performance as power coefficient compared with tip speed or advance ratio for range of thrust coefficients N73-21014
Flight tests of XH-51 helicopter to determine effects of gyroscope and control spring modifications on stability and control N73-21015
Effect of elastic flapping of rotor blades on stability and control of helicopter equipped with hingeless rotor system N73-21016
Discussion of speed record establishment by SA-341 helicopter to include aircraft preparation procedures and requirements for successful completion N73-21018
Analysis of factors inhibiting performance of rotary wing aircraft and mathematical models of rotary wing flow characteristics N73-21019
Flight characteristics and performance of Fenestron type helicopter tail rotor N73-21028
Evaluation of helicopter handling qualities based on ground-based piloted flight simulator tests N73-21030
Development of actuator disc theory for predicting time-averaged downwash distribution and response characteristics of helicopter rotors in forward flight N73-21033
Development of procedure for determining geometry and strength distribution of vortex wake generated by single-bladed hovering helicopter rotor N73-21035
Parameters for enhancing performance of helicopter rotors during stationary flight N73-21036
Improvements in basic rotary wing design and tests to determine effects on helicopter performance N73-21038
Analysis of unsteady aerodynamic environment of rotary wings and research projects to improve understanding of rotor unsteady airfoils N73-21041
Effect of rotary wing airfoil modifications on performance, stability, and control of helicopters N73-21045
Development of concept of circulation control applied to rotary wings to show effects on hover, transition, and high speed cruise performance N73-21050
- HELICOPTER PROPELLER DRIVE**
Analysis of parameters and elasto-hydrodynamic principles affecting lubrication of transmission components with application to helicopter mechanical drive systems
[NASA-TN-X-68215] N73-21069
- HELICOPTER WAKES**
Analytical and experimental techniques to define geometry of vortex field of hovering rotary wing and effect on rotor performance N73-21032
Development of actuator disc theory for predicting time-averaged downwash distribution and response characteristics of helicopter rotors in forward flight N73-21033
Development of procedure for determining geometry and strength distribution of vortex wake generated by single-bladed hovering helicopter rotor N73-21035
Analysis of unsteady aerodynamic loading on reference section of helicopter rotor blade in axial or hovering flight under compressible flow conditions N73-21044
Development of technique for rotor blade design and measurement of pressure distributions along the blade chord and across blade wake near rotor tip in flight N73-21047

SUBJECT INDEX

HYPERBOLIC NAVIGATION

- Analysis of aerodynamic noise produced by rotary wings and methods for noise reduction based on shed vortex wakes and blade tip modification
N73-21053
- HELICOPTERS**
- Prediction for a park of helicopters of the same type
A73-27077
- Application of equations of motion to develop analog computer simulation of helicopter rotor system
[AD-754547] N73-20024
- Numerical analysis of ideal and real gas equations for application to lift generated by helicopter rotors
[AD-754420] N73-20026
- Fatigue damage of helicopter rotary wing structures - bibliographies
[AD-754062] N73-20027
- Design of hydrofluidic flight control system for helicopter stabilization
[AD-754602] N73-20032
- Analysis of procedures and problems involved in operating helicopters from decks of ships
N73-21010
- Reliability and operational safety of mechanical helicopter transmission boxes
N73-21012
- Improvements in military helicopter flight test techniques to provide data for safety, maintainability, and reliability
N73-21013
- Aerodynamic, dynamic, and aeroelastic problems in rotary wing design for helicopters and V/STOL aircraft with application to hingeless rotor systems
N73-21051
- Analysis of helicopter internal and external noise levels for various flight conditions and timing of acoustical spectra
N73-21055
- Analysis of electrical charge generated by helicopter rotor operating near particulate matter with seeded vortex
[AD-755282] N73-21080
- True airspeed sensor for V/STOL aircraft with increased accuracy below 40 knots
[AD-755374] N73-21403
- HH-43 HELICOPTER**
- Noise control modification to HH-43B helicopter for 50 percent reduction in forward flight octave band sound pressure level signature
A73-25383
- HIGH SPEED**
- Discussion of speed record establishment by SA-341 helicopter to include aircraft preparation procedures and requirements for successful completion
N73-21018
- HIGH STRENGTH ALLOYS**
- I2048, a high strength, high toughness alloy for aircraft applications.
[AIAA PAPER 73-385] A73-25514
- HIGH TEMPERATURE TESTS**
- Method of life prediction for nickel-based Udimet alloy by high temperature creep/fatigue testing
[NASA-CR-120958] N73-21845
- HISTORIES**
- History of German aeronautical development during the first half of the century
N73-20956
- HOLOGRAPHY**
- The application of holography to sonic boom investigations.
A73-26633
- Temperature sensitivity of cfrp honey-comb structures under holographic ndt.
A73-27036
- HONEYCOMB STRUCTURES**
- Temperature sensitivity of cfrp honey-comb structures under holographic ndt.
A73-27036
- HOVERING**
- Analytical and experimental techniques to define geometry of vortex field of hovering rotary wing and effect on rotor performance
N73-21032
- Development of procedure for determining geometry and strength distribution of vortex wake generated by single-bladed hovering helicopter rotor
N73-21035
- Development of method for prediction of performance of heavily loaded propellers and rotors in steady hovering flight
N73-21040
- Development of pilot model parameters to provide data base for multiloop, single controller, multi-input analysis of aircraft performance
[AD-755367] N73-21078
- HOVERING STABILITY**
- Stability of elastic bending and torsion of uniform cantilevered rotor blades in hover.
[AIAA PAPER 73-405] A73-25534
- HUMAN FACTORS ENGINEERING**
- Radio Technical Commission for Aeronautics, Annual Assembly Meeting, Washington, D.C., November 9, 10, 1972, Proceedings.
A73-27360
- Comparative evaluation of cockpit displays considering human factors and aircraft control data
[NASA-TT-F-14846] N73-20019
- Application of normal bivariate distributions and anthropometric correlations for design of workspaces in aircraft
[AD-754780] N73-20468
- Proceedings of conference on research and development projects conducted by US Air Force Research and Development Command
[AD-753071] N73-21890
- HYDRAULIC CONTROL**
- Hydraulic powered integrated actuator package /IAP/ for V/STOL aircraft flight control, noting advantages in system weight, mechanical complexity and power loss reduction
A73-26271
- Problems in constructing aerodynamically active elements - Converters of input and output signals in automatic control systems
A73-26769
- Effects of trapped air on operation of aircraft hydraulic systems and methods for removing air contamination
[NLL-NEL-TT-2420-(6075.461)] N73-20005
- Design of hydrofluidic flight control system for helicopter stabilization
[AD-754602] N73-20032
- HYDRAULIC EQUIPMENT**
- Stress corrosion cracking and corrosion fatigue for hydraulic aluminum pressure cylinders used for landing gear, stabilizers and aircraft systems
A73-25827
- Numerical analysis of aircraft shock absorber operation to show initial charging, motion, and force parameters during static and dynamic compression of landing gear
[AD-754609] N73-20031
- HYDRAULIC FLUIDS**
- Effects of trapped air on operation of aircraft hydraulic systems and methods for removing air contamination
[NLL-NEL-TT-2420-(6075.461)] N73-20005
- HYDROCARBONS**
- Development of halogenated hydrocarbon materials for use as fire and ignition suppressants for aircraft fuel tanks subjected to incendiary ammunition
[AD-755362] N73-21079
- HYDRODYNAMICS**
- Hydrodynamic and chemical properties of stratospheric aircraft wake
[PB-213114] N73-20465
- HYDROPLANING**
- Performance tests to determine cornering characteristics of cantilever aircraft tire on dry, damp, and flooded runway surfaces over range of yaw angles
[NASA-TN-D-7203] N73-21058
- HYPERBOLIC NAVIGATION**
- Optimization of integrated navigation systems combining several independent navigation sensors to provide self-contained aircraft navigation capability
N73-20694

ICE FORMATION

- Airliner radomes erosion by atmospheric precipitation, water penetration, icing, bird and stone impact and lightning
A73-25297
- Instrumentation and data handling process of NAE T-33 turbulence research aircraft, stationary gas turbine icing problems, and role of plastic deformation in metal powder compaction [DHE/NAE-1972(4)]
N73-21882
- IDEAL FLUIDS**
Solid profile wing motion in ideal incompressible fluid at variable distance from screen in terms of small perturbation theory
A73-27815
- IL-62 AIRCRAFT**
Iliushin 62 aircraft horizontal stabilizer structural design and control, discussing mounting hardware and electrically driven servomechanism
A73-25795
- ILLUMINATION**
Cockpit instrument display systems visibility and reliability requirements, discussing various illumination methods in terms of power consumption, cost and human factors engineering
A73-26825
- IMAGERY**
Detection and identification of major airports in northeastern Kansas and northwestern Missouri [E73-10471]
N73-21308
- IMPACT LOADS**
Vibrations of an Euler beam with a system of discrete masses, springs, and dashpots.
A73-25788
- IMPACT TESTS**
Fatigue and impact tests on composite propeller blades made of glass- and carbon fiber reinforced plastics, noting comparison with measured vibratory strains
A73-26881
- IMPELLERS**
Design and fabrication of backswept impeller vane island diffuser, and advanced-concepts compressor rig [NASA-CR-120942]
N73-20531
- IN-FLIGHT MONITORING**
Display system for monitoring automatically controlled STOL landing glide paths, discussing computer controlled simulation
A73-25440
- In-flight flutter testing methods for determining aircraft structure natural frequencies and vibration damping ratios with air flow
A73-26593
- INCOMPRESSIBLE FLOW**
Development of method for solving three dimensional, incompressible laminar and turbulent boundary layer problems for swept infinite cylinders and small cross flow [AD-754440]
N73-20004
- INCOMPRESSIBLE FLUIDS**
Solid profile wing motion in ideal incompressible fluid at variable distance from screen in terms of small perturbation theory
A73-27815
- INDEPENDENT VARIABLES**
Practical quadratic optimal control for systems with large parameter variations.
A73-27166
- INDICATING INSTRUMENTS**
Digital flight director for precise aircraft control [AD-754028]
N73-20726
- INERTIAL NAVIGATION**
A new approach to Doppler-inertial navigation /Doppler Beam Sampling/.
A73-27162
- Research activities of electronic laboratory in development of inertial navigation systems to include applications for space missions and commercial aviation
N73-20686
- Optimization of integrated navigation systems combining several independent navigation sensors to provide self-contained aircraft navigation capability
N73-20694
- Contributions of quality inertial system to vehicle flight control
N73-20700
- Application of cluster rotation to improvement of existing platforms in strike aircraft
N73-20704
- Parameters of single-axis floated gyroscopes when used in inertial systems requiring rapid gyrocompassing for alignment
N73-20709
- A-7 aircraft airborne, ground, and shipboard inertial navigator alignment methodology
N73-20710
- Fault isolation and maintenance concepts of advanced inertial navigation system
N73-20713
- Life cycle cost analysis of inertial navigation systems for aircraft and air to surface missiles
N73-20717
- Development of navigation system design factors through computerized simulation for application to loran/inertial hybrid system [AD-754548]
N73-20731
- Analysis of equations of aircraft dynamics and development of analog-digital simulation capability [AD-755868]
N73-21077
- INFLUENCE COEFFICIENT**
Development and applications of supersonic unsteady consistent aerodynamics for interfering parallel wings. [AIAA PAPER 73-317]
A73-25548
- INFRARED ASTRONOMY**
Airborne IR 32 cm observatory, discussing atmospheric transmission and guiding methods to overcome aircraft instability effects
A73-26503
- INFRARED RADIATION**
Analysis of noise sources in jet aircraft based on measurement of infrared emission [NASA-TT-F-14851]
N73-20020
- INLET FLOW**
Performance characteristics of a model VTOL lift fan in crossflow.
A73-25782
- Researches on the two-dimensional retarded cascade. III - Cascade performances at high inlet angles.
A73-26338
- Effect of inlet-air humidity on formation of oxides of nitrogen from a gas turbine combustor under various air inlet temperature conditions [NASA-TM-X-68209]
N73-21691
- Effect of steady state circumferential total pressure distortion on loss in compressor-stall pressure ratio [NASA-CR-114577]
N73-21693
- INORGANIC MATERIALS**
Fabrication and physical, mechanical and electrical properties of inorganic composite material for aircraft radomes
A73-25288
- INSTRUMENT ERRORS**
Reduction of ILS errors caused by building reflections.
A73-25784
- INSTRUMENT LANDING SYSTEMS**
Reduction of ILS errors caused by building reflections.
A73-25784
- INTEGRAL EQUATIONS**
Higher order numerical solution of the integral equation for the two-dimensional Neumann problem.
A73-25434
- INTERNATIONAL COOPERATION**
German book - International air traffic conventions: Air piracy - Concept, facts, protective measures.
A73-25570
- German cooperation with AGARD research in aerospace sciences
N73-20958

SUBJECT INDEX

LASERS

- German cooperation in international aeronautical research N73-20959
- INTERNATIONAL LAW**
- German book - International air traffic conventions: Air piracy - Concept, facts, protective measures. A73-25570
- German book on national airspace protection against foreign aircraft intrusion in peacetime covering sovereign rights according to international law, conventions and treaties A73-26257
- Regularization of the legal status of international air charter services. A73-26349
- INVISCID FLOW**
- Calculation of unsteady transonic aerodynamics for oscillating wings with thickness. [AIAA PAPER 73-316] A73-25547
- J-52 ENGINE**
- Performance tests on J-52 turbojet engines to determine acceptable compressor stall margin [AD-755152] N73-20832
- J-75 ENGINE**
- Adverse effect of film cooling on suction surface of turbine blade [NASA-TN-X-68210] N73-21695
- JET AIRCRAFT**
- Criteria on jet blast velocities and effects during operation of commercial aircraft and recommended procedures to reduce adverse impact [AC-150/5325-6A] N73-20271
- Flight investigation to determine velocity and persistence characteristics of trailing vortices generated by jumbo jet transport [NASA-TN-D-7172] N73-21068
- JET AIRCRAFT NOISE**
- Acoustic and fluid dynamic tests of multilobed discharge silencers scale models, noting optimum jet noise attenuation configuration A73-27390
- Analysis of noise sources in jet aircraft based on measurement of infrared emission [NASA-TT-F-14851] N73-20020
- Research facility for studying noise generated by bluff body flow interaction inside ducted fuel combustion system [AD-754094] N73-20286
- Reduction of jet engine noise due to turbulent mixing of exhaust gases with ambient atmosphere [NASA-CASE-ARC-10712-1] N73-20826
- Analysis of common aircraft noise measures in terms of selected human response for jet transport aircraft [FAA-RD-71-112] N73-21074
- JET BLAST EFFECTS**
- Criteria on jet blast velocities and effects during operation of commercial aircraft and recommended procedures to reduce adverse impact [AC-150/5325-6A] N73-20271
- JET ENGINE FUELS**
- Chemistry of deposits and their precursors in jet turbine fuel systems [AD-754459] N73-20816
- JET ENGINES**
- Aerodynamic characteristics of torus shaped cascades involved in flame stabilization process of reheat devices for jet engines A73-26595
- An-2R aircraft conversion to flying test bed for feasibility studies of jet engine use in agricultural aircraft, describing structural design modifications A73-26823
- Aerodynamic performance of core-engine turbine stator vane tested in two-dimensional cascade of 10 vanes and in single-vane tunnel [NASA-TN-X-2766] N73-20823
- Analysis of acoustic properties of jet engine malfunction as means for detecting jet engine burnthrough - Vol. 1 [FAA-RD-72-149-VOL-1] N73-20825
- Analysis formation of carbon deposits on jet engines and effect on reliability, efficiency, and service life [AD-754607] N73-20837
- JET EXHAUST**
- Criteria on jet blast velocities and effects during operation of commercial aircraft and recommended procedures to reduce adverse impact [AC-150/5325-6A] N73-20271
- JET FLAPS**
- A comparative study of augmentor wing, ejector nozzle and power jet flap low noise STOL concepts. A73-25385
- A note on the lift coefficient of a thin jet-flapped airfoil. A73-27171
- Wind tunnel tests to determine aerodynamic characteristics of full scale H-126 aircraft using jet flap principle [NASA-TN-D-7252] N73-20997
- Development of jet-flap rotor and application to heavy helicopter and stoppable rotor designs N73-21025
- JET FLOW**
- Flow and acoustic characteristics determined for subsonic and supersonic jets and supersonic suppressors [NASA-CR-131297] N73-20006
- Analysis of transition region of subsonic turbulent jets to determine noise producing potential based on far field acoustic density [NASA-TN-D-7242] N73-21573
- K**
- KALMAN-SCHMIDT FILTERING**
- Application of lorán/inertial hybrid system and Kalman filter algorithm to fixed feedback gain N73-20701
- KANSAS**
- Detection and identification of major airports in northeastern Kansas and northwestern Missouri [E73-10471] N73-21308
- L**
- L-1011 AIRCRAFT**
- Fabrication of L-1011 aircraft panels to compare costs and service performance characteristics of FRD-49 and fiberglass [NASA-CR-112250] N73-20018
- LABORATORY EQUIPMENT**
- A modern mechanical laboratory for the support of aircraft engine design A73-27385
- LAND USE**
- Analysis of technical and economic feasibility of constructing offshore airport in New York Metropolitan area [FAA-RD-73-45] N73-20280
- LANDING AIDS**
- Analysis of electromagnetic compatibility of microwave landing guidance system and candidate interim systems [ECAC-PR-72-069] N73-21554
- LANDING GEAR**
- Numerical analysis of aircraft shock absorber operation to show initial charging, motion, and force parameters during static and dynamic compression of landing gear [AD-754609] N73-20031
- Performance tests to determine cornering characteristics of cantilever aircraft tire on dry, damp, and flooded runway surfaces over range of yaw angles [NASA-TN-D-7203] N73-21058
- LASER ALTIMETERS**
- On the estimation of the directional spectrum of surface gravity waves from a programmed aircraft altimeter. A73-26347
- LASERS**
- Proceedings of conference on research and development projects conducted by US Air Force Research and Development Command [AD-753071] N73-21890

LEADING EDGES

SUBJECT INDEX

LEADING EDGES

- Nonstationary flow downwash behind a delta wing during supersonic motion A73-25046
- Vibration and local edge buckling of thermally stressed, wedge airfoil cantilever wings. [AIAA PAPER 73-327] A73-25557
- Turbulent heat transfer to a fin leading edge - Flight test results. A73-26405
- Supersonic flow around a delta wing, taking into account flow separation at the leading edges A73-27098
- Turbulent heat transfer and pressure on leading edge of fin, swept wing, or antenna [SCL-RR-72-0308] N73-21863
- LEE WAVES**
- Mountain waves and CAT encountered by the XB-70 in the stratosphere. A73-25785
- LIFE (DURABILITY)**
- Method of life prediction for nickel-based Udimet alloy by high temperature creep/fatigue testing [NASA-CR-120958] N73-21845
- LIFE SUPPORT SYSTEMS**
- Proceedings of conference on research and development projects conducted by US Air Force Research and Development Command [AD-753071] N73-21890
- LIFT**
- A linearized potential flow theory for airfoils with spoilers. A73-25853
- Correction for change in fluid flow curvature about a lift-generating airfoil in a two-dimensional test section with perforated walls A73-25864
- A note on the lift coefficient of a thin jet-flapped airfoil. A73-27171
- Lift and drag at off-design Mach numbers of conically cambered wings with subsonic leading edges and supersonic trailing edge A73-27927
- Numerical analysis of ideal and real gas equations for application to lift generated by helicopter rotors [AD-754420] N73-20026
- Analysis of optimum pressure distribution on multi-element airfoils to obtain conditions for maximum lift coefficient N73-20996
- Friction effect on lift of airfoil section with slotted flap [DLR-PB-73-04] N73-21001
- LIFT AUGMENTATION**
- A comparative study of augmentor wing, ejector nozzle and power jet flap low noise STOL concepts. A73-25385
- Analysis of the aerodynamic characteristics of wing-lift augmentation devices. II. A73-25796
- Analysis of the aerodynamic characteristics of wing lift augmentation devices A73-26824
- Augmentor wing design and performance tests for multimission XFV-12 V/STOL prototype aircraft A73-27731
- Wind tunnel tests to determine aerodynamic characteristics of full scale H-126 aircraft using jet flap principle [NASA-TM-D-7252] N73-20997
- LIFT DEVICES**
- The theoretical and experimental methods used in France for flutter prediction. [AIAA PAPER 73-329] A73-25558
- Analysis of the aerodynamic characteristics of wing lift augmentation devices A73-26824
- LIFT FANS**
- Performance characteristics of a model VTOL lift fan in crossflow. A73-25782
- Wind tunnel tests to determine low speed aerodynamic characteristics of large scale V/STOL transport models with lift fan lift-cruise fan propulsion system [NASA-TM-X-62231] N73-20014
- Design of V/STOL research transport aircraft to achieve low fan noise with high thrust/weight capability of high pressure ratio lift fan system [NASA-CR-121146] N73-21065
- LIFTING BODIES**
- The theoretical and experimental methods used in France for flutter prediction. [AIAA PAPER 73-329] A73-25558
- Gust field generation in wind tunnel for determining transfer function of lifting surface A73-21248
- LIFTING ROTORS**
- Application of momentum theory to determine performance limits of propellers, and lifting rotors with axes parallel to undisturbed flow [AD-754072] N73-20025
- LIGHT AIRCRAFT**
- Light motorized glider-type aircraft design, development and flight testing, discussing aerodynamic configuration, structural design and performance characteristics A73-27732
- LIGHTNING**
- Study on the limit efficiency of lightning conductors on aircraft radomes. A73-25303
- Electrostatic charge induction on aircraft due to charged atmosphere and friction effects, noting lightning protection, fuel container shielding and charge removal methods A73-26722
- Probability of aircraft being struck by lightning [NLL-M-22800-(5828.4P)] N73-20656
- LOADING OPERATIONS**
- Airport computerized departure control for check-in, load control, cargo and catering operations, discussing load optimization and passenger acceptance control /LOPAC/ system A73-25210
- LOGIC CIRCUITS**
- Microprogrammed digital filters for strapdown guidance application. A73-27168
- LOGISTICS**
- Development and characteristics of dual cargo hook system for use on military transport helicopters N73-21022
- LONG ISLAND (NY)**
- Analysis of technical and economic feasibility of constructing offshore airport in New York Metropolitan area [FAA-RD-73-45] N73-20280
- LONGITUDINAL STABILITY**
- Flight test of X-22 aircraft to determine longitudinal stability requirements of short takeoff aircraft during terminal area operations [AD-754840] N73-20029
- LOREAN**
- Application of loran/inertial hybrid system and Kalman filter algorithm to fixed feedback gain N73-20701
- Development of navigation system design factors through computerized simulation for application to loran/inertial hybrid system [AD-754548] N73-20731
- LOW FREQUENCIES**
- Analysis of improved signal processing techniques for low frequency, one-way ranging for aircraft radio navigation [AD-754031] N73-20727
- LOW SPEED WIND TUNNELS**
- Wind tunnel tests to determine low speed aerodynamic characteristics of large scale V/STOL transport models with lift fan lift-cruise fan propulsion system [NASA-TM-X-62231] N73-20014
- LUBRICATING OILS**
- Spectroscopic, photometric, and electron microscope analyses of metal wear particles in JT3D turbojet engine oil [DLR-PB-73-06] N73-21417
- LUBRICATION**
- Analysis of parameters and elasto-hydrodynamic principles affecting lubrication of transmission components with application to helicopter mechanical drive systems [NASA-TM-X-68215] N73-21069

M

- MACH NUMBER**
Lift and drag at off-design Mach numbers of conically cambered wings with subsonic leading edges and supersonic trailing edge A73-27927
- MAINTENANCE**
Fault isolation and maintenance concepts of advanced inertial navigation system N73-20713
- MAJUNCTIONS**
On the improvement in survivability for avionics equipment. A73-27158
Analysis of acoustic properties of jet engine malfunction as means for detecting jet engine burnthrough - Vol. 1 [FAA-RD-72-149-VOL-1] N73-20825
- MAN MACHINE SYSTEMS**
Proceedings of conference on manual control to show interplay between man and machine and application of control theory in medicine and psychology [NASA-CR-131244] N73-20028
- MANAGEMENT PLANNING**
Research and development projects conducted by Federal Aviation Administration to improve air traffic control and flight safety [FAA-EH-73-2] N73-20720
Management models for large research institute considering aerospace sciences N73-20968
- MANUALS**
Electromagnetic compatibility of avionic weapon system [AD-754412] N73-20262
Manual on electromagnetic compatibility and interference between aircraft weapon systems [AD-754411] N73-20263
- MATERIALS HANDLING**
Development and characteristics of dual cargo hook system for use on military transport helicopters N73-21022
- MATHEMATICAL MODELS**
Methodologies for the analysis of transport requirements with particular regard to the aeronautic case A73-27070
Simple mathematical models of mechanical systems for ground support equipment, airborne launcher, vibration isolation design [AD-754537] N73-20283
Comparisons between analog and numerical methods for studying response of an aircraft [PUBL-97] N73-21007
- MATRIX METHODS**
Aeroelastic structural weight optimization under strength and flutter constraints, using finite element and displacement methods to describe equations of motion in matrix form [AIAA PAPER 73-389] A73-25518
Contribution to the theory of the finite element method applied to the overall stress analysis of a fuselage A73-27084
- MAXIMUM LIKELIHOOD ESTIMATES**
Application of maximum likelihood criterion and optimal input design for analyzing flight test data to obtain aircraft stability and control derivatives [NASA-CR-2200] N73-21071
- MECHANICAL DRIVES**
Twin-engine Anglo-French Lynx helicopter main rotor head, blade and drive train with conformal gearing, discussing design and material features A73-25790
Reliability analysis of helicopter mechanical transmission components and reduction gearboxes A73-26596
Reliability and operational safety of mechanical helicopter transmission boxes N73-21012
Analysis of parameters and elasto-hydrodynamic principles affecting lubrication of transmission components with application to helicopter mechanical drive systems [NASA-TM-X-68215] N73-21069
- MECHANICAL PROPERTIES**
Fabrication and physical, mechanical and electrical properties of inorganic composite material for aircraft radomes A73-25288
Technique for determining mechanical properties of full-size aircraft tires from tests conducted with small-scale model tires [NASA-CR-2220] N73-21006
- METAL FATIGUE**
Varying-temperature test installation for the interior design of the Concorde A73-25103
Phenomenological approach to low-cycle fatigue fracture of a typical aircraft full scale component static test. [AIAA PAPER 73-324] A73-25554
Aerospace component failure due to corrosion fatigue in aluminum wing attachment spar, helicopter rotor blade, landing gear cylinder and engine bearings A73-25803
Aircraft structures aluminum alloys fatigue crack growth rate relationship to cracking mode, stress ratio, cyclic frequency and corrosive environment severity A73-25826
Stress corrosion cracking and corrosion fatigue for hydraulic aluminum pressure cylinders used for landing gear, stabilizers and aircraft systems A73-25827
Fretting fatigue in titanium helicopter components. A73-25837
Certain fatigue phenomena in aeronautical structures with stiffened shells A73-27394
- METAL MATRIX COMPOSITES**
Design and manufacture of structure components made of fiber-reinforced materials A73-25417
- METAL PARTICLES**
Spectroscopic, photometric, and electron microscope analyses of metal wear particles in JT3D turbojet engine oil [DLR-FB-73-06] N73-21417
- METEOROLOGICAL SERVICES**
Research and development projects of Federal Aviation Administration to provide improved weather data acquisition and distribution [FAA-ED-15-1] N73-20662
- MICROPROGRAMMING**
Microprogrammed digital filters for strapdown guidance application. A73-27168
- MICROWAVE ANTENNAS**
The disc antenna - A possible L-band aircraft antenna. A73-27655
- MICROWAVE EQUIPMENT**
Analysis of electromagnetic compatibility of microwave landing guidance system and candidate interim systems [ECAC-PR-72-069] N73-21554
- MICROWAVE FILTERS**
Potential applications of acoustic matched filters to air-traffic control systems. A73-27572
- MICROWAVE SCATTERING**
Reduction of ILS errors caused by building reflections. A73-25784
- MILITARY AIRCRAFT**
Augmentor wing design and performance tests for multi-mission XPV-42 V/SPOI prototype aircraft A73-27731
Application of loran/inertial hybrid system and Kalman filter algorithm to fixed feedback gain N73-20701
Development of navigation system design factors through computerized simulation for application to loran/inertial hybrid system [AD-754548] N73-20731
- MILITARY HELICOPTERS**
Development and characteristics of dual cargo hook system for use on military transport helicopters N73-21022
- MILITARY TECHNOLOGY**
Air Force heating system for fog dispersal [AD-754900] N73-20675

MISSILE STRUCTURES

SUBJECT INDEX

Atmospheric density extremes up to 15,000 feet for design of military aircraft
 [AD-755791] N73-21382
 Air Weather Service fog dispersal and weather modification program
 [AD-755659] N73-21533
MISSILE STRUCTURES
 Test rails possibilities for rain erosion phenomena study on aircraft or missile structures
 A73-25296

MISSOURI
 Detection and identification of major airports in northeastern Kansas and northwestern Missouri
 [E73-10471] N73-21308

MODAL RESPONSE
 Parallel-redundant flight control systems, discussing sensor bias and combined control computer input effects on controllability and steady state modal response
 A73-25783

MONOPOLE ANTENNAS
 First order effects of terrain on the radiation pattern of a non-directional LP beacon.
 A73-26204
 Flush mountable elliptically polarized low silhouette blade antenna for aircraft, describing polarization and radiation characteristics
 A73-27043

MONOPULSE RADAR
 Signal processing in the Air Traffic Control Radar Beacon System.
 A73-27165

MOUNTAINS
 Mountain waves and CAT encountered by the XB-70 in the stratosphere.
 A73-25785

MULTIPATH TRANSMISSION
 First order effects of terrain on the radiation pattern of a non-directional LP beacon.
 A73-26204

N

NATIONAL AVIATION SYSTEM
 Status of funded improvements to the National Aviation System and planned improvements not yet funded.
 A73-27363

Improvements in the use of FAA resources for system performance assurance.
 A73-27364

National aviation system improvement via cost effectiveness, considering FAA facilities and equipment program, ATC automation and terminal aids
 A73-27365

NAVIGATION AIDS
 Digital flight director for precise aircraft control
 [AD-754028] N73-20726

NAVIGATION INSTRUMENTS
 Development and evaluation of discrete address beacon system for air traffic control applications
 [FAA-RD-73-12] N73-20184
 Optimization of integrated navigation systems combining several independent navigation sensors to provide self-contained aircraft navigation capability
 N73-20694

NETHERLANDS
 Organization, management, and research activities at National Institute for Aerospace Research of the Netherlands
 N73-20960

NEUMANN PROBLEM
 Higher order numerical solution of the integral equation for the two-dimensional Neumann problem.
 A73-25434

NICKEL ALLOYS
 Method of life prediction for nickel-based Udimet alloy by high temperature creep/fatigue testing
 [NASA-CR-120958] N73-21845

NITRIC OXIDE
 Effect on nitric oxide emissions of using premixed prevaporized fuel/air in turbojet combustors
 [NASA-TM-X-68220] N73-21862

NITROGEN OXIDES
 Effect of inlet-air humidity on formation of oxides of nitrogen from a gas turbine combustor under various air inlet temperature conditions
 [NASA-TM-X-68209] N73-21691

NOISE GENERATORS
 Design of noise source for simulating supersonic spinning modes in duct acoustics
 [NASA-CR-2260] N73-21067

NOISE INTENSITY
 Noise intensity in the field of subsonic turbulent jets
 A73-25738

Variations in the sound field of a STOL aircraft as a function of wing-flap deflection
 A73-26592

Analysis of helicopter internal and external noise levels for various flight conditions and timing of acoustical spectra
 N73-21055

Analysis of common aircraft noise measures in terms of selected human response for jet transport aircraft
 [FAA-RD-71-112] N73-21074

Measurement and analysis of aircraft noise generated by general aviation aircraft during level flyovers
 [TR-S-212] N73-21081

NOISE POLLUTION
 Acoustic measurement methods for evaluating aircraft noise pollution in urban areas
 [PB-212875] N73-20757

Control of transportation noise pollution
 [PB-213007] N73-20758

Guidelines for urban control of aircraft noise pollution
 [PB-213020] N73-20759

NOISE REDUCTION
 Synthesis of helicopter rotor tips for less noise.
 A73-24981

A single number rating for effective noise reduction.
 A73-25000

Noise control modification to HH-43B helicopter for 50 percent reduction in forward flight octave band sound pressure level signature
 A73-25383

Noise reduction for subsonic fluid flow over flat plate via interposition of secondary fluid layer at trailing edge
 A73-25386

Airport noise control and minimization for community and airline industry interests by technology application and legal-political approaches
 A73-26350

Theory of sound scattering by turbulence applied to scattering cross section calculation for turbulent jet flow and wind, discussing jet noise reduction
 A73-26496

Acoustic and fluid dynamic tests of multilobed discharge silencers scale models, noting optimum jet noise attenuation configuration
 A73-27390

Analysis of basic acoustic characteristics and noise reduction potential of upper surface of blown flap
 [NASA-CR-112246] N73-20017

Control of transportation noise pollution
 [PB-213007] N73-20758

Reduction of jet engine noise due to turbulent mixing of exhaust gases with ambient atmosphere
 [NASA-CASE-ARC-10712-1] N73-20826

Analysis of aerodynamic noise produced by rotary wings and methods for noise reduction based on shed vortex wakes and blade tip modification
 N73-21053

Shrouded divergent body attached to exhaust nozzle for jet noise suppression
 [NASA-CASE-LEW-11286-1] N73-21066

Design and aerodynamic performance of low speed fan stage for low noise turboengine
 [NASA-CR-121148] N73-21070

NOISE SPECTRA
 Analysis of helicopter internal and external noise levels for various flight conditions and timing of acoustical spectra
 N73-21055

SUBJECT INDEX

PERFORMANCE PREDICTION

Noise spectrum characteristics and directivity patterns for rotary wings as function of blade tip speed, total rotor thrust, and angle of rotor disc plane
N73-21056

NONDESTRUCTIVE TESTS
Non-destructive testing of adhesive bonding.
A73-26299
Temperature sensitivity of cfrp honey-comb structures under holographic ndt.
A73-27036

NONFLAMMABLE MATERIALS
Recent developments in commercial fire resistant fibrous materials.
A73-26419

NONLINEAR SYSTEMS
Solid body on elastic supports as model for helicopter stability and nonlinear oscillations analysis
A73-27791

NOZZLE FLOW
Wind tunnel tests to determine effects of nozzle geometry and upper surface blowing on aerodynamic characteristics of 14 percent thick airfoil
[NASA-CR-114560]
N73-19998

NOZZLE GEOMETRY
Gas turbine nozzle geometry of two phase flow fuel injectors
[AD-754051]
N73-20831

NOZZLE THRUST COEFFICIENTS
Experimental tests on scale models of conical variable geometry propulsion nozzle with short petals for fighter aircraft, discussing aerodynamic and thrust coefficients
A73-27388

NUMERICAL CONTROL
Airport computerized departure control for check-in, load control, cargo and catering operations, discussing load optimization and passenger acceptance control /LOPAC/ system
A73-25210

OCEAN SURFACE
On the estimation of the directional spectrum of surface gravity waves from a programmed aircraft altimeter.
A73-26347

OH-13 HELICOPTER
Three component wake velocity measurements of full scale OH-13 helicopter rotary wing during hovering flight
[AD-754644]
N73-20030

OPERATIONS RESEARCH
Development of statistical methods for estimating annual operations at non-tower airports and establishment of standardized estimation procedure
[SCI-2040]
N73-20278
Development of procedures for accurately estimating annual air traffic levels at airports without tower control
[SCI-2-2040]
N73-20722

OPTIMAL CONTROL
An optimal control approach to terminal area air traffic control.
A73-25786
Practical quadratic optimal control for systems with large parameter variations.
A73-27166
Response-optimum control of the angular and torsional oscillations of an elastic flying wing.
A73-27459

OPTIMIZATION
Application of computer-aided aircraft design in a multidisciplinary environment.
[AIAA PAPER 73-353]
A73-25490
Aeroelastic structural weight optimization under strength and flutter constraints, using finite element and displacement methods to describe equations of motion in matrix form
[AIAA PAPER 73-389]
A73-25518
Gradient optimization of structural weight for specified flutter speed.
[AIAA PAPER 73-390]
A73-25519

Numerical procedure for determining optimal member sizes of aircraft structural components with weight minimization and flutter speed lower bound
[AIAA PAPER 73-391]
A73-25520
Eigenvalue problem and stiffness optimization procedure for incremental flutter analysis, describing method use in computer graphics mode
[AIAA PAPER 73-392]
A73-25521
Optimization of aircraft structures with multiple stiffness requirements.
A73-26298
Analysis of the operational parameters of a bypass turbojet
A73-27069
Aircraft design parameters optimization based on criterial function representing overall deviation for specifications with application to subsonic passenger aircraft
A73-27095
Aerospace systems evaluation and optimization via systems analysis, discussing capability, dependability and availability and cost
A73-27384

OZONE
Stratospheric photochemical reactions of ozone in relation to climatology and supersonic transport pollution
[NOAA-TM-NESS-47]
N73-21526

P

PANELS
Fabrication of L-1011 aircraft panels to compare costs and service performance characteristics of PRD-49 and fiberglass
[NASA-CR-112250]
N73-20018

PARAWINGS
Parawing-drag chute system operation on wind shear energy to maintain payload flight altitude
A73-25787
Application of parafoil equations of motion to predict flight performance of powered parafoil flight vehicle
[AD-754907]
N73-20034

PASSENGER AIRCRAFT
Airliner radomes erosion by atmospheric precipitation, water penetration, icing, bird and stone impact and lightning
A73-25297
Aircraft design parameters optimization based on criterial function representing overall deviation for specifications with application to subsonic passenger aircraft
A73-27095
Design of perforated tube uniform distribution of fire extinguishing agent into commercial air transport compartments
[FAA-NA-73-3]
N73-20009

PASSENGERS
Dusseldorf airport passenger terminal facilities project, considering handling capacity, building and wide bodied jet traffic requirements
A73-25206

PAYLOADS
Parawing-drag chute system operation on wind shear energy to maintain payload flight altitude
A73-25787

PERFORMANCE
Influence of various aerodynamic forces on rectangular wing performance with harmonic movement parallel to sieve flow movement
N73-21043

PERFORMANCE PREDICTION
Application of parafoil equations of motion to predict flight performance of powered parafoil flight vehicle
[AD-754907]
N73-20034
Technique for determining mechanical properties of full-size aircraft tires from tests conducted with small-scale model tires
[NASA-CR-2220]
N73-21006
Analysis of factors inhibiting performance of rotary wing aircraft and mathematical models of rotary wing flow characteristics
N73-21019
Development of method for predicting performance of heavily loaded propellers and rotors in steady hovering flight
N73-21040

PERFORMANCE TESTS

SUBJECT INDEX

- Development of algorithm for calculating inviscid flow about arbitrary planform rotors and application to analyzing various rotary wing configurations
N73-21048
- Effect of steady state circumferential total pressure distortion on loss in compressor stall pressure ratio
[NASA-CR-114577]
N73-21693
- PERFORMANCE TESTS**
- Ti alloy coating and surface treatment to prolong fatigue life by eliminating fretting damage, discussing design parameters selection, screening and strength tests and performance evaluation
N73-25838
- Performance tests of low-pressure-ratio centrifugal compressor with four different diffuser configurations
[NASA-TN-D-7237]
N73-19997
- Comparison tests of strobe and incandescent beacons to determine suitability as replacement for standard rotating airport beacon
[FAA-NA-73-1]
N73-20182
- Performance tests on J-52 turbojet engines to determine acceptable compressor stall margin
[AD-755152]
N73-20832
- Evaluation of helicopter handling qualities based on ground-based piloted flight simulator tests
N73-21030
- Analysis of effect of grooved runway configurations on aircraft tire braking traction on flooded runway surfaces
[NASA-TN-D-7245]
N73-21057
- PERSONNEL MANAGEMENT**
- Airline pilots problems in terms of job security, working conditions, management relations, public relations, flight safety due to noise abatement rules, etc
N73-27599
- PERTURBATION THEORY**
- Solid profile wing motion in ideal incompressible fluid at variable distance from screen in terms of small perturbation theory
N73-27845
- PHOTOCHEMICAL REACTIONS**
- Stratospheric photochemical reactions of ozone in relation to climatology and supersonic transport pollution
[NOAA-TN-NESS-47]
N73-21526
- PILOT PERFORMANCE**
- Development of pilot model parameters to provide data base for multiloop, single controller, multi-input analysis of aircraft performance
[AD-755367]
N73-21078
- PILOT TRAINING**
- Development and use of synthetic flight trainers based on degree and fidelity of simulation as key design considerations
[AD-754957]
N73-21260
- PITCH (INCLINATION)**
- Aircraft and spacecraft hand controllers for yaw, pitch, and roll
[NASA-CASE-MSC-12394-1]
N73-20041
- PLANFORMS**
- Procedures for calculating velocity potential and pressure distribution of planforms oscillating harmonically in supersonic flow
[FOK-Y-440]
N73-19994
- Development of algorithm for calculating inviscid flow about arbitrary planform rotors and application to analyzing various rotary wing configurations
N73-21048
- PLASTIC DEFORMATION**
- Instrumentation and data handling process of NAE T-33 turbulence research aircraft, stationary gas turbine icing problems, and role of plastic deformation in metal powder compaction
[DHE/NAE-1972(4)]
N73-21882
- PLATE THEORY**
- Creep analysis of a thin-walled wing on the basis of the plate analogy
N73-27086
- PNEUMATIC CONTROL**
- Problems in constructing aerodynamically active elements - Converters of input and output signals in automatic control systems
N73-26769
- POLYBENZIMIDAZOLE**
- Thermal resistance and aging properties of polybenzimidazoles, polyimides and polyamides-imides used for Mach 3 aircraft radomes
N73-25291
- POLYIMIDE RESINS**
- Thermal resistance and aging properties of polybenzimidazoles, polyimides and polyamides-imides used for Mach 3 aircraft radomes
N73-25291
- POSITION INDICATORS**
- Doppler compensated communication system for locating supersonic transport position
[NASA-CASE-GSC-10087-4]
N73-20174
- POTENTIAL FLOW**
- Potential flow past axisymmetric ring wing profiles via singularity method, applying source and vortex distributions to curved thick profiles
N73-25348
- Higher order numerical solution of the integral equation for the two-dimensional Neumann problem.
N73-25434
- Unsteady subsonic compressible flow around finite thickness wings.
[AIAA PAPER 73-313]
N73-25544
- A linearized potential flow theory for airfoils with spoilers.
N73-25853
- Aerodynamics of wake vortices.
N73-26385
- POWDER METALLURGY**
- Instrumentation and data handling process of NAE T-33 turbulence research aircraft, stationary gas turbine icing problems, and role of plastic deformation in metal powder compaction
[DHE/NAE-1972(4)]
N73-21882
- PRESSURE CHAMBERS**
- Stress corrosion cracking and corrosion fatigue for hydraulic aluminum pressure cylinders used for landing gear, stabilizers and aircraft systems
N73-25827
- PRESSURE DISTRIBUTION**
- An exploratory investigation of the unsteady aerodynamic response of a two-dimensional airfoil at high reduced frequency.
[AIAA PAPER 73-309]
N73-25540
- Buffeting pressures on a swept wing in transonic flight - Comparison of model and full scale measurements.
[AIAA PAPER 73-311]
N73-25542
- Procedures for calculating velocity potential and pressure distribution of planforms oscillating harmonically in supersonic flow
[FOK-Y-440]
N73-19994
- Method for computing lifting pressure distribution on wing with partial span, swept control surfaces
[NASA-TN-D-7251]
N73-19999
- Design of airfoil sections for low Reynolds numbers based on requirement to achieve transition upstream of major adverse pressure gradient
N73-20995
- Analysis of optimum pressure distribution on multi-element airfoils to obtain conditions for maximum lift coefficient
N73-20996
- Scale effect on swept wings at subsonic speed on basis of pressure distribution measured in flight and on wind tunnel super VC 10 model
[ARC-R/M-3707]
N73-20999
- PRESSURE GRADIENTS**
- Application of gas dynamics equations to determine magnitude of pressure rise due to sonic boom in stratified atmosphere
[NASA-TN-D-7105]
N73-20010
- PRESSURE MEASUREMENTS**
- The theoretical and experimental methods used in France for flutter prediction.
[AIAA PAPER 73-329]
N73-25558
- PRODUCTION ENGINEERING**
- Reliability and quality control of production engineering computer programs.
[AIAA PAPER 73-356]
N73-25493
- PROPELLER BLADES**
- Fatigue and impact tests on composite propeller blades made of glass- and carbon fiber reinforced plastics, noting comparison with measured vibratory strains
N73-26881

SUBJECT INDEX

RADOME MATERIALS

- Deformation equations of a propeller blade and the orthogonality characteristics of its normal mode shapes of vibration
A73-27085
- PROPELLERS**
Analysis of whirl stability boundaries and aerodynamic characteristics of tilting rotors
N73-21004
- PROPULSION SYSTEM CONFIGURATIONS**
Development program of medium range winged design helicopter, describing wing-fuselage structure, propulsion and power transmission systems and combustion, electrical and hydraulic plants
A73-27383
- Analysis of integrated airframe and engine configuration for hypersonic transport at 70,000 feet altitude and Mach 6.0
[NASA-CR-112300]
N73-20022
- Bibliography of supersonic transport aircraft data to include program management, systems engineering, aircraft structures, and operational considerations
[AD-755600]
N73-21076
- PROPULSION SYSTEM PERFORMANCE**
Analysis of the operational parameters of a bypass turbojet
A73-27069
- Influence of the turbine air cooling system on the characteristics of a turbojet engine during regulation of the latter
A73-27091
- PROTECTIVE COATINGS**
Ti alloy coating and surface treatment to prolong fatigue life by eliminating fretting damage, discussing design parameters selection, screening and strength tests and performance evaluation
A73-25838
- PUBLIC RELATIONS**
Airline pilots problems in terms of job security, working conditions, management relations, public relations, flight safety due to noise abatement rules, etc
A73-27599
- Q**
- Q SWITCHED LASERS**
The application of holography to sonic boom investigations.
A73-26633
- QUALITY CONTROL**
Reliability and quality control of production engineering computer programs.
[AIAA-PAPER 73-356]
A73-25493
- R**
- RADAR ANTENNAS**
Study on the limit efficiency of lightning conductors on aircraft radomes.
A73-25303
- RADAR BEACONS**
Signal processing in the Air Traffic Control Radar Beacon System.
A73-27165
- Development and evaluation of discrete address beacon system for air traffic control applications
[FAA-RD-73-12]
N73-20184
- Analysis of synchronized discrete address beacon system for improved air traffic control capability
[SD-FR-01]
N73-20189
- Development and evaluation of aircraft tracking techniques based on radar and beacon target reports from common sensor site
[PX-6392]
N73-21177
- Development and evaluation of cross-band radar/beacon system for operation with airport surveillance radar/air traffic control beacon interrogator system
[FAA-RD-73-38]
N73-21182
- RADAR FILTERS**
Potential applications of acoustic matched filters to air-traffic control systems.
A73-27572
- RADAR IMAGERY**
Development and evaluation of aircraft tracking techniques based on radar and beacon target reports from common sensor site
[PX-6392]
N73-21177
- RADAR MEASUREMENT**
Utilization of the Doppler effect to measure the drift angle and the ground speed of an aircraft
A73-25797
- RADAR NAVIGATION**
A new approach to Doppler-inertial navigation /Doppler Beam Sampling/.
A73-27162
- RADAR TARGETS**
Computerized simulation of aircraft as radar target
[AD-755854]
N73-21189
- RADAR TRACKING**
Balloon-aircraft ranging, data, and voice experiment.
A73-27680
- Characteristics of operational airport surveillance radars and methods for improving performance to meet air route surveillance requirements
[ATC-14]
N73-20183
- Development and evaluation of aircraft tracking techniques based on radar and beacon target reports from common sensor site
[PX-6392]
N73-21177
- Development and evaluation of cross-band radar/beacon system for operation with airport surveillance radar/air traffic control beacon interrogator system
[FAA-RD-73-38]
N73-21182
- RADIAL FLOW**
A reappraisal of design methods for inward flow radial gas turbines.
A73-26370
- RADIO BEACONS**
First order effects of terrain on the radiation pattern of a non-directional LF beacon.
A73-26204
- RADIO COMMUNICATION**
Factors affecting the frequency chosen for aircraft to satellite communications.
A73-27667
- Air force radio communication and navigation system development planning
[AD-754930]
N73-20207
- RADIO EQUIPMENT**
Research projects to develop all-weather, low level navigation systems based on one way ranging, range-range navigation techniques
[AD-755205]
N73-21556
- RADIO NAVIGATION**
Analysis of improved signal processing techniques for low frequency, one-way ranging for aircraft radio navigation
[AD-754031]
N73-20727
- Research projects to develop all-weather, low level navigation systems based on one way ranging, range-range navigation techniques
[AD-755205]
N73-21556
- RADIO RECEIVERS**
Analysis of improved signal processing techniques for low frequency, one-way ranging for aircraft radio navigation
[AD-754031]
N73-20727
- RADOME MATERIALS**
Fabrication and physical, mechanical and electrical properties of inorganic composite material for aircraft radomes
A73-25288
- Thermal resistance and aging properties of polybenzimidazoles, polyimides and polyamides-imides used for Mach 3 aircraft radomes
A73-25291
- Military aircraft radome design technology developments in Sweden, discussing use of glass fiber reinforced plastics, manufacturing method, computerized optimization and measurement techniques
A73-25300
- Aircraft and missile radomes technology in France, discussing materials, antenna radiation pattern calculation, computer programming for transmission and angular aberrations, and raindrop erosion tests
A73-25301

RADOMES

SUBJECT INDEX

RADOMES

- Airliner radomes erosion by atmospheric precipitation, water penetration, icing, bird and stone impact and lightning
A73-25297
- Military aircraft radome design technology developments in Sweden, discussing use of glass fiber reinforced plastics, manufacturing method, computerized optimization and measurement techniques
A73-25300
- Study on the limit efficiency of lightning conductors on aircraft radomes.
A73-25303
- RAIL TRANSPORTATION**
Comparison of air pollution from aircraft, automobiles, buses, trucks, railroads, and electric trains in US from 1940-1980 [FAA-EQ-73-2]
N73-21522
- RAIN IMPACT DAMAGE**
Test rails possibilities for rain erosion phenomena study on aircraft or missile structures
A73-25296
- Airliner radomes erosion by atmospheric precipitation, water penetration, icing, bird and stone impact and lightning
A73-25297
- Aircraft and missile radomes technology in France, discussing materials, antenna radiation pattern calculation, computer programming for transmission and angular aberrations, and raindrop erosion tests
A73-25301
- RAMJET ENGINES**
Analysis of integrated airframe and engine configuration for hypersonic transport at 70,000 feet altitude and Mach 6.0 [NASA-CR-112300]
N73-20022
- RANDOM PROCESSES**
The spatial correlation method and a time-varying flexible structure. [AIAA PAPER 73-406]
A73-25535
- RANGEFINDING**
Analysis of improved signal processing techniques for low frequency, one-way ranging for aircraft radio navigation [AD-754031]
N73-20727
- RAPID TRANSIT SYSTEMS**
Control technology for air cushion passenger vehicle
N73-20969
- REACTION KINETICS**
Stratospheric chemical reactions and perturbations caused by supersonic aircraft exhaust [PB-213111]
N73-20464
- Survey on aeronomic dynamics of photochemical reactions caused by supersonic aircraft exhaust [PB-213126]
N73-20466
- RECTANGULAR WINGS**
Influence of various aerodynamic forces on rectangular wing performance with harmonic movement parallel to sieve flow movement
N73-21043
- REDUNDANT COMPONENTS**
Parallel-redundant flight control systems, discussing sensor bias and combined control computer input effects on controllability and steady state modal response
A73-25783
- REINFORCED PLASTICS**
Military aircraft radome design technology developments in Sweden, discussing use of glass fiber reinforced plastics, manufacturing method, computerized optimization and measurement techniques
A73-25300
- Fatigue and impact tests on composite propeller blades made of glass- and carbon fiber reinforced plastics, noting comparison with measured vibratory strains
A73-26881
- Temperature sensitivity of CFRP honey-comb structures under holographic ndt.
A73-27036
- REINFORCED SHELLS**
Contribution to the theory of the finite element method applied to the overall stress analysis of a fuselage
A73-27084
- Certain fatigue phenomena in aeronautical structures with stiffened shells
A73-27394
- RELIABILITY ANALYSIS**
Aircraft design and reliability analysis method based on accidents occurrence investigation by Franco-British airworthiness authorities, noting applicability to Concorde aircraft
A73-26589
- Reliability analysis of helicopter mechanical transmission components and reduction gearboxes
A73-26596
- Improvements in military helicopter flight test techniques to provide data for safety, maintainability, and reliability
N73-21013
- RELIABILITY ENGINEERING**
Reliability and quality control of production engineering computer programs. [AIAA PAPER 73-356]
A73-25493
- Improvements in the use of FAA resources for system performance assurance.
A73-27364
- Reliability and operational safety of mechanical helicopter transmission boxes
N73-21012
- Research projects in structural reliability engineering for transport vehicles
N73-21878
- REMOTELY PILOTED VEHICLES**
Design, development, and production of low cost remotely piloted vehicles based on innovative approach for aircraft engineering procedures [P-4902]
N73-21060
- REPLACING**
Prediction for a park of helicopters of the same type
A73-27077
- RESEARCH AIRCRAFT**
A description of the NAE T-33 turbulence research aircraft, instrumentation and data analysis.
A73-26269
- RESEARCH AND DEVELOPMENT**
General aviation requirements within National Aviation System, discussing basic services, facilities, federal spending and R and D
A73-27361
- Air force radio communication and navigation system development planning [AD-754930]
N73-20207
- Annual report of German aerospace research institute, 1972
N73-21259
- Proceedings of conference on research and development projects conducted by US Air Force Research and Development Command [AD-753071]
N73-21890
- RESEARCH FACILITIES**
Description of turbopropulsion laboratory in aeronautics department at Naval Postgraduate School [AD-754380]
N73-20287
- Research activities of electronic laboratory in development of inertial navigation systems to include applications for space missions and commercial aviation
N73-20686
- History and organization of German Society for Aerospace Research
N73-20961
- Management models for large research institute considering aerospace sciences
N73-20968
- Annual report of German aerospace research institute, 1972
N73-21259
- RESEARCH MANAGEMENT**
History and organization of German Society for Aerospace Research
N73-20961
- RESEARCH PROJECTS**
U.S., UK and French research programs on conditions encountered by civil aviation and supersonic transports in stratosphere
A73-26594
- Research and development projects of Federal Aviation Administration to provide improved weather data acquisition and distribution [FAA-ED-15-1]
N73-20662

SUBJECT INDEX

ROTARY WINGS

- Research activities of electronic laboratory in development of inertial navigation systems to include applications for space missions and commercial aviation
N73-20686
- Research and development projects conducted by Federal Aviation Administration to improve air traffic control and flight safety [FAA-EM-73-2] N73-20720
- German cooperation with AGARD research in aerospace sciences N73-20958
- German cooperation in international aeronautical research N73-20959
- Organization, management, and research activities at National Institute for Aerospace Research of the Netherlands N73-20960
- Analysis of transition region of subsonic turbulent jets to determine noise producing potential based on far field acoustic density [NASA-TN-D-7242] N73-21573
- RESIDENTIAL AREAS**
Acoustic measurement methods for evaluating aircraft noise pollution in urban areas [PB-212875] N73-20757
- RESONANT FREQUENCIES**
European contribution to structural response to noise. [AIAA PAPER 73-332] A73-25561
In-flight flutter testing methods for determining aircraft structure natural frequencies and vibration damping ratios with air flow A73-26593
- RESOURCE ALLOCATION**
Design of control and display panels using computer algorithms. A73-25180
Improvements in the use of FAA resources for system performance assurance. A73-27364
- REYNOLDS NUMBER**
Design of airfoil sections for low Reynolds numbers based on requirement to achieve transition upstream of major adverse pressure gradient N73-20995
- RIGID ROTOR HELICOPTERS**
Stability of elastic bending and torsion of uniform cantilevered rotor blades in hover. [AIAA PAPER 73-405] A73-25534
- RIGID ROTORS**
Effect of elastic flapping of rotor blades on stability and control of helicopter equipped with hingeless rotor system N73-21016
Flight tests of Westland Scout helicopter fitted with reduced scale version of rigid rotor to determine airworthiness and handling characteristics N73-21017
- RING WINGS**
Potential flow past axisymmetric ring wing profiles via singularity method, applying source and vortex distributions to curved thick profiles A73-25348
- ROLL**
Aircraft and spacecraft hand controllers for yaw, pitch, and roll [NASA-CASE-MSC-12394-1] N73-20041
- ROOTS OF EQUATIONS**
Synthesis of searchless self-adjusting systems based on the root locus method. I. A73-27460
- ROTARY STABILITY**
Analysis of whirl stability boundaries and aerodynamic characteristics of tilting rotors N73-21004
- ROTARY WING AIRCRAFT**
Prediction of height-velocity boundaries for rotorcraft by application of optimization techniques. A73-27175
- ROTARY WINGS**
Synthesis of helicopter rotor tips for less noise. A73-24981
- Analysis of stall flutter of a helicopter rotor blade. [AIAA PAPER 73-403] A73-25532
The spatial correlation method and a time-varying flexible structure. A73-25535
Twin-engined Anglo-French Lynx helicopter main rotor head, blade and drive train with conformal gearing, discussing design and material features A73-25790
- Application of equations of motion to develop analog computer simulation of helicopter rotor system [AD-754547] N73-20024
- Application of momentum theory to determine performance limits of propellers, and lifting rotors with axes parallel to undisturbed flow [AD-754072] N73-20025
- Numerical analysis of ideal and real gas equations for application to lift generated by helicopter rotors [AD-754420] N73-20026
- Fatigue damage of helicopter rotary wing structures - bibliographies [AD-754062] N73-20027
- Three component wake velocity measurements of full scale OH-13 helicopter rotary wing during hovering flight [AD-754644] N73-20030
- Proceedings of conference on rotary wing aircraft developments to include operational experience, flight tests, and evaluation of structural concepts [AGARD-CP-121] N73-21008
- Effect of elastic flapping of rotor blades on stability and control of helicopter equipped with hingeless rotor system N73-21016
- Flight tests of Westland Scout helicopter fitted with reduced scale version of rigid rotor to determine airworthiness and handling characteristics N73-21017
- Analysis of factors inhibiting performance of rotary wing aircraft and mathematical models of rotary wing flow characteristics N73-21019
- Survey of problems encountered in prediction of structural design loads and aeroelastic stability margins during development of rotary wing aircraft N73-21020
- Structural concepts of rotary wing system capabilities to show changes in design of specific vertical takeoff aircraft components N73-21021
- Aerodynamic characteristics of circulation controlled rotor and fundamental problems of stopped rotor aircraft N73-21024
- Development of jet-flap rotor and application to heavy helicopter and stoppable rotor designs N73-21025
- Development of rotary wings with cold, hot, and mixed cycle tip jet propulsion systems and application for torque-free rotor drive system N73-21026
- Review of tilting rotor technology and comparison of tilting rotor performance with standard rotary wings N73-21027
- Development of advancing blade concept rotary wing and wind tunnel tests of full scale model N73-21029
- Proceedings of conference on fluid dynamics of rotary wings and aerodynamic characteristics of rotary wing systems [AGARD-CP-111] N73-21031
- Analytical and experimental techniques to define geometry of vortex field of hovering rotary wing and effect on rotor performance N73-21032
- Development of actuator disc theory for predicting time-averaged downwash distribution and response characteristics of helicopter rotors in forward flight N73-21033

ROTOR BLADES

SUBJECT INDEX

Procedures for measuring velocity distribution through helicopter rotor blade tip vortex using single full scale rotor blade N73-21034

Development of procedure for determining geometry and strength distribution of vortex wake generated by single-bladed hovering helicopter rotor N73-21035

Parameters for enhancing performance of helicopter rotors during stationary flight N73-21036

Wind tunnel tests of rotary wing to determine retreating blade stall at several preset parameters and effect of reverse flow area N73-21037

Improvements in basic rotary wing design and tests to determine effects on helicopter performance N73-21038

Aerodynamic characteristics of rotary wings under axial flow conditions and development of numerical analysis techniques N73-21039

Development of method for predicting performance of heavily loaded propellers and rotors in steady hovering flight N73-21040

Analysis of unsteady aerodynamic environment of rotary wings and research projects to improve understanding of rotor unsteady airfoils N73-21041

Analysis of unsteady aerodynamic loading on reference section of helicopter rotor blade in axial or hovering flight under compressible flow conditions N73-21044

Effect of rotary wing airfoil modifications on performance, stability, and control of helicopters N73-21045

Developments in techniques for analyzing boundary layer characteristics of rotary wings based on unsteady viscous-inviscid interaction N73-21046

Development of technique for rotor blade design and measurement of pressure distributions along the blade chord and across blade wake near rotor tip in flight N73-21047

Development of algorithm for calculating inviscid flow about arbitrary planform rotors and application to analyzing various rotary wing configurations N73-21048

Wind tunnel tests to determine effects of blade twist and aeroelasticity on tilt rotor performance from hover to Mach number 0.7 N73-21049

Development of concept of circulation control applied to rotary wings to show effects on hover, transition, and high speed cruise performance N73-21050

Aerodynamic, dynamic, and aeroelastic problems in rotary wing design for helicopters and V/STOL aircraft with application to hingeless rotor systems N73-21051

Analysis of aerodynamic noise produced by rotary wings and methods for noise reduction based on shed vortex wakes and blade tip modification N73-21053

Generation of aerodynamic noise by turbulent wake behind rotary wing airfoil and relationship to drag and lift coefficients N73-21054

Noise spectrum characteristics and directivity patterns for rotary wings as function of blade tip speed, total rotor thrust, and angle of rotor disc plane N73-21056

Analysis of electrical charge generated by helicopter rotor operating near particulate matter with seeded vortex [AD-755282] N73-21080

ROTOR BLADES

Analysis of stall flutter of a helicopter rotor blade. [AIAA PAPER 73-403] A73-25532

Sensitivity of rotor blade vibration characteristics to torsional oscillations. [AIAA PAPER 73-404] A73-25533

Stability of elastic bending and torsion of uniform cantilevered rotor blades in hover. [AIAA PAPER 73-405] A73-25534

Twin-engined Anglo-French Lynx helicopter main rotor head, blade and drive train with conformal gearing, discussing design and material features A73-25790

Development of advancing blade concept rotary wing and wind tunnel tests of full scale model N73-21029

Procedures for measuring velocity distribution through helicopter rotor blade tip vortex using single full scale rotor blade N73-21034

Wind tunnel tests of rotary wing to determine retreating blade stall at several preset parameters and effect of reverse flow area. N73-21037

Development of technique for rotor blade design and measurement of pressure distributions along the blade chord and across blade wake near rotor tip in flight N73-21047

ROTORS

Flight characteristics and performance of Penestron type helicopter tail rotor N73-21028

RUNWAY CONDITIONS

Aquaplaning prevention during take-off and landing, discussing friction loss factors, aircraft tires and runway surface treatment by antiskid overlays and grooving A73-25209

Analysis of effect of grooved runway configurations on aircraft tire braking traction on flooded runway surfaces [NASA-TN-D-7215] N73-21057

RUNWAYS

Analysis of effect of grooved runway configurations on aircraft tire braking traction on flooded runway surfaces [NASA-TN-D-7215] N73-21057

S

SAFETY DEVICES

Design of perforated tube uniform distribution of fire extinguishing agent into commercial air transport compartments [FAA-NA-73-3] N73-20009

SATELLITE ANTENNAS

Satellite systems for mobile communications and surveillance; Proceedings of the International Conference, London, England, March 13-15, 1973. A73-27652

SATELLITE TRANSMISSION

The disc antenna - A possible L-band aircraft antenna. A73-27655

A radiating element giving circularly polarised radiation over a large solid angle. A73-27656

The provision of ground station facilities for an aeronautical satellite system. A73-27658

Factors affecting the frequency chosen for aircraft to satellite communications. A73-27667

Message organization in the ground segment of an aeronautical satellite system. A73-27668

SCALE MODELS

Buffeting pressures on a swept wing in transonic flight - Comparison of model and full scale measurements. [AIAA PAPER 73-311] A73-25542

Experimental tests on scale models of conical variable geometry propulsion nozzle with short petals for fighter aircraft, discussing aerodynamic and thrust coefficients A73-27388

Acoustic and fluid dynamic tests of multilooped discharge silencers scale models, noting optimum jet noise attenuation configuration A73-27390

SUBJECT INDEX

SIZE DETERMINATION

- Technique for determining mechanical properties of full-size aircraft tires from tests conducted with small-scale model tires [NASA-CR-2220] N73-21006
- SCATTERING CROSS SECTIONS**
Theory of sound scattering by turbulence applied to scattering cross section calculation for turbulent jet flow and wind, discussing jet noise reduction A73-26496
- SCHLIEREN PHOTOGRAPHY**
The application of holography to sonic boom investigations. A73-26633
- SCREEN EFFECT**
Solid profile wing motion in ideal incompressible fluid at variable distance from screen in terms of small perturbation theory A73-27815
- SCREENING**
Ti alloy coating and surface treatment to prolong fatigue life by eliminating fretting damage, discussing design parameters selection, screening and strength tests and performance evaluation A73-25838
- SECONDARY FLOW**
Noise reduction for subsonic fluid flow over flat plate via interposition of secondary fluid layer at trailing edge A73-25386
- SEISMIC WAVES**
Seismic measurement data from Cornish cottage during Concorde sonic boom flight, using moving coil geophones A73-26292
- SELF ADAPTIVE CONTROL SYSTEMS**
Synthesis of searchless self-adjusting systems based on the root locus method. I. A73-27460
- SEPARATED FLOW**
Aeroelastic dynamic response to shock induced flow separation, analyzing wing buffet components at high Mach number subsonic flow [AIAA PAPER 73-308] A73-25539
Supersonic flow around a delta wing, taking into account flow separation at the leading edges A73-27098
- SERVICE LIFE**
Prediction for a park of helicopters of the same type A73-27077
Test plan for extending service life of E-2A arresting gear [AD-754752] N73-20284
Test plan for extending life of C-2A arresting hook A-frame to 3000 arrested landings [AD-754076] N73-20289
- SERVOCONTROL**
The effect of servomechanical control and stability systems on the flutter behavior of aircraft A73-25349
- SERVO MECHANISMS**
Design and evaluation of miniature control surface actuation systems for aeroelastic models. [AIAA PAPER 73-323] A73-25553
Iliushin 62 aircraft horizontal stabilizer structural design and control, discussing mounting hardware and electrically driven servomechanism A73-25795
- SHAFTS (MACHINE ELEMENTS)**
Development of beryllium-copper bearings for use with stainless steel shafts under high bearing stress levels imposed by airframes [AD-754759] N73-20540
- SHIPS**
Satellite communication channels assignment to ships and aircraft, considering automated digital calling method for ship-to-shore communication A73-27670
Analysis of procedures and problems involved in operating helicopters from decks of ships N73-21010
- SHOCK ABSORBERS**
Effects of trapped air on operation of aircraft hydraulic systems and methods for removing air contamination [NLL-NEL-TT-2420-(6075.461)] N73-20005
Numerical analysis of aircraft shock absorber operation to show initial charging, motion, and force parameters during static and dynamic compression of landing gear [AD-754609] N73-20031
- SHOCK WAVE INTERACTION**
Aeroelastic dynamic response to shock induced flow separation, analyzing wing buffet components at high Mach number subsonic flow [AIAA PAPER 73-308] A73-25539
- SHORT HAUL AIRCRAFT**
Analysis of factors involving commercial application of short takeoff aircraft for short haul airline operations [NASA-TN-X-62239] N73-20016
- SHORT TAKEOFF AIRCRAFT**
A comparative study of augmentor wing, ejector nozzle and power jet flap low noise STOL concepts. A73-25385
Display system for monitoring automatically controlled STOL landing glide paths, discussing computer controlled simulation A73-25440
Parametric studies of the wing flutter behavior of a STOL transport. [AIAA PAPER 73-394] A73-25523
Variations in the sound field of a STOL aircraft as a function of wing-flap deflection A73-26592
Analysis of gust alleviation system for short takeoff aircraft for improved performance under random turbulence conditions [NASA-TN-D-7201] N73-20013
Analysis of factors involving commercial application of short takeoff aircraft for short haul airline operations [NASA-TN-X-62239] N73-20016
Annotated bibliography of aerodynamic configurations and characteristics of short takeoff aircraft [AD-754500] N73-20037
Development of jet-flap rotor and application to heavy helicopter and stoppable rotor designs N73-21025
Development of pilot model parameters to provide data base for multiloop, single controller, multi-input analysis of aircraft performance [AD-755367] N73-21078
- SIEVES**
Influence of various aerodynamic forces on rectangular wing performance with harmonic movement parallel to sieve flow movement N73-21043
- SIGNAL PROCESSING**
Signal processing in the Air Traffic Control Radar Beacon System. A73-27165
- SIGNAL REFLECTION**
Reduction of ILS errors caused by building reflections. A73-25784
- SIGNATURE ANALYSIS**
Noise control modification to HH-43B helicopter for 50 percent reduction in forward flight octave band sound pressure level signature A73-25383
- SILENCERS**
Acoustic and fluid dynamic tests of multilobed discharge silencers scale models, noting optimum jet noise attenuation configuration A73-27390
- SINGULARITY (MATHEMATICS)**
Potential flow past axisymmetric ring wing profiles via singularity method, applying source and vortex distributions to curved thick profiles A73-25348
Higher order numerical solution of the integral equation for the two-dimensional Neumann problem. A73-25434
- SIZE DETERMINATION**
Numerical procedure for determining optimal member sizes of aircraft structural components with weight minimization and flutter speed lower bound [AIAA PAPER 73-391] A73-25520

SKID LANDINGS

Aquaplaning prevention during take-off and landing, discussing friction loss factors, aircraft tires and runway surface treatment by antiskid overlays and grooving
A73-25209

SKIDDING

Performance tests to determine cornering characteristics of cantilever aircraft tire on dry, damp, and flooded runway surfaces over range of yaw angles
[NASA-TN-D-7203] N73-21058

SKYLAB PROGRAM

Analysis of KC-135 flight samples of Star-J Satellite solidified in near-zero gravity
[NASA-CR-124179] N73-20610

SLENDER BODIES

Development of method for estimating normal force, axial force, and pitching moment coefficients for slender bodies of varying cross section equipped with lifting surfaces
[NASA-TN-D-7228] N73-20998

SLOT ANTENNAS

Flush mountable elliptically polarized low silhouette blade antenna for aircraft, describing polarization and radiation characteristics
A73-27043

A radiating element giving circularly polarized radiation over a large solid angle.
A73-27656

SLOTS

Design and aerodynamic performance of low speed fan stage for low noise turboengine
[NASA-CR-121148] N73-21070

SOLIDIFICATION

Analysis of KC-135 flight samples of Star-J Satellite solidified in near-zero gravity
[NASA-CR-124179] N73-20610

SONIC BOOMS

Seismic measurement data from Cornish cottage during Concorde sonic boom flight, using moving coil geophones
A73-26292

The application of holography to sonic boom investigations.
A73-26633

Application of gas dynamics equations to determine magnitude of pressure rise due to sonic boom in stratified atmosphere
[NASA-TN-D-7105] N73-20010

SOUND FIELDS

Noise radiated from a turbulent boundary layer.
A73-24979

Variations in the sound field of a STOL aircraft as a function of wing-flap deflection
A73-26592

SOUND GENERATORS

Synthesis of helicopter rotor tips for less noise.
A73-24981

SOUND INTENSITY

Optimal and preferred listening levels for speech in aircraft acoustical environments.
A73-25387

SOUND PRESSURE

Noise radiated from a turbulent boundary layer.
A73-24979

Noise control modification to HH-43E helicopter for 50 percent reduction in forward flight octave band sound pressure level signature
A73-25383

SOUND PROPAGATION

Sound directivity pattern radiated from small airfoils.
A73-24980

SOUND TRANSMISSION

A single number rating for effective noise reduction.
A73-25000

SOUND WAVES

Design of noise source for simulating supersonic spinning modes in duct acoustics
[NASA-CR-2260] N73-21067

SOVEREIGNTY

German book on national airspace protection against foreign aircraft intrusion in peacetime covering sovereign rights according to international law, conventions and treaties
A73-26257

SPACECRAFT COMMUNICATION

The provision of ground station facilities for an aeronautical satellite system.
A73-27658

Satellite communication channels assignment to ships and aircraft, considering automated digital calling method for ship-to-shore communication
A73-27670

Satellite communication systems for long haul air transport operations, discussing political, operational/technical and economic problems
A73-27671

SPACECRAFT CONTROL

Aircraft and spacecraft hand controllers for yaw, pitch, and roll
[NASA-CASE-MSC-12394-1] N73-20041

SPATIAL DISTRIBUTION

The spatial correlation method and a time-varying flexible structure.
[AIAA PAPER 73-406] A73-25535

SPECTROSCOPIC ANALYSIS

Spectroscopic, photometric, and electron microscope analyses of metal wear particles in JT3D turbojet engine oil
[DLR-PB-73-06] N73-21417

SPECTRUM ANALYSIS

On the estimation of the directional spectrum of surface gravity waves from a programmed aircraft altimeter.
A73-26347

SPEECH RECOGNITION

Optimal and preferred listening levels for speech in aircraft acoustical environments.
A73-25387

SPOILERS

A linearized potential flow theory for airfoils with spoilers.
A73-25853

SPRINGS (ELASTIC)

Vibrations of an Euler beam with a system of discrete masses, springs, and dashpots.
A73-25788

STABILITY DERIVATIVES

Application of maximum likelihood criterion and optimal input design for analyzing flight test data to obtain aircraft stability and control derivatives
[NASA-CR-2200] N73-21071

STABILIZED PLATFORMS

Research activities of electronic laboratory in development of inertial navigation systems to include applications for space missions and commercial aviation
N73-20686

Optimization of integrated navigation systems combining several independent navigation sensors to provide self-contained aircraft navigation capability
N73-20694

Application of cluster rotation to improvement of existing platforms in strike aircraft
N73-20704

STABILIZERS (FLUID DYNAMICS)

Iliushin 62 aircraft horizontal stabilizer structural design and control, discussing mounting hardware and electrically driven servomechanism
A73-25795

STATIC ELECTRICITY

Analysis of electrical charge generated by helicopter rotor operating near particulate matter with seeded vortex
[AD-755282] N73-21080

STATIC TESTS

Phenomenological approach to low-cycle fatigue fracture of a typical aircraft full scale component static test.
[AIAA PAPER 73-324] A73-25554

STATISTICAL ANALYSIS

Statistical analysis of aircraft accidents occurring in US civil aviation during calendar year 1971
[NTSB-BA-73-1] N73-20015

Development of statistical methods for estimating annual operations at non-tower airports and establishment of standardized estimation procedure
[SCI-2040] N73-20278

- Development of procedures for accurately estimating annual air traffic levels at airports without tower control
[SCI-2-2040] A73-20722
- STEEPEST DESCENT METHOD**
An optimal control approach to terminal area air traffic control. A73-25786
- STIFFNESS**
Eigenvalue problem and stiffness optimization procedure for incremental flutter analysis, describing method use in computer graphics mode [AIAA PAPER 73-392] A73-25521
Optimization of aircraft structures with multiple stiffness requirements. A73-26298
- STRAPDOWN INERTIAL GUIDANCE**
Microprogrammed digital filters for strapdown guidance application. A73-27168
Development of electrostatic gyro systems N73-20698
- STRATOSPHERE**
Mountain waves and CAT encountered by the XB-70 in the stratosphere. A73-25785
U.S., UK and French research programs on conditions encountered by civil aviation and supersonic transports in stratosphere A73-26594
Hydrodynamic and chemical properties of stratospheric aircraft wake [PB-213114] N73-20465
Stratospheric photochemical reactions of ozone in relation to climatology and supersonic transport pollution [NOAA-TM-NZSS-47] N73-21526
- STRESS ANALYSIS**
Contribution to the theory of the finite element method applied to the overall stress analysis of a fuselage A73-27084
- STRESS CORROSION CRACKING**
Aerospace component failure due to corrosion fatigue in aluminum wing attachment spar, helicopter rotor blade, landing gear cylinder and engine bearings A73-25803
Stress corrosion cracking and corrosion fatigue for hydraulic aluminum pressure cylinders used for landing gear, stabilizers and aircraft systems A73-25827
- STRESSED-SKIN STRUCTURES**
Creep analysis of a thin-walled wing on the basis of the plate analogy A73-27086
- STRUCTURAL ANALYSIS**
Taylor series algorithms for computerized structural design and reanalysis of modified structures, applying to aircraft fuselage midsection [AIAA PAPER 73-338] A73-25478
Development of structural optimization algorithm used with large finite element program based on displacement method of structural analysis N73-21005
- STRUCTURAL DESIGN**
Aircraft design philosophies and structural integrity considerations for reliability without major NDT and maintenance, proposing research program for future computerized design A73-25128
Design and manufacture of structure components made of fiber-reinforced materials A73-25417
Application of computer-aided aircraft design in a multidisciplinary environment. [AIAA PAPER 73-353] A73-25490
Numerical procedure for determining optimal member sizes of aircraft structural components with weight minimization and flutter speed lower bound [AIAA PAPER 73-391] A73-25520
Iliushin 62 aircraft horizontal stabilizer structural design and control, discussing mounting hardware and electrically driven servomechanism A73-25795
- Optimization of aircraft structures with multiple stiffness requirements. A73-26298
- Light motorized glider-type aircraft design, development and flight testing, discussing aerodynamic configuration, structural design and performance characteristics A73-27732
- Lift and drag at off-design Mach numbers of conically cambered wings with subsonic leading edges and supersonic trailing edge A73-27927
- Design of noise source for simulating supersonic spinning modes in duct acoustics [NASA-CR-2260] N73-21067
- STRUCTURAL FAILURE**
Preliminary design of aircraft structures to meet structural integrity requirements. [AIAA PAPER 73-374] A73-25506
Aerospace component failure due to corrosion fatigue in aluminum wing attachment spar, helicopter rotor blade, landing gear cylinder and engine bearings A73-25803
- STRUCTURAL RELIABILITY**
Preliminary design of aircraft structures to meet structural integrity requirements. [AIAA PAPER 73-374] A73-25506
- STRUCTURAL STABILITY**
Russian book on airplane and helicopter design and stability covering selection of wing/rotor/configuration and power plant, subsystem design, strength, reliability, lifetime, etc A73-26256
Development of structural optimization algorithm used with large finite element program based on displacement method of structural analysis N73-21005
Research projects in structural reliability engineering for transport vehicles N73-21878
- STRUCTURAL VIBRATION**
Gradient optimization of structural weight for specified flutter speed. [AIAA PAPER 73-390] A73-25519
The spatial correlation method and a time-varying flexible structure. [AIAA PAPER 73-406] A73-25535
European contribution to structural response to noise. [AIAA PAPER 73-332] A73-25561
Vibrations of an Euler beam with a system of discrete masses, springs, and dashpots. A73-25788
In-flight flutter testing methods for determining aircraft structure natural frequencies and vibration damping ratios with air flow A73-26593
Condition monitoring - A new technology for aircraft engine maintenance A73-27389
Solid body on elastic supports as model for helicopter stability and nonlinear oscillations analysis A73-27791
Effect of ovality of radial thrust bearing balls on axial vibration of rapidly rotating rotor of engine [AD-754615] N73-20546
- STRUCTURAL WEIGHT**
Aeroelastic structural weight optimization under strength and flutter constraints, using finite element and displacement methods to describe equations of motion in matrix form [AIAA PAPER 73-389] A73-25518
Gradient optimization of structural weight for specified flutter speed. [AIAA PAPER 73-390] A73-25519
Numerical procedure for determining optimal member sizes of aircraft structural components with weight minimization and flutter speed lower bound [AIAA PAPER 73-391] A73-25520
A new method for the study of the phenomenon of dynamic instability of thin-walled bars used in the construction of aeroplanes, ships and bridges. A73-27063

SUBSONIC AIRCRAFT

SUBJECT INDEX

SUBSONIC AIRCRAFT

Aircraft design parameters optimization based on criterial function representing overall deviation for specifications with application to subsonic passenger aircraft

A73-27095

SUBSONIC FLOW

Noise reduction for subsonic fluid flow over flat plate via interposition of secondary fluid layer at trailing edge

A73-25386

Aeroelastic dynamic response to shock induced flow separation, analyzing wing buffet components at high Mach number subsonic flow

[AIAA PAPER 73-308] A73-25539

Unsteady subsonic compressible flow around finite thickness wings.

[AIAA PAPER 73-313] A73-25544

Noise intensity in the field of subsonic turbulent jets

A73-25738

Flow and acoustic characteristics determined for subsonic and supersonic jets and supersonic suppressors

[NASA-CR-131297] N73-20006

SUBSONIC FLUTTER

Flutter technology in the United Kingdom - A survey. [AIAA PAPER 73-330]

A73-25559

SUBSONIC WIND TUNNELS

Application of certain generalized data from wind-tunnel tests with plane subsonic compressor cascades to the calculation of the characteristic flow regimes in supersonic cascades

A73-27480

SUPERSONIC AIRCRAFT

Critique of paper on supersonic aircraft configuration with zero wave drag, discussing tubular outer structure and convergent-divergent inner duct

A73-25798

Stratospheric chemical reactions and perturbations caused by supersonic aircraft exhaust

[PB-213111] N73-20464

Survey on aeronomic dynamics of photochemical reactions caused by supersonic aircraft exhaust

[PB-213126] N73-20466

Atmospheric models for fluid dynamic and chemical impacts of supersonic aircraft on climatology

[PB-212819] N73-20473

SUPERSONIC AIRFOILS

Minimum weight design of supersonic aircraft wing with finite element modeling to meet strength, stability, frequency, and flutter requirements

N73-21003

SUPERSONIC COMPRESSORS

Application of certain generalized data from wind-tunnel tests with plane subsonic compressor cascades to the calculation of the characteristic flow regimes in supersonic cascades

A73-27480

SUPERSONIC FLOW

Nonstationary flow downwash behind a delta wing during supersonic motion

A73-25046

Development and applications of supersonic unsteady consistent aerodynamics for interfering parallel wings.

[AIAA PAPER 73-317] A73-25548

Supersonic gas flow past the leeward side of a conical wing

A73-26439

Supersonic flow around a delta wing, taking into account flow separation at the leading edges

A73-27098

Flow and acoustic characteristics determined for subsonic and supersonic jets and supersonic suppressors

[NASA-CR-131297] N73-20006

Development of computer program and algorithm for determining interference between lifting surface elements at various Mach numbers

[NASA-CR-112264] N73-21272

SUPERSONIC FLUTTER

Flutter technology in the United Kingdom - A survey. [AIAA PAPER 73-330]

A73-25559

SUPERSONIC SPEEDS

Effect of plume-induced boundary layer separation on afterbody during powered supersonic flight

[AD-754640] N73-20326

Analysis of requirements, instruments, and procedures for measurement of aircraft temperatures up to Mach 2.3 and altitudes up to 80,000 feet

[AGARD-AG-160-VOL-2] N73-20499

Theories, numerical methods, and computer programs for determining inviscid three dimensional flow around spherically-capped smooth bodies and wings at supersonic speeds

[AD-753696] N73-21002

SUPERSONIC TRANSPORTS

U.S., UK and French research programs on conditions encountered by civil aviation and supersonic transports in stratosphere

A73-26594

Doppler compensated communication system for locating supersonic transport position

[NASA-CASE-GSC-10087-4] N73-20174

Bibliography of supersonic transport aircraft data to include program management, systems engineering, aircraft structures, and operational considerations

[AD-755600] N73-21076

Stratospheric photochemical reactions of ozone in relation to climatology and supersonic transport pollution

[NOAA-TM-NESS-47] N73-21526

SUPERSONIC WAKES

Hydrodynamic and chemical properties of stratospheric aircraft wake

[PB-213114] N73-20465

SUPPRESSORS

Flow and acoustic characteristics determined for subsonic and supersonic jets and supersonic suppressors

[NASA-CR-131297] N73-20006

SURFACE NAVIGATION

Satellite systems for mobile communications and surveillance; Proceedings of the International Conference, London, England, March 13-15, 1973.

A73-27652

SURFACE ROUGHNESS

Aquaplaning prevention during take-off and landing, discussing friction loss factors, aircraft tires and runway surface treatment by antiskid overlays and grooving

A73-25209

SURFACE VEHICLES

Comparison of air pollution from aircraft, automobiles, buses, trucks, railroads, and electric trains in US from 1940-1980

[FAA-EQ-73-2] N73-21522

SURVEILLANCE

Satellite systems for mobile communications and surveillance; Proceedings of the International Conference, London, England, March 13-15, 1973.

A73-27652

SURVEILLANCE RADAR

Characteristics of operational airport surveillance radars and methods for improving performance to meet air route surveillance requirements

[ATC-14] N73-20183

SURVIVAL

On the improvement in survivability for avionics equipment.

A73-27158

SWEEP WINGS

Buffeting pressures on a swept wing in transonic flight - Comparison of model and full scale measurements.

[AIAA PAPER 73-311] A73-25542

Turbulent heat transfer and pressure on leading edge of fin, swept wing, or antenna

[SCL-RR-72-0308] N73-21863

SWEEPBACK TAIL SURFACES

Turbulent heat transfer to a fin leading edge - Flight test results.

A73-26405

SYSTEM EFFECTIVENESS

Improvements in the use of FAA resources for system performance assurance.

A73-27364

SYSTEM FAILURES

On the improvement in survivability for avionics equipment.

A73-27158

SUBJECT INDEX

TEST EQUIPMENT

- Fault isolation and maintenance concepts of advanced inertial navigation system N73-20713
- SYSTEMS ANALYSIS**
- Regional airport systems study for San Francisco bay area, discussing commercial and general aviation future needs, environmental and economic aspects and alternative options A73-26125
- Aerospace systems evaluation and optimization via systems analysis, discussing capability, dependability and availability and cost A73-27384
- SYSTEMS ENGINEERING**
- Signal processing in the Air Traffic Control Radar Beacon System. A73-27165
- Data acquisition process to plan and engineer air traffic system, considering design aspects and piecemeal evolution A73-27362
- Status of funded improvements to the National Aviation System and planned improvements not yet funded. A73-27363
- National aviation system improvement via cost effectiveness, considering FAA facilities and equipment program, ATC automation and terminal aids A73-27365
- Synthesis of searchless self-adjusting systems based on the root locus method. I. A73-27460
- Message organization in the ground segment of an aeronautical satellite system. A73-27668
- Research and development projects conducted by Federal Aviation Administration to improve air traffic control and flight safety [FAA-EM-73-2] N73-20720
- T**
- T-33 AIRCRAFT**
- A description of the NAE T-33 turbulence research aircraft, instrumentation and data analysis. A73-26269
- Computerized simulation of aircraft as radar target [AD-755854] N73-21189
- Instrumentation and data handling process of NAE T-33 turbulence research aircraft, stationary gas turbine icing problems, and role of plastic deformation in metal powder compaction [DME/NAE-1972(4)] N73-21882
- TACTICS**
- Helicopter flight performance in tactical environment N73-21009
- Operational performance of helicopters in French Army N73-21011
- TAILLESS AIRCRAFT**
- Aeroelastic effects on flying wing aircraft aerodynamic stability characteristics, using elementary beam-rod differential equations and aerodynamic strip theory [AIAA PAPER 73-397] A73-25526
- Response-optimum control of the angular and torsional oscillations of an elastic flying wing. A73-27459
- TAKEOFF**
- Analysis of procedures and problems involved in operating helicopters from decks of ships N73-21010
- TAKEOFF RUNS**
- Aircraft accident involving Boeing 707 aircraft at San Francisco, California airport following rejected takeoff on 13 Sept. 1972 [NTSB-ABR-73-4] N73-21062
- TAYLOR SERIES**
- Taylor series algorithms for computerized structural design and reanalysis of modified structures, applying to aircraft fuselage midsection [AIAA PAPER 73-338] A73-25478
- TECHNOLOGIES**
- History of German aeronautical development during the first half of the century N73-20956
- TECHNOLOGY ASSESSMENT**
- Aircraft design philosophies and structural integrity considerations for reliability without major NDT and maintenance, proposing research program for future computerized design A73-25128
- Military aircraft radome design technology developments in Sweden, discussing use of glass fiber reinforced plastics, manufacturing method, computerized optimization and measurement techniques A73-25300
- Aircraft and missile radomes technology in France, discussing materials, antenna radiation pattern calculation, computer programming for transmission and angular aberrations, and raindrop erosion tests A73-25301
- Flutter technology in the United Kingdom - A survey. [AIAA PAPER 73-330] A73-25559
- TECHNOLOGY UTILIZATION**
- Airport noise control and minimization for community and airline industry interests by technology application and legal-political approaches A73-26350
- Potential applications of acoustic matched filters to air-traffic control systems. A73-27572
- The use of satellites for aircraft communications and air traffic control. A73-27666
- TEMPERATURE EFFECTS**
- Temperature sensitivity of cfrp honey-comb structures under holographic ndt. A73-27036
- TEMPERATURE MEASUREMENT**
- Analysis of requirements, instruments, and procedures for measurement of aircraft temperatures up to Mach 2.3 and altitudes up to 80,000 feet [AGARD-AG-160-VOL-2] N73-20499
- TERMINAL FACILITIES**
- Dusseldorf airport passenger terminal facilities project, considering handling capacity, building and wide bodied jet traffic requirements A73-25206
- Malmo-Sturup airport facilities layout, discussing passenger terminal, lounges, baggage and cargo handling, ATC school, etc A73-25207
- Ireland commercial airports at Dublin, Shannon and Cork, discussing management, terminal facilities and operations A73-25208
- National aviation system improvement via cost effectiveness, considering FAA facilities and equipment program, ATC automation and terminal aids A73-27365
- An appraisal of the funding provisions of the Airport and Airways Development Act of 1970 to implement system improvements. A73-27366
- Comparison tests of strobe and incandescent beacons to determine suitability as replacement for standard rotating airport beacon [FAA-WA-73-1] N73-20182
- Characteristics of operational airport surveillance radars and methods for improving performance to meet air route surveillance requirements [ATC-14] N73-20183
- Analysis of technical and economic feasibility of constructing offshore airport in New York Metropolitan area [FAA-RD-73-45] N73-20280
- Research and development projects conducted by Federal Aviation Administration to improve air traffic control and flight safety [FAA-EM-73-2] N73-20720
- TERRAIN ANALYSIS**
- First order effects of terrain on the radiation pattern of a non-directional LP beacon. A73-26204
- TEST EQUIPMENT**
- Test rails possibilities for rain erosion phenomena study on aircraft or missile structures A73-25296

TEST FACILITIES

SUBJECT INDEX

- A modern mechanical laboratory for the support of aircraft engine design
A73-27385
- TEST FACILITIES**
Varying-temperature test installation for the interior design of the Concorde
A73-25103
- Research facility for studying noise generated by bluff body flow interaction inside ducted fuel combustion system
[AD-754094] N73-20286
- Description of turbopropulsion laboratory in aeronautics department at Naval Postgraduate School
[AD-754380] N73-20287
- THERMAL CYCLING TESTS**
Varying-temperature test installation for the interior design of the Concorde
A73-25103
- THERMAL INSULATION**
Development of methods for protecting aircraft compartments from aerodynamic heating effects
[AD-754606] N73-20036
- THERMAL RESISTANCE**
Thermal resistance and aging properties of polybenzimidazoles, polyimides and polyamides-imides used for Mach 3 aircraft radomes
A73-25291
- THERMAL STRESSES**
Vibration and local edge buckling of thermally stressed, wedge airfoil cantilever wings.
[AIAA PAPER 73-327] A73-25557
- THERMODYNAMIC CYCLES**
Gas-turbine processes with interrupted expansion and interrupted compression
A73-26371
- THERMODYNAMIC EFFICIENCY**
Gas-turbine processes with interrupted expansion and interrupted compression
A73-26371
- THIN AIRFOILS**
A note on the lift coefficient of a thin jet-flapped airfoil.
A73-27171
- THIN WALLED SHELLS**
Contribution to the theory of the finite element method applied to the overall stress analysis of a fuselage
A73-27084
- Creep analysis of a thin-walled wing on the basis of the plate analogy
A73-27086
- THIN WALLS**
A new method for the study of the phenomenon of dynamic instability of thin-walled bars used in the construction of aeroplanes, ships and bridges.
A73-27063
- THIN WINGS**
Supersonic flow around a delta wing, taking into account flow separation at the leading edges
A73-27098
- THREE DIMENSIONAL FLOW**
Theory on blades of axial, mixed, and radial turbomachines by inverse method.
A73-26340
- Development of method for solving three dimensional, incompressible laminar and turbulent boundary layer problems for swept infinite cylinders and small cross flow
[AD-754440] N73-20004
- Theories, numerical methods, and computer programs for determining inviscid three dimensional flow around spherically-capped smooth bodies and wings at supersonic speeds
[AD-753696] N73-21002
- THRUST AUGMENTATION**
A comparative study of augmentor wing, ejector nozzle and power jet flap low noise STOL concepts.
A73-25385
- THRUST MEASUREMENT**
Presentation of helicopter level flight performance as power coefficient compared with tip speed or advance ratio for range of thrust coefficients
N73-21014
- THRUST REVERSAL**
Aerodynamic tests and noise levels of slot nozzle with V gutter reverser for STOL
[NASA-TN-X-2758] N73-21072
- THUNDERSTORMS**
Probability of aircraft being struck by lightning
[NLL-M-22800-(5828.4F)] N73-20656
- TILTING ROTORS**
Analysis of whirl stability boundaries and aerodynamic characteristics of tilting rotors
N73-21004
- Review of tilting rotor technology and comparison of tilting rotor performance with standard rotary wings
N73-21027
- Wind tunnel tests to determine effects of blade twist and aeroelasticity on tilt rotor performance from hover to mach number 0.7
N73-21049
- Aerodynamic, dynamic, and aeroelastic problems in rotary wing design for helicopters and V/STOL aircraft with application to hingeless rotor systems
N73-21051
- TIP DRIVEN ROTORS**
Development of rotary wings with cold, hot, and mixed cycle tip jet propulsion systems and application for torque-free rotor drive system
N73-21026
- TITANIUM ALLOYS**
Fretting fatigue in titanium helicopter components.
A73-25837
- Ti alloy coating and surface treatment to prolong fatigue life by eliminating fretting damage; discussing design parameters selection, screening and strength tests and performance evaluation
A73-25838
- TORSIONAL STRESS**
Stability of elastic bending and torsion of uniform cantilevered rotor blades in hover.
[AIAA PAPER 73-405] A73-25534
- TORSIONAL VIBRATION**
Sensitivity of rotor blade vibration characteristics to torsional oscillations.
[AIAA PAPER 73-404] A73-25533
- TRACTION**
Performance tests to determine cornering characteristics of cantilever aircraft tire on dry, damp, and flooded runway surfaces over range of yaw angles
[NASA-TN-D-7203] N73-21058
- TRAILING EDGES**
Noise reduction for subsonic fluid flow over flat plate via interposition of secondary fluid layer at trailing edge
A73-25386
- TRAILING-EDGE FLAPS**
Friction effect on lift of airfoil section with slotted flap
[DLR-PB-73-04] N73-21001
- TRAINING DEVICES**
Development and use of synthetic flight trainers based on degree and fidelity of simulation as key design considerations
[AD-754957] N73-21260
- TRAJECTORY ANALYSIS**
Determination of the turn start point coordinates for modern commercial aircraft
A73-26723
- TRAJECTORY OPTIMIZATION**
An optimal control approach to terminal area air traffic control.
A73-25786
- Evaluation of glide paths for landing a VTOL airplane using linear regulator theory.
A73-27154
- TRANSDUCERS**
Problems in constructing aerodynamically active elements - Converters of input and output signals in automatic control systems
A73-26769
- TRANSFER FUNCTIONS**
Gust field generation in wind tunnel for determining transfer function of lifting surface
N73-21248
- TRANSLATIONAL MOTION**
Flight-mechanics analysis of various flight conditions of conventional aircraft. VII - Mechanical foundations: Dynamic equations of motion of the translational motion of a rigid body
A73-26725

SUBJECT INDEX

TURBULENT FLOW

TRANSONIC FLIGHT

Buffeting pressures on a swept wing in transonic flight - Comparison of model and full scale measurements.
[AIAA PAPER 73-311] A73-25542

TRANSONIC FLOW

Calculation of unsteady, transonic aerodynamics for oscillating wings with thickness.
[AIAA PAPER 73-316] A73-25547
The theoretical and experimental methods used in France for flutter prediction.
[AIAA PAPER 73-329] A73-25558
Development of computer program and algorithm for determining interference between lifting surface elements at various Mach numbers
[NASA-CR-112264] N73-21272

TRANSONIC FLUTTER

Flutter of pairs of aerodynamically interfering delta wings.
[AIAA PAPER 73-314] A73-25545
Flutter technology in the United Kingdom - A survey.
[AIAA PAPER 73-330] A73-25559

TRANSONIC WIND TUNNELS

Correction for change in fluid flow curvature about a lift-generating airfoil in a two-dimensional test section with perforated walls
A73-25864

TRANSPORT AIRCRAFT

Transport aircraft maintenance program, discussing safety and reliability correlation with design
A73-26591

Wind tunnel tests to determine low speed aerodynamic characteristics of large scale V/STOL transport models with lift fan lift-cruise fan propulsion system
[NASA-TN-X-62231] N73-20014
Development and characteristics of dual cargo hook system for use on military transport helicopters
N73-21022

Design of V/STOL research transport aircraft to achieve low fan noise with high thrust/weight capability of high pressure ratio lift fan system
[NASA-CR-121146] N73-21065
Flight investigation to determine velocity and persistence characteristics of trailing vortices generated by jumbo jet transport
[NASA-TN-D-7172] N73-21068

TRANSPORT VEHICLES

Research projects in structural reliability engineering for transport vehicles
N73-21878

TRANSPORTATION

Technology assessment for long range year-round transportation in Arctic
[AD-754381] N73-20296
Control of transportation noise pollution
[PB-213007] N73-20758
House hearings on air passenger fees, related taxation, and government regulation of commercial airline operations
N73-20970

TROPOSPHERE

Chemically reacting wave of aircraft flying at subsonic and supersonic velocity in upper troposphere and stratosphere
[AD-754918] N73-20447

TURBINE BLADES

Theory on blades of axial, mixed, and radial turbomachines by inverse method.
A73-26340
Turbine blades cooling effectiveness for engines gas temperature energy gain compensation
A73-27090

Performance tests of axial flow transonic compressor stage with multiple circular arc blades to determine effects of blade shape on efficiency and stall margin
[NASA-TN-X-2731] N73-19995

Aerodynamic performance of core-engine turbine stator vane tested in two-dimensional cascade of 10 vanes and in single-vane tunnel
[NASA-TN-X-2766] N73-20823

Adverse effect of film cooling on suction surface of turbine blade
[NASA-TN-X-68210] N73-21695

TURBINE ENGINES

Effect of steady state circumferential total pressure distortion on loss in compressor stall pressure ratio
[NASA-CR-114577] N73-21693

TURBINE WHEELS

A reappraisal of design methods for inward flow radial gas turbines.
A73-26370

Analysis of gas turbine engine rotor failures as basis for conducting program to provide equipment for protection of passengers and aircraft structures from damage
[NASA-CR-131525] N73-21692

TURBOCOMPRESSORS

Researches on the two-dimensional retarded cascade. III - Cascade performances at high inlet angles.
A73-26338

Researches on the two-dimensional retarded cascade. IV - Determination of blade elements at retarded blade row.
A73-26339

Theory on blades of axial, mixed, and radial turbomachines by inverse method.
A73-26340

Effect of steady state circumferential total pressure distortion on loss in compressor stall pressure ratio
[NASA-CR-114577] N73-21693

TURBOPAN ENGINES

Design and aerodynamic performance of low speed fan stage for low noise turboengine
[NASA-CR-121148] N73-21070

TURBOJET ENGINE CONTROL

Influence of the turbine air cooling system on the characteristics of a turbojet engine during regulation of the latter
A73-27091

TURBOJET ENGINES

Analysis of the operational parameters of a bypass turbojet
A73-27069

Description of turbopropulsion laboratory in aeronautics department at Naval Postgraduate School
[AD-754380] N73-20287

Spectroscopic, photometric, and electron microscope analyses of metal wear particles in JT3D turbojet engine oil
[DLR-FB-73-06] N73-21417

Analysis of gas turbine engine rotor failures as basis for conducting program to provide equipment for protection of passengers and aircraft structures from damage
[NASA-CR-131525] N73-21692

Effect on nitric oxide emissions of using premixed pre vaporized fuel/air in turbojet combustors
[NASA-TN-X-68220] N73-21862

TURBOMACHINE BLADES

Graphic-interactive analysis of the velocity field around blade cascades for turbomachines
A73-27387

Effect of wing span loading on wing trailing vortices
[AD-754055] N73-20003

Theory of sound scattering by turbulence applied to scattering cross section calculation for turbulent jet flow and wind, discussing jet noise reduction
A73-26496

Graphic-interactive analysis of the velocity field around blade cascades for turbomachines
A73-27387

TURBULENCE

Effect of wing span loading on wing trailing vortices
[AD-754055] N73-20003

Theory of sound scattering by turbulence applied to scattering cross section calculation for turbulent jet flow and wind, discussing jet noise reduction
A73-26496

Graphic-interactive analysis of the velocity field around blade cascades for turbomachines
A73-27387

Noise radiated from a turbulent boundary layer.
A73-24979

Development of method for solving three dimensional, incompressible laminar and turbulent boundary layer problems for swept infinite cylinders and small cross flow
[AD-754440] N73-20004

TURBULENT FLOW

Three component wake velocity measurements of full scale OH-13 helicopter rotary wing during hovering flight
[AD-754644] N73-20030

TURBULENT HEAT TRANSFER

SUBJECT INDEX

Analysis of point vortex approximation of vortex sheet in two space dimensions and application to vortex sheet induced by elliptically loaded wing [AD-755007] N73-20335

Analysis of aerodynamic noise produced by rotary wings and methods for noise reduction based on shed vortex wakes and blade tip modification N73-21053

Gust field generation in wind tunnel for determining transfer function of lifting surface N73-21248

TURBULENT HEAT TRANSFER

Turbulent heat transfer to a fin leading edge - Flight test results. A73-26405

Turbulent heat transfer and pressure on leading edge of fin, swept wing, or antenna [SCL-RR-72-0308] N73-21863

TURBULENT JETS

Noise intensity in the field of subsonic turbulent jets A73-25738

Theory of sound scattering by turbulence applied to scattering cross section calculation for turbulent jet flow and wind, discussing jet noise reduction A73-26496

TURBULENT WAKES

Analysis of factors inhibiting performance of rotary wing aircraft and mathematical models of rotary wing flow characteristics N73-21019

Generation of aerodynamic noise by turbulent wake behind rotary wing airfoil and relationship to drag and lift coefficients N73-21054

Flight investigation to determine velocity and persistence characteristics of trailing vortices generated by jumbo jet transport [NASA-TN-D-7172] N73-21068

TURNING FLIGHT

Determination of the turn start point coordinates for modern commercial aircraft A73-26723

TWO DIMENSIONAL BODIES

An exploratory investigation of the unsteady aerodynamic response of a two-dimensional airfoil at high reduced frequency. [AIAA PAPER 73-309] A73-25540

TWO DIMENSIONAL FLOW

A linearized potential flow theory for airfoils with spoilers. A73-25853

Researches on the two-dimensional retarded cascade. III - Cascade performances at high inlet angles. A73-26338

Researches on the two-dimensional retarded cascade. IV - Determination of blade elements at retarded blade row. A73-26339

Analysis of point vortex approximation of vortex sheet in two space dimensions and application to vortex sheet induced by elliptically loaded wing [AD-755007] N73-20335

Analysis of whirl stability boundaries and aerodynamic characteristics of tilting rotors N73-21004

U

UDINET ALLOYS

Method of life prediction for nickel-based Udimet alloy by high temperature creep/fatigue testing [NASA-CR-120958] N73-21845

UNSTEADY FLOW

An exploratory investigation of the unsteady aerodynamic response of a two-dimensional airfoil at high reduced frequency. [AIAA PAPER 73-309] A73-25540

Unsteady subsonic compressible flow around finite thickness wings. [AIAA PAPER 73-313] A73-25544

Calculation of unsteady transonic aerodynamics for oscillating wings with thickness. [AIAA PAPER 73-316] A73-25547

Development and applications of supersonic unsteady consistent aerodynamics for interfering parallel wings. [AIAA PAPER 73-317] A73-25548

An investigation of unsteady aerodynamics on an oscillating airfoil. [AIAA PAPER 73-318] A73-25549

URBAN DEVELOPMENT

Regional airport systems study for San Francisco bay area, discussing commercial and general aviation future needs, environmental and economic aspects and alternative options A73-26125

URBAN PLANNING

Guidelines for urban control of aircraft noise pollution [PB-213020] N73-20759

URBAN TRANSPORTATION

Airport access and ground travel modes [PB-212814] N73-20990

UTILITY AIRCRAFT

An-2R aircraft conversion to flying test bed for feasibility studies of jet engine use in agricultural aircraft, describing structural design modifications A73-26823

V

V/STOL AIRCRAFT

Hydraulic powered integrated actuator package /IAP/ for V/STOL aircraft flight control, noting advantages in system weight, mechanical complexity and power loss reduction A73-26271

Augmentor wing design and performance tests for multimission IPV-12 V/STOL prototype aircraft A73-27731

Wind tunnel tests to determine low speed aerodynamic characteristics of large scale V/STOL transport models with lift fan lift-cruise fan propulsion system [NASA-TN-X-62231] N73-20014

Proceedings of conference on rotary wing aircraft developments to include operational experience, flight tests, and evaluation of structural concepts [AGARD-CP-121] N73-21008

Aerodynamic, dynamic, and aeroelastic problems in rotary wing design for helicopters and V/STOL aircraft with application to hingeless rotor systems N73-21051

Design of V/STOL research transport aircraft to achieve low fan noise with high thrust/weight capability of high pressure ratio lift fan system [NASA-CR-121146] N73-21065

VALUE ENGINEERING

Aerospace systems evaluation and optimization via systems analysis, discussing capability, dependability and availability and cost A73-27384

VAPORIZING

Effects of prevaporized fuel on exhaust emissions of an experimental gas turbine combustor. A73-26424

VELOCITY DISTRIBUTION

Graphic-interactive analysis of the velocity field around blade cascades for turbomachines A73-27387

Procedures for measuring velocity distribution through helicopter rotor blade tip vortex using single full scale rotor blade N73-21034

VELOCITY MEASUREMENT

Procedures for measuring velocity distribution through helicopter rotor blade tip vortex using single full scale rotor blade N73-21034

VERTICAL FLIGHT

Parameters for enhancing performance of helicopter rotors during stationary flight N73-21036

VERTICAL LANDING

Performance characteristics of a model VTOL lift fan in crossflow. A73-25782

SUBJECT INDEX

WIND TUNNEL MODELS

- VERTICAL TAKEOFF**
Performance characteristics of a model VTOL lift fan in crossflow. A73-25782
- VERTICAL TAKEOFF AIRCRAFT**
Evaluation of glide paths for landing a VTOL airplane using linear regulator theory. A73-27154
Prediction of height-velocity boundaries for rotorcraft by application of optimization techniques. A73-27175
Structural concepts of rotary wing system capabilities to show changes in design of specific vertical takeoff aircraft components N73-21021
Development and application of composite materials for vertical takeoff aircraft airframes and effect on improved aircraft performance N73-21023
Aerodynamic characteristics of circulation controlled rotor and fundamental problems of stopped rotor aircraft N73-21024
Development of jet-flap rotor and application to heavy helicopter and stoppable rotor designs N73-21025
Development of rotary wings with cold, hot, and mixed cycle jet propulsion systems and application for torque-free rotor drive system N73-21026
- VIBRATION DAMPING**
Analysis of stall flutter of a helicopter rotor blade. [AIAA PAPER 73-403] A73-25532
European contribution to structural response to noise. [AIAA PAPER 73-332] A73-25561
In-flight flutter testing methods for determining aircraft structure natural frequencies and vibration damping ratios with air flow A73-26593
- VIBRATION ISOLATORS**
Simple mathematical models of mechanical systems for ground support equipment, airborne launcher, vibration isolation design [AD-754537] N73-20283
- VIBRATION MODE**
Gradient optimization of structural weight for specified flutter speed. [AIAA PAPER 73-390] A73-25519
Vibration and local edge buckling of thermally stressed, wedge airfoil cantilever wings. [AIAA PAPER 73-327] A73-25557
Deformation equations of a propeller blade and the orthogonality characteristics of its normal mode shapes of vibration A73-27085
- VISCOUS FLOW**
Developments in techniques for analyzing boundary layer characteristics of rotary wings based on unsteady viscous-inviscid interaction N73-21046
- VOICE COMMUNICATION**
The use of satellites for aircraft communications and air traffic control. A73-27666
Balloon-aircraft ranging, data, and voice experiment. A73-27680
- VORTEX SHEETS**
Analysis of point vortex approximation of vortex sheet in two space dimensions and application to vortex sheet induced by elliptically loaded wing [AD-755007] N73-20335
- VORTEX STRUCTURES**
Synthesis of helicopter rotor tips for less noise. A73-24981
- VORTICES**
Aerodynamics of wake vortices. A73-26385
Effect of wing span loading on wing trailing vortices [AD-754055] N73-20003
Application of momentum theory to determine performance limits of propellers, and lifting rotors with axes parallel to undisturbed flow [AD-754072] N73-20025
- Three component wake velocity measurements of full scale OH-13 helicopter rotary wing during hovering flight [AD-754644] N73-20030
Procedures for measuring velocity distribution through helicopter rotor blade tip vortex using single full scale rotor blade N73-21034
Analysis of electrical charge generated by helicopter rotor operating near particulate matter with seeded vortex [AD-755282] N73-21080
- W**
- WATER EROSION**
Test rails possibilities for rain erosion phenomena study on aircraft or missile structures A73-25296
Airliner radomes erosion by atmospheric precipitation, water penetration, icing, bird and stone impact and lightning A73-25297
Aircraft and missile radomes technology in France, discussing materials, antenna radiation pattern calculation, computer programming for transmission and angular aberrations, and raindrop erosion tests A73-25301
- WAVE DRAG**
Critique of paper on supersonic aircraft configuration with zero wave drag, discussing tubular outer structure and convergent-divergent inner duct A73-25798
- WAVE FRONT RECONSTRUCTION**
The application of holography to sonic boom investigations. A73-26633
- WAVE PROPAGATION**
European contribution to structural response to noise. [AIAA PAPER 73-332] A73-25561
- WEAPON SYSTEMS**
Electromagnetic compatibility of avionic weapon system [AD-754412] N73-20262
Manual on electromagnetic compatibility and interference between aircraft weapon systems [AD-754411] N73-20263
- WEAR**
Spectroscopic, photometric, and electron microscope analyses of metal wear particles in JT3D turbojet engine oil [DLR-FB-73-06] N73-21417
- WEATHER FORECASTING**
Research and development projects of Federal Aviation Administration to provide improved weather data acquisition and distribution [FAA-ED-15-1] N73-20662
- WEATHER MODIFICATION**
Air Weather Service fog dispersal and weather modification program [AD-755659] N73-21533
- WEIGHTLESSNESS**
Analysis of KC-135 flight samples of Star-J Satellite solidified in near-zero gravity [NASA-CR-124179] N73-20610
- WESTLAND AIRCRAFT**
Flight tests of Westland Scout helicopter fitted with reduced scale version of rigid rotor to determine airworthiness and handling characteristics N73-21017
- WIND EFFECTS**
Theory of sound scattering by turbulence applied to scattering cross section calculation for turbulent jet flow and wind, discussing jet noise reduction A73-26496
- WIND SHEAR**
Parawing-drag chute system operation on wind shear energy to maintain payload flight altitude A73-25787
- WIND TUNNEL MODELS**
Design and evaluation of miniature control surface actuation systems for aeroelastic models. [AIAA PAPER 73-323] A73-25553

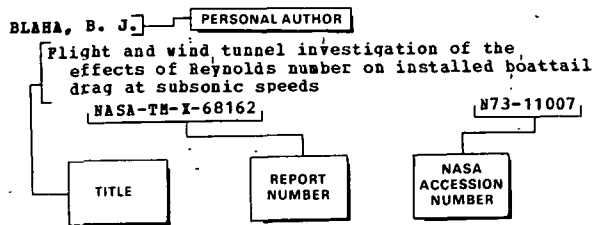
WIND TUNNEL STABILITY TESTS

SUBJECT INDEX

- Flutter technology in the United Kingdom - A survey.
[AIAA PAPER 73-330] A73-25559
- Wind tunnel tests to determine low speed aerodynamic characteristics of large scale V/STOL transport models with lift fan lift-cruise fan propulsion system
[NASA-TM-X-62231] N73-20014
- Development of advancing blade concept rotary wing and wind tunnel tests of full scale model
N73-21029
- Wind tunnel tests to determine effects of blade twist and aeroelasticity on tilt rotor performance from hover to mach number 0.7
N73-21049
- Wind tunnel tests to determine effects of nonrotating components on helicopter performance and application for helicopter design optimization
N73-21052
- WIND TUNNEL STABILITY TESTS**
- Scale effect on swept wings at subsonic speed on basis of pressure distribution measured in flight and on wind tunnel super VC 10 model
[ARC-R/M-3707] N73-20999
- WIND TUNNEL WALLS**
- Correction for change in fluid flow curvature about a lift-generating airfoil in a two-dimensional test section with perforated walls
A73-25864
- WIND TUNNELS**
- Existing position and future prospects of wind tunnels in European research
[AGARD-AR-60] N73-20269
- Evaluation of acoustic properties of conventional wind tunnels for analyzing aerodynamically generated noise
[NASA-CR-114575] N73-20277
- WING FLAPS**
- Variations in the sound field of a STOL aircraft as a function of wing-flap deflection
A73-26592
- Analysis of the aerodynamic characteristics of wing lift augmentation devices
A73-26824
- WING LOADING**
- Aerodynamics of wake vortices.
A73-26385
- Analysis of point vortex approximation of vortex sheet in two space dimensions and application to vortex sheet induced by elliptically loaded wing
[AD-755007] N73-20335
- WING OSCILLATIONS**
- Parametric studies of the wing flutter behavior of a STOL transport.
[AIAA PAPER 73-394] A73-25523
- Calculation of unsteady transonic aerodynamics for oscillating wings with thickness.
[AIAA PAPER 73-316] A73-25547
- Response-optimum control of the angular and torsional oscillations of an elastic flying wing.
A73-27459
- Procedures for calculating velocity potential and pressure distribution of planforms oscillating harmonically in supersonic flow
[POK-X-440] N73-19994
- Calculation and measurement of aerodynamic forces on oscillating airfoil with and without aerodynamic stalling
N73-21042
- WING PLANFORMS**
- Unsteady subsonic compressible flow around finite thickness wings.
[AIAA PAPER 73-313] A73-25544
- Development and applications of supersonic unsteady consistent aerodynamics for interfering parallel wings.
[AIAA PAPER 73-317] A73-25548
- Development of computer program and algorithm for determining interference between lifting surface elements at various Mach numbers
[NASA-CR-112264] N73-21272
- WING PROFILES**
- Analysis of the aerodynamic characteristics of wing-lift augmentation devices. II
A73-25796
- Solid profile wing motion in ideal incompressible fluid at variable distance from screen in terms of small perturbation theory
A73-27815
- WING SPAN**
- Effect of wing span loading on wing trailing vortices
[AD-754055] N73-20003
- WINGS**
- Creep analysis of a thin-walled wing on the basis of the plate analogy
A73-27086
- Comparisons between analog and numerical methods for studying response of an aircraft
[PUBL-97] N73-21007
- X**
- X-22 AIRCRAFT**
- Flight test of X-22 aircraft to determine longitudinal stability requirements of short takeoff aircraft during terminal area operations
[AD-754840] N73-20029
- XH-51 HELICOPTER**
- Flight tests of XH-51 helicopter to determine effects of gyroscopes and control spring modifications on stability and control
N73-21015
- Y**
- YAW**
- Aircraft and spacecraft hand controllers for yaw, pitch, and roll
[NASA-CASE-MSC-12394-1] N73-20041
- YAWING MOMENTS**
- Characteristics of system for providing yaw control of vehicles at high supersonic and hypersonic speeds by deflecting flaps mounted on upper wing surface
[NASA-CASE-LAR-11140-1] N73-20008

PERSONAL AUTHOR INDEX

Typical Personal Author Index Listing



Listings in this index are arranged alphabetically by personal author. The title of the document provides the user with a brief description of the subject matter. The report number helps to indicate the type of document cited (e.g., NASA report, translation, NASA contractor report). The accession number is located beneath and to the right of the title, e.g., N73-11007. Under any one author's name the accession numbers are arranged in sequence with the IAA accession numbers appearing first.

A

- ADDY, A. L.**
A study of the effects of boundary layer on axisymmetric jet-on base pressure in transonic and supersonic flows
[AD-754640] N73-20326
- AIKEN, T. W.**
Results of full-scale wind tunnel tests on the H.126 jet flap aircraft
[NASA-TN-D-7252] N73-20997
- AJAYKUMAR, K.**
Evaluation of lift and drag of a family of conically cambered wings at off design Mach numbers.
A73-27927
- AKERSTEDT, C.**
Malmo-Sturup, Sweden's colourful airport.
A73-25207
- ALEKSANDROV, V.**
The electrostatic charge of the aircraft
A73-26722
- ALEKSANDROV, V. S.**
Methods of determining the electrically dangerous zones in nimbo-stratus
[NLL-N-22800-(5828.4F)] N73-20656
- ALLEN, W. K.**
Doppler compensation by shifting transmitted object frequency within limits
[NASA-CASE-GSC-10087-4] N73-20174
- ANDERSON, D.**
Gyro characteristics for rapid gyrocompassing
N73-20709
- ANDERSON, D. W.**
Effect of premixing on nitric oxide formation
[NASA-TM-X-68220] N73-21862
- ANDERSON, L. B.**
Study of high-altitude aircraft wake Dynamics.
Task 1: Problem definition
[AD-754918] N73-20447
- ANSLOW, W. G.**
Long haul airlines and satellite communications.
A73-27671
- APPA, K.**
Development and applications of supersonic unsteady consistent aerodynamics for interfering parallel wings.
[AIAA PAPER 73-317] A73-25548
- APPLEMAN, H. S.**
Air weather service weather-modification program, FY 1972
[AD-755659] N73-21533

- ARNDT, R. E. A.**
Aeroacoustic research in wind tunnels: A status report
[NASA-CR-114575] N73-20277
- ASCHOFF, V.**
Mission and organization of the DFVLR: Two years of integrated society of German aeronautical and space flight research
N73-20961
- ASHLEY, H.**
Static aeroelasticity and the flying wing.
[AIAA PAPER 73-397] A73-25526
- ATENCIO, A., JR.**
Low speed wind tunnel investigation of a large scale lift fan STOL transport model
[NASA-TM-X-62231] N73-20014

B

- BABCOCK, D. F.**
Improvements in the use of FAA resources for system performance assurance.
A73-27364
- BABIASE, E.**
Illumination of aircraft cockpit instrument indicators
A73-26825
- BABUNKER, A.**
On the management of German aerotechnology during the first half century 1900 to 1945
N73-20956
- BAILEY, C. D.**
Vibration and local edge buckling of thermally stressed, wedge airfoil cantilever wings.
[AIAA PAPER 73-327] A73-25557
- BAILEY, C. L., JR.**
Three axes controller
[NASA-CASE-HSC-12394-1] N73-20041
- BALDOCK, J. C. A.**
Flutter technology in the United Kingdom - A survey.
[AIAA PAPER 73-330] A73-25559
- BALFOUR, C.**
How real are the pilot's problems.
A73-27599
- BALLHAUS, W. F.**
The effect of planform shape on the transonic flow past rotor tips
N73-21048
- BALMFORD, D. E. H.**
Ground and flight test experience with the Westland Scout hingeless rotor helicopter
N73-21017
- BARANOV, I. A.**
The effect of the ovality of the balls of a radial-thrust bearing on the axial vibration of a rapidly rotating rotor of an engine
[AD-754615] N73-20546
- BARTLETT, F. D., JR.**
The development of a controlled lateral gust facility for determining the transfer function of a lifting surface
N73-21248
- BARTLETT, M. W.**
Design of control and display panels using computer algorithms.
A73-25180
- BARTON, C. K.**
A single number rating for effective noise reduction.
A73-25000
- BASTIAN, C.**
Regional airport systems study: Final Plan.
A73-26125

BATEMAN, T. E. B.

PERSONAL AUTHOR INDEX

- BATEMAN, T. E. B.
A comparison of wing pressure distributions measured in flight and on a wind tunnel model of the super VC 10
[ARC-R/H-3707] N73-20999
- BATILL, S. M.
An investigation of unsteady aerodynamics on an oscillating airfoil.
[AIAA PAPER 73-318] A73-25549
- BECKER, K. F.
Hydraulics for V/STOL aircraft. A73-26271
- BELAND, R. D.
Aircraft noise impact-planning guidelines for local agencies
[PB-213020] N73-20759
- BENDER, J.
Aeroacoustic research in wind tunnels: A status report
[NASA-CR-114575] N73-20277
- BENETKA, J.
Correction for change in fluid flow curvature about a lift-generating airfoil in a two-dimensional test section with perforated walls
A73-25864
- BENNETT, R. M.
An automated procedure for computing flutter eigenvalues.
[AIAA PAPER 73-393] A73-25522
- BENNETT, W. F.
Non-destructive testing of adhesive bonding. A73-26299
- BENT, R. D.
Basic science for aerospace vehicles /4th edition/. A73-27054
- BERGMANN, G. E.
Design and evaluation of miniature control surface actuation systems for aeroelastic models.
[AIAA PAPER 73-323] A73-25553
- BERNARD, P. S.
Discretization of a vortex sheet, with an example of a roll-up
[AD-755007] N73-20335
- BERNER, S.
Reliability and safety of operating mechanical helicopter pieces
N73-21012
- BERTHOUX, M.
Tactical flight of helicopter and repercussions on the conception
N73-21009
- BEYER, R.
Display for aircraft landing at a steep angle
A73-25440
Efficiency studies on cockpit displays
[NASA-TT-F-14846] N73-20019
Assessment of cockpit displays
[DLR-PB-73-03] N73-21400
- BHINDER, P. S.
A reappraisal of design methods for inward flow radial gas turbines.
A73-26370
- BIANCHI, E.
Developments of the SV-20 program
A73-27383
- BIRKHOLZ, B.
ARTS 3 augmented tracking study
[PX-6392] N73-21177
- BLUME, W.
Study on the limit efficiency of lightning conductors on aircraft radomes.
A73-25303
- BOATWRIGHT, D. W.
Measurements of velocity components in the wake of a full scale helicopter rotor in hover
[AD-754644] N73-20030
- BOGOMOLOV, E. M.
Influence of the turbine air cooling system on the characteristics of a turbojet engine during regulation of the latter
A73-27091
- BOHL, P. B.
Electrical charging of a cylinder by a seeded vortex
[AD-755282] N73-21080
- BONANI, C.
Radome technology in France
A73-25301
- BOSCO, A.
Aerodynamics of helicopter components other than rotors
N73-21052
- BOWES, M. A.
Test and evaluation of a quiet helicopter configuration HH-43B.
A73-25383
- BOYTOS, J. P.
J52-P-8 engine compressor stall margin acceptance tests
[AD-755152] N73-20832
- BRADLEY, J.
Seismic vibrations induced by Concorde sonic booms.
A73-26292
- BRAIN, D. J.
The disc antenna - A possible L-band aircraft antenna.
A73-27655
- BRATANOW, T.
Sensitivity of rotor blade vibration characteristics to torsional oscillations.
[AIAA PAPER 73-404] A73-25533
- BRAYBROOK, L. J.
The use of satellites for aircraft communications and air traffic control.
A73-27666
- BRIGHT, C.
Comparison of mobile source emissions from aircraft, automobiles, buses, trucks, railroads, and electric trains (Project Eagle)
[FAA-EQ-73-2] N73-21522
- BRIGNONE, S.
Condition monitoring - A new technology for aircraft engine maintenance
A73-27389
- BROTHERHOOD, P.
Some flight experiments on the XH-51 N helicopter
N73-21015
The derivation and verification of a new rotor profile on the basis of flow phenomena; aerofoil research and flight tests
N73-21047
- BROWN, B.
Statistical method for measuring aeronautical activity at nontowered airports
[SCI-2040] N73-20278
Instructional manual for measuring aeronautical activity at non-towered airports
[SCI-2-2040] N73-20722
- BROWN, C. E.
Aerodynamics of wake vortices.
A73-26385
On the aerodynamics of wake vortices
[AD-754055] N73-20003
- BROWN, G. P.
A linearized potential flow theory for airfoils with spoilers.
A73-25853
- BROWN, G. W.
A vortex analysis of a single bladed hovering rotor and a comparison with experimental data
N73-21035
- BROWN, K. E.
Gyro characteristics for rapid gyrocompassing
N73-20709
- BROWNE, G. C.
A comparison of wing pressure distributions measured in flight and on a wind tunnel model of the super VC 10
[ARC-R/H-3707] N73-20999
- BRUSSAT, T. R.
Preliminary design of aircraft structures to meet structural integrity requirements.
[AIAA PAPER 73-374] A73-25506
- BURDSALL, E. A.
High loading, low speed fan study, 5
[NASA-CR-121148] N73-21070
- BURGESS, R. K.
Development of the ABC rotor
N73-21029
- BURMAN, E. I.
Contribution to the theory of the finite element method applied to the overall stress analysis of a fuselage
A73-27084

- BURMISTROV, A. I.**
Application of certain generalized data from wind-tunnel tests with plane subsonic compressor cascades to the calculation of the characteristic flow regimes in supersonic cascades
A73-27480
- BUSCH, G.**
Investigation of KC-135 flight samples solidified in near-zero gravity
[NASA-CR-124179] N73-20610
- BYRDSONG, T. A.**
Some effects of grooved runway configurations on aircraft tire braking traction under flooded runway conditions
[NASA-TN-D-7215] N73-21057
- C**
- CADMAN, R. B.**
Test plan to substantiate the capacity of E-2A arrested landings
[AD-754752] N73-20284
Hook bounce test of the E-2A airplane A-frame
[AD-754753] N73-20285
Hook bounce test of the C-2A airplane arresting gear A-frame
[AD-754077] N73-20288
Test plan to substantiate the capacity of the C-2A arresting hook A-frame to sustain 3,000 arrested landings
[AD-754076] N73-20289
- CADY, L.**
ARTS 3 augmented tracking study
[PX-6392] N73-21177
- CALL, R. W.**
A new approach to Doppler-inertial navigation /Doppler Beam Sampling/.
A73-27162
- CARADONNA, P. X.**
The effect of planform shape on the transonic flow past rotor tips
N73-21048
- CARLSON, C.**
Statistical method for measuring aeronautical activity at nontowered airports
[SCI-2040] N73-20278
Instructional manual for measuring aeronautical activity at non-towered airports
[SCI-2-2040] N73-20722
- CARTA, P. O.**
An exploratory investigation of the unsteady aerodynamic response of a two-dimensional airfoil at high reduced frequency.
[AIAA PAPER 73-309] A73-25540
- CARTER, E. S.**
Impact of new structural concepts on system capabilities
N73-21021
- CASABOSA, C.**
Certain fatigue phenomena in aeronautical structures with stiffened shells
A73-27394
- CATO, R. J.**
Ignition and fire suppression in aerospace vehicles (phase 2)
[AD-755362] N73-21079
- CEBECI, T.**
A general method for calculating three-dimensional incompressible laminar and turbulent boundary layers. 1: Swept infinite cylinders and small cross flow
[AD-754440] N73-20004
- CHEN, A. W.**
The determination of the geometries of multiple element airfoils optimized for maximum lift coefficient
N73-20996
- CHENEY, M. C., JR.**
Rotor wakes: Key to performance prediction
N73-21032
- CHERNENKO, ZH. S.**
Design and stability of airplanes and helicopters
A73-26256
- CHIARA, G.**
Systems analysis in aerospace projects
A73-27384
- CHIPMAN, R. R.**
Flutter of pairs of aerodynamically interfering delta wings.
[AIAA PAPER 73-314] A73-25545
- CHORIN, A. J.**
Discretization of a vortex sheet, with an example of a roll-up
[AD-755007] N73-20335
- CHU, C.**
The calculation of three-dimensional supersonic flows around spherically-capped smooth bodies and wings. Volume 2: Manual for computer programs
[AD-753696] N73-21002
- CHUANG, C. A.**
Analytic radar target modeling
[AD-755854] N73-21189
- CLARK, J. O.**
Long haul airlines and satellite communications.
A73-27671
- CLARK, R. P.**
Design of a Kalman derived, fixed, gain, hybrid navigation system
N73-20701
Design of a Kalman derived, fixed gain, hybrid navigation system
[AD-754548] N73-20731
- CLARK, S. K.**
Structural modeling of aircraft tires
[NASA-CR-2220] N73-21006
- CLARKSON, B. L.**
European contribution to structural response to noise.
[AIAA PAPER 73-332] A73-25561
- COCKSHUTT, B.**
Propulsion nozzles - Experimental analysis on models
A73-27388
- COHEN, B.**
Corrosion fatigue in the aerospace industry.
A73-25803
- COINER, J. C.**
Variations in the detectability of major airports in northeastern Kansas and northwestern Missouri
[E73-10471] N73-21308
- COLEMAN, H. W.**
Turbulent heat transfer to a fin leading edge - Flight test results.
A73-26405
Turbulent heat transfer and pressure on leading edges of fins mounted on a cone
[SCL-RR-72-0308] N73-21863
- COLLINS, J. H.**
Potential applications of acoustic matched filters to air-traffic control systems.
A73-27572
- COMBERFORD, G. L.**
An exploratory investigation of the unsteady aerodynamic response of a two-dimensional airfoil at high reduced frequency.
[AIAA PAPER 73-309] A73-25540
- CONN, A. P.**
High frequency fatigue testing of Udinet 700 at 1400 F
[NASA-CR-120958] N73-21845
- CONTI, R. J.**
Study of high-altitude aircraft wake Dynamics. Task 1: Problem definition
[AD-754918] N73-20447
- COOK, A. H.**
Results of full-scale wind tunnel tests on the H.126 jet flap aircraft
[NASA-TN-D-7252] N73-20997
- COOK, C. V.**
The structure of the rotor blade tip vortex
N73-21034
- COOK, W. L.**
A summary of wind tunnel research on tilt-rotors from hover to cruise flight
N73-21049
- COONIER, R. V.**
Extremes of low atmospheric density near the ground for elevations up to 15,000 feet for MIL-STD-210B
[AD-755791] N73-21382
- CORON, W.**
A 32-cm airborne infrared observatory.
A73-26503

- CORRENTI, V.
Methodologies for the analysis of transport requirements with particular regard to the aeronautic case
A73-27070
- CREAGER, M.
Preliminary design of aircraft structures to meet structural integrity requirements.
[AIAA PAPER 73-374] A73-25506
- CREMIN, J.
Concepts for improvement of airport surveillance radars
[ATC-14] N73-20183
- CRESS, T. S.
Air weather service weather-modification program, FY 1972
[AD-755659] N73-21533
- CRILLY, E. B.
Flight service evaluation of PRD-49/epoxy composite panels in wide bodied commercial transport aircraft
[NASA-CR-112250] N73-20018
- CRIMI, P.
Analysis of stall flutter of a helicopter rotor blade.
[AIAA PAPER 73-403] A73-25532
- CROSBY, J. J.
Fretting resistant coatings for titanium alloys.
A73-25838
- CRUZ, J. E.
Aircraft sound-description system: Background and application
[FAA-EQ-73-3] N73-21064
- CUNNINGHAM, A. H., JR.
The application of general aerodynamic lifting surface elements to problems in unsteady transonic flow
[NASA-CR-112264] N73-21272
- D**
- DAMBRA, F.
Measure of helicopter noise during flight
N73-21055
- DARBY, B. J.
Potential applications of acoustic matched filters to air-traffic control systems.
A73-27572
- DARPENTIGNY, C.
A 32-cm airborne infrared observatory.
A73-26503
- DAT, B.
The theoretical and experimental methods used in France for flutter prediction.
[AIAA PAPER 73-329] A73-25558
- DEDIEU, J.
Measure of helicopter noise during flight
N73-21055
- DEICH, M. E.
Method of calculating a two-phase ejector
[AD-754051] N73-20831
- DEL PUGLIA, A.
Certain fatigue phenomena in aeronautical structures with stiffened shells
A73-27394
- DELUCCIA, R. A.
Rotor burst protection program: Statistics on aircraft gas turbine engine failures that occurred in commercial aviation during 1971
[NASA-CR-131525] N73-21692
- DESHARAI, R. N.
An automated procedure for computing flutter eigenvalues.
[AIAA PAPER 73-393] A73-25522
- DIEDRICH, J. H.
Performance characteristics of a model VTOL lift fan in crossflow.
A73-25782
- DIKII, N. A.
Method of calculating a two-phase ejector
[AD-754051] N73-20831
- DODGE, E. H.
Structural modeling of aircraft tires
[NASA-CR-2220] N73-21006
- DREHER, R. C.
Experimental investigation of the cornering of a C40 x 14-21 cantilever aircraft tire
[NASA-TN-D-7203] N73-21058
- DUFFY, R. A.
Summary of new developments at the Draper Laboratory
N73-20686
- DUPRANE, K. F.
Sleeve bearing materials and lubricants for advanced airframes
[AD-754759] N73-20540
- DUNHAM, R. E., JR.
A flight investigation of the trailing vortices generated by a jumbo jet transport
[NASA-TN-D-7172] N73-21068
- DUNN, W. R.
Microprogrammed digital filters for strapdown guidance application.
A73-27168
- DUROV, V. H.
The combat use and combat effectiveness of fighter-interceptors
[AD-751512] N73-21894
- DWYER, W. J.
An automated procedure for the optimization of aerospace structures
N73-21005
- E**
- EBSEW, H. E.
Advanced hydrofluidic stabilization system
[AD-754602] N73-20032
- ECER, A.
Sensitivity of rotor blade vibration characteristics to torsional oscillations.
[AIAA PAPER 73-404] A73-25533
- EKVALL, J. C.
Preliminary design of aircraft structures to meet structural integrity requirements.
[AIAA PAPER 73-374] A73-25506
- ELLIOTT, C. T.
Design of a Kalman derived, fixed, gain, hybrid navigation system
N73-20701
- Design of a Kalman derived, fixed gain, hybrid navigation system
[AD-754548] N73-20731
- ERICSSON, L. E.
Dynamic effects of shock-induced flow separation.
[AIAA PAPER 73-308] A73-25539
- F**
- FEDCHENKO, A.
The electrostatic charge of the aircraft
A73-26722
- FEDER, A.
Utilization of the Doppler effect to measure the drift angle and the ground speed of an aircraft
A73-25797
- FEO, G.
A modern mechanical laboratory for the support of aircraft engine design
A73-27385
- FERRARI, E.
Summary of FY 1972 activities on Air Force Systems Command (AFSC) program 634A: Communication, Navigation Identification (CNI) system development planning
[AD-754930] N73-20207
- FISCHER, C.
Research and development on rotors with tip reaction drive in Germany
N73-21026
- FISHER, J. J.
Electromagnetic compatibility manual
[AD-754411] N73-20263
- FISHER, H. J.
Design of a Kalman derived, fixed, gain, hybrid navigation system
N73-20701
- Design of a Kalman derived, fixed gain, hybrid navigation system
[AD-754548] N73-20731
- FOERSCHING, H.
The effect of servomechanical control and stability systems on the flutter behavior of aircraft
A73-25349

- FOX, H.
Studies of engine-airframe integrated hypersonic vehicles
[NASA-CR-112300] N73-20022
- FRADENBURGH, E. A.
Aerodynamic factors influencing overall hover performance N73-21038
- FRAZIER, R. A.
In-band compatibility analysis of the RTCA-proposed microwave Landing Guidance System (LGS) and candidate systems [ECAC-PR-72-069] N73-21554
- PULTON, R. E.
Application of computer-aided aircraft design in a multidisciplinary environment. [AIAA PAPER 73-353] A73-25490
- G**
- GABRIELLI, G.
Observations on some technical aspects of guided air cushion vehicles N73-20969
- GALANTI, C. J.
Design of a Kalman derived, fixed, gain, hybrid navigation system N73-20701
Design of a Kalman derived, fixed gain, hybrid navigation system [AD-754548] N73-20731
- GALLOT, J.
Fenestron: New solution of tail rotor N73-21028
- GANIEV, R. F.
Stability and nonlinear oscillations of a helicopter A73-27791
- GARNICAREK, R.
Analysis of the aerodynamic characteristics of wing-lift augmentation devices. II A73-25796
Analysis of the aerodynamic characteristics of wing lift augmentation devices A73-26824
- GARRETT, P. H.
Optimum adaptive phase estimation receiver for one-way ranging aircraft navigation [AD-754031] N73-20727
- GARTSHORE, I. S.
The development of an efficient hovering propeller/rotor performance prediction method N73-21040
- GASPAROVIC, H.
Gas-turbine processes with interrupted expansion and interrupted compression A73-26371
- GASTINEL, H.
Materials for Mach 3 aircraft radomes A73-25291
- GAUNTNER, D. J.
An adverse effect of film cooling on the suction surface of a turbine vane [NASA-TN-X-68210] N73-21695
- GAUNTNER, J. W.
An adverse effect of film cooling on the suction surface of a turbine vane [NASA-TN-X-68210] N73-21695
- GAWAIN, T. H.
Generalized performance limits for propellers, windmills and lifting rotors with axes parallel to the undisturbed flow [AD-754072] N73-20025
- GEISLER, W.
Calculation of the potential flow past axisymmetric annular profiles A73-25348
- GENET, R. H.
Life cycle cost analysis of inertial systems for aircraft and air to surface missiles N73-20717
- GERANZANI, A.
Graphic-interactive analysis of the velocity field around blade cascades for turbomachines A73-27387
- GERKEI, U.
Analysis of the operational parameters of a bypass turbojet A73-27069
- GHOSE, R. H.
Reduction of ILS errors caused by building reflections. A73-25784
- GILCHRIST, I. J.
Design integration and noise studies for jet STOL aircraft. Task 7B: Wind tunnel investigation of a 14-percent-thick airfoil with upper surface blowing at high subsonic Mach numbers [NASA-CR-114560] N73-19998
- GILHAM, A. E.
Message organization in the ground segment of an aeronautical satellite system. A73-27668
- GILLFILLAN, W. E.
Regional airport systems study: Final Plan. A73-26125
- GILLMORE, K. B.
Survey of tilt rotor technology development N73-21027
- GILMORE, D. C.
The development of an efficient hovering propeller/rotor performance prediction method N73-21040
- GLADCHENKO, N. K.
Some causes for the appearance of the 'extraneous noise' defect in transfer pumps of aircraft fuel systems A73-27094
- GLADDEEN, H. J.
An adverse effect of film cooling on the suction surface of a turbine vane [NASA-TN-X-68210] N73-21695
- GLAESER, W. A.
Sleeve bearing materials and lubricants for advanced airframes [AD-754759] N73-20540
- GLASS, R. E.
Analysis of operational noise measurements in terms of selected human response noise evaluation measures [FAA-RD-71-112] N73-21074
- GOFF, W. E.
The Lynx's rotor system. A73-25790
- GOGOLIN, V. P.
Optimization of aircraft parameters A73-27095
- GOLD, B.
Concepts for improvement of airport surveillance radars [ATC-14] N73-20183
- GOODYKOONTZ, J. H.
Noise measurements for various configurations of a model of a mixer nozzle externally blown flap system [NASA-TN-X-2776] N73-21059
- GRAHAM, H. A.
New York offshore airport feasibility study [FAA-RD-73-45] N73-20280
- GRANT, P. E.
Potential applications of acoustic matched filters to air-traffic control systems. A73-27572
- GRAY, D. C.
Results of noise surveys of seventeen general aviation type aircraft [FAA-EQ-73-1] N73-21063
- GRAY, R. B.
A vortex analysis of a single bladed hovering rotor and a comparison with experimental data N73-21035
- GRISDALE, G. L.
Traffic channel assignment in the mobile services. A73-27670
- GRYGA, A.
Problems involving the shape of a supersonic aircraft A73-25798
- GUTIERREZ, O. A.
Small-scale noise tests of a slot nozzle with V-gutter target thrust reverser [NASA-TN-X-2758] N73-21072
- GWIN, L. B.
A general method for flutter optimization. [AIAA PAPER 73-391] A73-25520

H

- HAILBRONNER, K.
The protection of the air frontier in peace
A73-26257
- HAINES, A. B.
A comparison of wing pressure distributions measured in flight and on a wind tunnel model of the super VC 10 [ARC-R/M-3707]
N73-20999
- HALL, L. P.
Low speed wind tunnel investigation of a large scale lift fan STOL transport model [NASA-TN-X-62231]
N73-20014
- HANMAL, K.
A 32-cm airborne infrared observatory.
A73-26503
- HANMOND, C. B.
A compressible unsteady theory for helicopter rotors
N73-21044
- HANKO, K.
Comparison of mobile source emissions from aircraft, automobiles, buses, trucks, railroads, and electric trains (Project Eagle) [FAA-EQ-73-2]
N73-21522
- HANSEN, S. D.
Reliability and quality control of production engineering computer programs. [AIAA PAPER 73-356]
A73-25493
- HARDIE, J. C.
Analysis of noise produced by an orderly structure of turbulent jets [NASA-TN-D-7242]
N73-21573
- HARDEATH, H. F.
Structural integrity in aircraft.
A73-25128
- HARDY, D. L., JR.
Life cycle cost analysis of inertial systems for aircraft and air to surface missiles
N73-20717
- HAROULES, G. G.
Signal processing in the Air Traffic Control Radar Beacon System.
A73-27165
- HARRIS, D. G.
The use of a cluster rotated inertial system, in a strike aircraft environment
N73-20704
- HASDORFF, L.
Evaluation of glide paths for landing a VTOL airplane using linear regulator theory.
A73-27154
- HASEKAMP, A. J. L. R.
Some test cases, based on analytical methods in linearized supersonic oscillating lifting surface theory, part 2 [POK-X-440]
N73-19994
- HAYDEN, R. E.
A preliminary evaluation of noise reduction potential for the upper surface blown flap [NASA-CR-112246]
N73-20017
- HEDEEN, J. O.
Advanced hydrofluidic stabilization system [AD-754602]
N73-20032
- HELFAND, R.
Comparison of mobile source emissions from aircraft, automobiles, buses, trucks, railroads, and electric trains (Project Eagle) [FAA-EQ-73-2]
N73-21522
- HELLER, R.
Comparison of mobile source emissions from aircraft, automobiles, buses, trucks, railroads, and electric trains (Project Eagle) [FAA-EQ-73-2]
N73-21522
- HEESH, A. S.
Sound directivity pattern radiated from small airfoils.
A73-24980
- HESS, J. L.
Higher order numerical solution of the integral equation for the two-dimensional Neumann problem.
A73-25434
- HESS, R. W.
Flutter of pairs of aerodynamically interfering delta wings. [AIAA PAPER 73-314]
A73-25545
- HILL, A. B.
A new look at helicopter level flight performance
N73-21014
- HIRST, D.
Factors affecting the frequency chosen for aircraft to satellite communications.
A73-27667
- HIRTH, A.
The application of holography to sonic boom investigations.
A73-26633
- HODGES, D. H.
Stability of elastic bending and torsion of uniform cantilevered rotor blades in hover. [AIAA PAPER 73-405]
A73-25534
- HODGES, G. E.
Active flutter suppression - B-52 controls configured vehicle. [AIAA PAPER 73-322]
A73-25552
- HOEPPNER, D. W.
Crack propagation of aluminum alloys in corrosive environments.
A73-25826
- HOPPMAN, W. C.
Functional error analysis and modeling for ATC system concepts evaluation [PB-213148]
N73-20730
- HOPSTETTER, E.
Concepts for improvement of airport surveillance radars [ATC-14]
N73-20183
- HOLBROOK, H. R.
Backswept impeller and vane island diffuser and shroud for NASA advanced-concepts compressor test rig [NASA-CR-120942]
N73-20531
- HOLLA, V. S.
Evaluation of lift and drag of a family of conically cambered wings at off design Mach numbers.
A73-27927
- HOLLENBAUGH, R. C.
Doppler compensation by shifting transmitted object frequency within limits [NASA-CASE-GSC-10087-4]
N73-20174
- HOLLISTER, W. H.
Functional error analysis and modeling for ATC system concepts evaluation [PB-213148]
N73-20730
- HORWITZ, D. L.
Development of a gyro-less digital flight director [AD-754028]
N73-20726
- HOSHIZAKI, H.
Study of high-altitude aircraft wake dynamics. Task 1: Problem definition [AD-754918]
N73-20447
- HOYDISH, W.
Studies of engine-airframe integrated hypersonic vehicles [NASA-CR-112300]
N73-20022
- HSU, Y. H.
Comparison of mobile source emissions from aircraft, automobiles, buses, trucks, railroads, and electric trains (Project Eagle) [FAA-EQ-73-2]
N73-21522
- HUBER, H. B.
Influence of elastic coupling effects on the handling qualities of a hingeless rotor helicopter
N73-21016
- Some objectives in applying hingeless rotors to helicopters and V/STOL aircrafts
N73-21051
- HUFF, R. G.
Jet exhaust noise suppressor [NASA-CASE-LEW-11286-1]
N73-21066
- HUNTER, M. S.
Stress corrosion fatigue of aluminum pressure cylinders.
A73-25827
- IKUI, T.
Researches on the two-dimensional retarded cascade. III - Cascade performances at high inlet angles.
A73-26338

- Researches on the two-dimensional retarded cascade. IV - Determination of blade elements at retarded blade row. A73-26339
- ILYANKOV, A. I.**
The effect of the ovality of the balls of a radial-thrust bearing on the axial vibration of a rapidly rotating rotor of an engine [AD-754615] N73-20546
- INCROCCI, T. P.**
Mountain waves and CAT encountered by the XB-70 in the stratosphere. A73-25785
- INGEBO, B. D.**
Effects of prevaporized fuel on exhaust emissions of an experimental gas turbine combustor. A73-26424
- INGRAM, C. W.**
An investigation of unsteady aerodynamics on an oscillating airfoil. [AIAA PAPER 73-318] A73-25549
- INOUE, M.**
Researches on the two-dimensional retarded cascade. III - Cascade performances at high inlet angles. A73-26338
- Researches on the two-dimensional retarded cascade. IV - Determination of blade elements at retarded blade row. A73-26339
- ISRAEL, D. B.**
How to think more clearly about future air traffic systems or a handful of rules-of-thumb. A73-27362
- JACOBSON, R. H.**
Low cost tactical RPVs [P-4902] N73-21060
- JAMES, C. A.**
Some flight experiments on the YH-51 H helicopter N73-21015
- JANNOT, R.**
Variations in the sound field of a STOL aircraft as a function of wing-flap deflection A73-26592
- JANTZEN, E.**
Spectroscopic analysis of metal wear based on tests of aircraft turbine engine oils [DLR-FB-73-06] N73-21417
- JARVINEN, P. O.**
Wind shear payload support system. A73-25787
- JEBRICK, W.**
Regional airport systems study: Final Plan. A73-26125
- JOATTON, R.**
International programs for stratospheric studies A73-26594
- JOHNSON, D. T.**
Evaluation of energy maneuverability procedures in aircraft flight path optimization and performance estimation [AD-754909] N73-20035
- JOHNSON, M. G., JR.**
A-7 aircraft airborne, ground, and shipboard inertial navigator alignment methodology and results N73-20710
- JOHNSTON, J. B. B.**
The operation of helicopters from small ships N73-21010
- JOHNSTON, B.**
Evaluate improved airport beacon [FAA-NA-73-1] N73-20182
- JONES, P. E.**
Air density and helicopter lift [AD-754420] N73-20026
- JONES, J. A.**
Design calculations for a Halon 1301 distribution tube for an aircraft cabin fire extinguishing system [FAA-NA-73-3] N73-20009
- JONES, J. P.**
Materials for advanced rotorcraft N73-21023
- JORGESEN, L. B.**
A method for estimating static aerodynamic characteristics for slender bodies of circular and noncircular cross section alone and with lifting surfaces at angles of attack from 0 deg to 90 deg [NASA-TN-D-7228] N73-20998
- JUBE, G.**
Environmental problems for airliner radomes A73-25297
- JULIENNE, A.**
Measure of helicopter noise during flight N73-21055
- ## K
- KADMAN, Y.**
A preliminary evaluation of noise reduction potential for the upper surface blown flap [NASA-CR-112246] N73-20017
- KALININ, Y. P.**
Method of calculating a two-phase ejector [AD-754051] N73-20831
- KANIA, W.**
Problems involving the shape of a supersonic aircraft A73-25798
- KAPADIA, K.**
Microprogrammed digital filters for strapdown guidance application. A73-27168
- KASHIWABARA, Y.**
Theory on blades of axial, mixed, and radial turbomachines by inverse method. A73-26340
- KAUPS, K.**
A general method for calculating three-dimensional incompressible laminar and turbulent boundary layers. 1: Swept infinite cylinders and small cross flow [AD-754440] N73-20004
- KAVRAK, I.**
Wake characteristics of a two dimensional asymmetric aerofoil N73-21054
- KAYNE, V. J.**
General aviation and the National Aviation System. A73-27361
- KAYNES, I. W.**
A summary of the analysis of gust loads recorded by counting accelerometers on seventeen types of aircraft [AGARD-R-605] N73-20023
- KEENAN, M. J.**
High loading, low speed fan study, 5 [NASA-CR-121148] N73-21070
- KELLY, G.**
ARTS 3 augmented tracking study [PX-6392] N73-21177
- KEER, R. I.**
Optimization of aircraft structures with multiple stiffness requirements. A73-26298
- KIDA, T.**
A note on the lift coefficient of a thin jet-flapped airfoil. A73-27171
- KIRK, J. V.**
Low speed wind tunnel investigation of a large scale lift fan STOL transport model [NASA-TN-X-62231] N73-20014
- KIRSHEN, M. A.**
The chemistry of fuel deposits and their precursors [AD-754459] N73-20816
- KLASSEN, H. A.**
Performance of a low-pressure-ratio centrifugal compressor with four diffuser designs [NASA-TN-D-7237] N73-19997
- KLESTOV, R. A.**
Response-optimum control of the angular and torsional oscillations of an elastic flying wing. A73-27459
- KLINE, J. P.**
Aerodynamic performance of a core-engine turbine stator vane tested in a two-dimensional cascade of 10 vanes and in a single vane tunnel [NASA-TN-X-2766] N73-20823

- KNIGHT, J. A.
Design of a Kalman derived, fixed, gain, hybrid navigation system N73-20701
- KOBAYASHI, S.
The state of the art in aeroelasticity of aerospace vehicles in Japan. [AIAA PAPER 73-331] A73-25560
- KOCH, E.
Air effects in aircraft hydraulic systems: Measures for their removal [NLL-NEL-TT-2420-(6075.461)] N73-20005
- KONODA, H.
Prediction of height-velocity boundaries for rotorcraft by application of optimization techniques. A73-27175
- KOVICH, G.
Overall and blade-element performance of a transonic compressor stage with multiple-circular-arc blades at tip speed of 419 meters per second [NASA-TM-X-2731] N73-19995
- KRAVETS, V. H.
Motion of a wing of solid profile at a variable distance from a screen A73-27815
- KRETTZ, H.
Fields of application of jet flapped rotors N73-21025
- KRUPP, W. E.
Crack propagation of aluminum alloys in corrosive environments. A73-25826
- KRUTOVA, I. H.
Synthesis of searchless self-adjusting systems based on the root locus method. I. A73-27460
- KUCHARSKI, K.
Utilization of the Doppler effect to measure the drift angle and the ground speed of an aircraft A73-25797
- KUCHTA, J. H.
Ignition and fire suppression in aerospace vehicles (phase 2) [AD-755362] N73-21079
- KUO, C.-C.
Unsteady subsonic compressible flow around finite thickness wings. [AIAA PAPER 73-313] A73-25544
- KUROHARU, H.
Researches on the two-dimensional retarded cascade. III - Cascade performances at high inlet angles. A73-26338
Researches on the two-dimensional retarded cascade. IV - Determination of blade elements at retarded blade row. A73-26339
- KUZNETSOV, Y. D.
Mathematical simulation of flight dynamics [AD-755868] N73-21077
- KYSEB, A. C.
Parametric studies of the wing flutter behavior of a STOL transport. [AIAA PAPER 73-394] A73-25523
- LABITT, H.
Concepts for improvement of airport surveillance radars [ATC-14] N73-20183
Concepts for improvement of airport surveillance radars [ATC-14] N73-20183
- LACKEY, J. I.
Structural modeling of aircraft tires [NASA-CR-2220] N73-21006
- LAGOSIUK, G. S.
Design and stability of airplanes and helicopters A73-26256
- LAKSHMIKANTHAM, C.
The spatial correlation method and a time-varying flexible structure. [AIAA PAPER 73-406] A73-25535
- LAMMINEN, T.
Comparison of mobile source emissions from aircraft, automobiles, buses, trucks, railroads, and electric trains (Project Eagle) [FAA-EQ-73-2] N73-21522
- LANDGRABE, A. J.
Rotor wakes: Key to performance prediction N73-21032
- LANDRUM, E. J.
Application of computer-aided aircraft design in a multidisciplinary environment. [AIAA PAPER 73-353] A73-25490
- LANG, J. E.
Large area Display switching plate design, fabrication and test [AD-755938] N73-21227
- LAPIGIN, V. I.
Supersonic gas flow past the leeward side of a conical wing A73-26439
- LARSON, D., JR.
Investigation of KC-135 flight samples solidified in near-zero gravity [NASA-CR-124179] N73-20610
- LAUGHLIN, C. E., JR.
Doppler compensation by shifting transmitted object frequency within limits [NASA-CASE-GSC-10087-4] N73-20174
- LAZARICK, R. T.
J52-P-8 engine compressor stall margin acceptance tests [AD-755152] N73-20832
- LEBACQZ, J. V.
Flight investigation of various longitudinal short-term dynamics for STOL landing approach using the X-22A variable stability aircraft [AD-754840] N73-20029
- LECARNE, H.
Rotor requirements beyond the usual flight domain of ONERA large wind tunnel at Mondane N73-21037
- LEE, S. W.
Analytic radar target modeling [AD-755854] N73-21189
- LEIS, H.
Design and manufacture of structure components made of fiber-reinforced materials A73-25417
- LEMLEY, C. E.
Buffeting pressures on a swept wing in transonic flight - Comparison of model and full scale measurements. [AIAA PAPER 73-311] A73-25542
- LEMON, E. C.
Turbulent heat transfer to a fin leading edge - Flight test results. A73-26405
Turbulent heat transfer and pressure on leading edges of fins mounted on a cone [SCL-RR-72-0308] N73-21863
- LENA, P.
A 32-cm airborne infrared observatory. A73-26503
- LEWNER, L.
New York offshore airport feasibility study [FAA-RD-73-45] N73-20280
- LEVERTON, J. W.
The noise characteristics of a large clean rotor N73-21056
- LEVINE, I.
Design of a Kalman derived, fixed, gain, hybrid navigation system N73-20701
- LEVI, S. A.
X2048, a high strength, high toughness alloy for aircraft applications. [AIAA PAPER 73-385] A73-25514
- LIBBER, J.-P.
Reliability of helicopter transmission components A73-26596
- LICHTMAN, R. H.
Regularization of the legal status of international air charter services. A73-26349
- LIEBLEIN, S.
Performance characteristics of a model VTOL lift fan in crossflow. A73-25782

PERSONAL AUTHOR INDEX

HELICK, H. C.

- LIPKA, B. W.
Stress corrosion fatigue of aluminum pressure cylinders. A73-25827
- LIGHT, W. R., JR.
Design of a Kalman derived, fixed, gain, hybrid navigation system N73-20701
Design of a Kalman derived, fixed gain, hybrid navigation system [AD-754548] N73-20731
- LIPPOLD, H.
Malmo-Sturup, Sweden's colourful airport. A73-25207
- LIPSCOMB, M. L.
Inertial system enhancement of flight control N73-20700
- LISS, A. IU.
Deformation equations of a propeller blade and the orthogonality characteristics of its normal mode shapes of vibration A73-27085
- LIU, A. P.
Preliminary design of aircraft structures to meet structural integrity requirements. [AIAA PAPER 73-374] A73-25506
- LOEBDORF, D.
Application of computer-aided aircraft design in a multidisciplinary environment. [AIAA PAPER 73-353] A73-25490
- LOKAI, V. I.
Increasing the gas temperature in front of the turbine as a major trend in the development of gas-turbine engines A73-27090
- LONGHIRE, H. S.
Stratospheric photochemistry of ozone and SST pollution: An introduction and survey of selected developments since 1965 [NOAA-TM-NESS-47] N73-21526
- LOWSON, M. V.
Fundamental Consideration of Noise radiation by rotary wings N73-21053
- LUCAS, J. J.
Fretting fatigue in titanium helicopter components. A73-25837
- LUM, D. W.
Fretting resistant coatings for titanium alloys. A73-25838
- LYON, R. H.
Synthesis of helicopter rotor tips for less noise. A73-24981
- M**
- MACDONALD, H. I.
Survey of rotary wing loads and stability analysis problems N73-21020
- MACF, W. D.
AGARD flight test instrumentation series. Volume 2: In-flight temperature measurements [AGARD-AG-160-VOL-2] N73-20499
- MACFELLAR, A. C.
Factors relating to the choice of antenna characteristics for the aircraft terminal in an aeronautical satellite communications/surveillance system. A73-27654
- MACPHERSON, J. I.
A description of the NAE T-33 turbulence research aircraft, instrumentation and data analysis. A73-26269
- MAHAL, A. S.
Design integration and noise studies for jet STOL aircraft. Task 7B: Wind tunnel investigation of a 14-percent-thick airfoil with upper surface blowing at high subsonic Mach numbers [NASA-CR-114560] N73-19998
- MANGANO, G. J.
Rotor burst protection program: Statistics on aircraft gas turbine engine failures that occurred in commercial aviation during 1971 [NASA-CR-131525] N73-21692
- MANN, P. P.
Aircraft noise impact-planning guidelines for local agencies [PB-213020] N73-20759
- MARCHANT, M.
Temperature sensitivity of cfrp honey-comb structures under holographic mt. A73-27036
- MARCHIONNA, M. R.
Effect of inlet-air humidity on the formation of oxides of nitrogen in a gas-turbine combustor [NASA-TM-X-68209] N73-21691
- MARINI, M.
Reduction of jet noise A73-27390
- MARR, J. R.
The disc antenna - A possible L-band aircraft antenna. A73-27655
- MARR, W. D.
Synthesis of helicopter rotor tips for less noise. A73-24981
- MARROWITZ, P.
Comparison of mobile source emissions from aircraft, automobiles, buses, trucks, railroads, and electric trains (Project Eagle) [FAA-EQ-73-2] N73-21522
- MARTINDILL, G. H.
Ignition and fire suppression in aerospace vehicles (phase 2) [AD-755362] N73-21079
- MARR, A.
Some guidelines on direction, management, and activities of the NLR N73-20960
- MATHIS, L. H.
Hydraulics for V/STOL aircraft. A73-26271
- MATTESON, T. D.
Advanced maintenance programs for transport aircraft A73-26591
- MATTON, G.
Basic aerodynamic parameters of flame stabilizers A73-26595
- MAYO, F. R.
The chemistry of fuel deposits and their precursors [AD-754459] N73-20816
- MCCONAS, A. D.
Synchronized Discrete Address Beacon System (Synchro-DABS) study [SD-FR-01] N73-20189
- MCCROSKBY, W. J.
Recent developments in rotor blade stall N73-21046
- MCELEBATH, K. W.
True airspeed sensor for V/STOL aircraft [AD-755374] N73-21403
- MCHARG, Q. D.
Reliability and quality control of production engineering computer programs. [AIAA PAPER 73-356] A73-25493
- MCKINLEY, J. L.
Basic science for aerospace vehicles /4th edition/. A73-27054
- MCLLWAIN, D.
Computerised departure control. A73-25210
- MCVAUGH, J. H.
Backswept impeller and vane island diffuser and shroud for NASA advanced-concepts compressor test rig [NASA-CR-120942] N73-20531
- MEDAN, R. T.
Steady, subsonic, lifting surface theory for wings with swept, partial span, trailing edge control surfaces [NASA-TN-D-7251] N73-19999
- MECHAN, W. C.
Sound directivity pattern radiated from small airfoils. A73-24980
- MEHRA, R. K.
Maximum likelihood identification and optimal input design for identifying aircraft stability and control derivatives [NASA-CR-2200] N73-21071
- MELICK, H. C.
Analysis of inlet flow distortion and turbulence effects on compressor stability [NASA-CR-114577] N73-21693

- MELIK-ZADE, N. A.
The operation of a two-chamber pneudraulic shock absorber
[AD-754609] N73-20031
- MENEZES, J.
Composite inorganic material for aircraft radomes
A73-25288
- MESHEV, A. D.
Advanced auxiliary power system
[AD-754903] N73-20049
- MEYER, A.
International air traffic conventions: Air piracy
- Concept, facts, protective measures
A73-25570
- MEYER, J. W.
Study of high-altitude aircraft wake Dynamics.
Task 1: Problem definition
[AD-754918] N73-20447
- MILCH'KII, I. D.
Design and stability of airplanes and helicopters
A73-26256
- MILES, T. S.
An appraisal of the funding provisions of the Airport and Airway Development Act of 1970 in relation to implementing system improvements.
A73-27367
- MILEY, S. J.
An analysis of the design of airfoil sections for low Reynolds numbers
N73-20995
- MIRTOV, K. D.
Design and stability of airplanes and helicopters
A73-26256
- MITTRA, R.
Analytic radar target modeling
[AD-755854] N73-21189
- MIYAI, Y.
A note on the lift coefficient of a thin jet-flapped airfoil.
A73-27171
- MOISEEV, V. S.
Prediction for a park of helicopters of the same type
A73-27077
- MONTGOMERY, R. C.
Evaluation of glide paths for landing a VTOL airplane using linear regulator theory.
A73-27154
- MORAIN, S. A.
Variations in the detectability of major airports in northeastern Kansas and northwestern Missouri
[E73-10471] N73-21308
- MORGAN, D. P.
Potential applications of acoustic matched filters to air-traffic control systems.
A73-27572
- MORINO, L.
Unsteady subsonic compressible flow around finite thickness wings.
[AIAA PAPER 73-313] A73-25544
- MORONEY, W. F.
Intercorrelations and selected descriptive statistics for 96 anthropometric measures on 1549 Naval aviation personnel
[AD-754780] N73-20468
- MOSINSKIS, G. J.
A general method for calculating three-dimensional incompressible laminar and turbulent boundary layers. 1: Swept infinite cylinders and small cross flow
[AD-754440] N73-20004
- MOUTIER, H.
The test rails - Methods of simulation of rain erosion
A73-25296
- MUEBE, C.
Concepts for improvement of airport surveillance radars
[ATC-14] N73-20183
- MUEZZER, P. J.
Properties of the submerged low silhouette blade antenna
A73-27043
- MULLALY, J.
Comparison of mobile source emissions from aircraft, automobiles, buses, trucks, railroads, and electric trains (Project Eagle)
[FAA-EQ-73-2] N73-21522
- MULLANS, R. E.
Buffeting pressures on a swept wing in transonic flight - Comparison of model and full scale measurements.
[AIAA PAPER 73-311] A73-25542
- MURPHY, F. H.
Fault isolation and maintenance concepts of an advanced inertial navigation system
N73-20713
- MURTHY, V. K.
Annotated bibliography on cumulative fatigue damage and structural reliability models
[AD-754062] N73-20027
- MUSIATOWICZ, S.
Horizontal stabilizer of the Iliushin-62 aircraft
A73-25795
- N
- MAGANATSU, H. T.
Subsonic and supersonic jets and supersonic suppressor characteristics
[NASA-CR-131297] N73-20006
- MENHAW, H.
Structural optimization for aeroelastic requirements.
[AIAA PAPER 73-389] A73-25518
- MICKSON, T. B.
A comparative study of augmentor wing, ejector nozzle and power jet flap low noise STOL concepts.
A73-25385
- NICOLAIDES, J. D.
Parafol powered flight performance
[AD-754907] N73-20034
- NIKITIN, A. I.
Optimization of aircraft parameters
A73-27095
- NORDMARK, G. E.
Stress corrosion fatigue of aluminum pressure cylinders.
A73-25827
- NORGEEN, C. T.
Effects of prevaporized fuel on exhaust emissions of an experimental gas turbine combustor.
A73-26424
- NYBAKKEN, G. H.
Structural modeling of aircraft tires
[NASA-CR-2220] N73-21006
- O
- O'CONNELL, R. P.
Incremented flutter analysis.
[AIAA PAPER 73-392] A73-25521
- O'DONNELL, J. J.
An appraisal of the funding provisions of the Airport and Airways Development Act of 1970 to implement system improvements.
A73-27366
- O'KEEFE, J. V.
A comparative study of augmentor wing, ejector nozzle and power jet flap low noise STOL concepts.
A73-25385
- ORSHAN, W. I.
Analytical study of the performance of a gust alleviation system for a STOL airplane
[NASA-TN-D-7201] N73-20013
- ORHNE, D.
Determination of the turn start point coordinates for modern commercial aircraft
A73-26723
- OPPI, D. L.
Tests of the Vega Aircraft Radar Enhancing System (VARES)
[FAA-RD-73-38] N73-21182
- OLIVER, J. H.
Ground support equipment airborne launcher vibration isolation design
[AD-754537] N73-20283
- ORHISTON, R. A.
Stability of elastic bending and torsion of uniform cantilevered rotor blades in hover.
[AIAA PAPER 73-405] A73-25534
- An actuator disc theory for rotor wake induced velocities
N73-21033

- ORTOLANI, C.
Analysis of the operational parameters of a bypass turbojet
A73-27069
- OSOKIN, D. P.
Design and stability of airplanes and helicopters
A73-26256
- OSTAPENKO, N. A.
Supersonic gas flow past the leeward side of a conical wing
A73-26439
- OTT, R. H.
First order effects of terrain on the radiation pattern of a non-directional LP beacon.
A73-26204
- P**
- PADDISON, F. C.
Transportation in the Arctic
[AD-754381]
N73-20296
- PAPOK, K. K.
Carbon deposits in jet engines
[AD-754607]
N73-20837
- PARKINSON, G. V.
A linearized potential flow theory for airfoils with spoilers.
A73-25853
- PASCHAL, D. B.
Flight-service evaluation of PRD-49/epoxy composite panels in wide bodied commercial transport aircraft
[NASA-CR-112250]
N73-20018
- PASCO, C.
Comparison of mobile source emissions from aircraft, automobiles, buses, trucks, railroads, and electric trains (Project Eagle)
[FAA-EQ-73-2]
N73-21522
- PAVITT, H.
A comparison of wing pressure distributions measured in flight and on a wind tunnel model of the super VC 10
[ARC-R/B-3707]
N73-20999
- PEARCEY, H. H.
The derivation and verification of a new rotor profile on the basis of flow phenomena; aerofoil research and flight tests
N73-21047
- PERARDI, A.
Graphic-interactive analysis of the velocity field around blade cascades for turbomachines
A73-27387
- PERRONE, G. L.
Backswept impeller and vane island diffuser and shroud for NASA advanced-concepts compressor test rig
[NASA-CR-120942]
N73-20531
- PEW, R. W.
Proceedings of the 8th Annual Conference on Manual Control
[NASA-CR-131244]
N73-20028
- PHILIPPE, J. J.
Aerodynamic forces computation and measurement on an oscillating aerofoil profile with and without stall
N73-21042
- PIAZZOLI, G.
In-flight flutter testing methods and techniques
A73-26593
- PIERCE, G. A.
A compressible unsteady theory for helicopter rotors
N73-21044
- PINES, S.
Structural optimization for aeroelastic requirements.
[AIAA PAPER 73-389]
A73-25518
- PINKEL, B.
Reduction of noise generated by flow of fluid over plate.
A73-25386
- PINUS, H. X.
Turbulence in the free atmosphere.
A73-27134
- PISKUNOV, V. A.
Carbon deposits in jet engines
[AD-754607]
N73-20837
- PLETT, E. G.
Research on noise generated by ducted air-fuel combustion systems
[AD-754094]
N73-20286
- POISSON-QUINTON, P.
A summary of wind tunnel research on tilt-rotors from hover to cruise flight
N73-21049
- POOL, A.
AGARD flight test instrumentation series. Volume 2: In-flight temperature measurements
[AGARD-AG-160-VOL-2]
N73-20499
- POPESCU, N. D.
A new method for the study of the phenomenon of dynamic instability of thin-walled bars used in the construction of aeroplanes, ships and bridges.
A73-27063
- PORITZKY, S. B.
Assessing the cost effectiveness of planned improvements.
A73-27365
- POWERS, S. A.
The calculation of three-dimensional supersonic flows around spherically-capped smooth bodies and wings. Volume 2: Manual for computer programs
[AD-753696]
N73-21002
- PRESSMAN, J.
Problem areas of stratospheric chemical dynamics
[PB-213111]
N73-20464
- Survey of stratospheric aircraft wake chemical dynamics
[PB-213114]
N73-20465
- Survey of stratospheric chemical dynamics
[PB-213126]
N73-20466
- PRICE, F. C.
Heat production for Air Force fog dissipation program
[AD-754900]
N73-20675
- PRUSLIN, D.
Concepts for improvement of airport surveillance radars
[ATC-14]
N73-20183
- PUCCINELLI, L.
Comparisons between analogical and numerical methods for studying the response of an aircraft to gusts
[PUBL-97]
N73-21007
- PULLEN, K. A., JR.
On the improvement in survivability for avionics equipment.
A73-27158
- PULLING, R. W.
Status of funded improvements to the National Aviation System and planned improvements not yet funded.
A73-27363
- PLYE, R. W., JR.
Synthesis of helicopter rotor tips for less noise.
A73-24981
- R**
- RAGHAVAN, K. S.
Vibrations of an Euler beam with a system of discrete masses, springs, and dashpots.
A73-25788
- RANAGE, J. K.
Advanced flight control systems - Power-by-wire and fly-by-wire.
A73-26272
- HAO, S. S.
Automated optimum design of aircraft wings to satisfy strength, stability, frequency and flutter requirements
N73-21003
- RASTOGI, K. V.
Exhaust emissions from gas turbine engines.
A73-27934
- RAUCH, F. J.
Flutter of pairs of aerodynamically interfering delta wings.
[AIAA PAPER 73-314]
A73-25545
- REBONT, J.
Aerodynamic efforts on a large wing profile with quick harmonic movement parallel to sieve flow
N73-21043

BECK, R. H.

PERSONAL AUTHOR INDEX

BECK, R. H.
A North Atlantic air traffic analysis program
[AD-755910] N73-21557

REDLER, K. O.
Study of high-altitude aircraft wake Dynamics.
Task 1: Problem definition
[AD-754918] N73-20447

REETHOF, G.
Design and development of the spinning mode
synthesizer
[NASA-CR-2260] N73-21067

REICHERT, G.
Influence of elastic coupling effects on the
handling qualities of a hingeless rotor helicopter
N73-21016
Some aspects of the design of rotor-airfoil shapes
N73-21045

REID, G. F.
Evaluation of glide paths for landing a VTOL
airplane using linear regulator theory. A73-27154

REID, L.
Overall and blade-element performance of a
transonic compressor stage with
multiple-circular-arc blades at tip speed of 419
meters per second
[NASA-TN-X-2731] N73-19995

REINHARDT, H.
AGARD flight test instrumentation series. Volume
2: In-flight temperature measurements
[AGARD-AG-160-VOL-2] N73-20499

RENAUD, A.
Ten years experience with the helicopter from
operation in French Army N73-21011

RICH, W. A.
J52-P-8 engine compressor stall margin acceptance
tests
[AD-755152] N73-20832

RICHARDSON, R.
The chemistry of fuel deposits and their precursors
[AD-754459] N73-20816

RIECK, J. M.
Airports promote Ireland. A73-25208

RILEY, M. J.
The derivation and verification of a new rotor
profile on the basis of flow phenomena;
airfoil research and flight tests N73-21047

RINGO, R. L.
The evolution of ESG technology N73-20698

RIZO, L.
Variations in the sound field of a STOL aircraft
as a function of wing-flap deflection A73-26592

ROBBINS, T.
An analog computer simulation of a generalized
helicopter rotor system
[AD-754547] N73-20024

ROBERTSON, R. H.
Optimal and preferred listening levels for speech
in aircraft acoustical environments. A73-25387

ROBINSON, C. A., JR.
XPV-12 may spur Navy VTOL family. A73-27731

ROSCOE, S. H.
Synthetic flight training revisited
[AD-754957] N73-21260

ROSS, J. H.
Recent developments in commercial fire resistant
fibrous materials. A73-26419

ROTHMAN, H. H.
Evaluation, development, and advantages of the
helicopter tandem dual cargo hook system N73-21022

RUBINGER, B.
Signal processing in the Air Traffic Control Radar
Beacon System. A73-27165

RUDD, H. J.
A note on the scattering of sound in jets and the
wind. A73-26496

A preliminary evaluation of noise reduction
potential for the upper surface blown flap
[NASA-CR-112246] N73-20017

RUDY, S. L.
High frequency fatigue testing of Udimet 700 at
1400 P
[NASA-CR-120958] N73-21845

RUO, S. Y.
Calculation of unsteady transonic aerodynamics for
oscillating wings with thickness.
[AIAA PAPER 73-316] A73-25547

RUSPA, G.
Reduction of jet noise A73-27390

RUSSELL, J. G.
Use of reinforced plastics in a composite
propeller blade. A73-26881

S

SAGNER, M.
Aerodynamic forces computation and measurement on
an oscillating aerofoil profile with and without
stall N73-21042

SALAND, H.
Studies of engine-airframe integrated hypersonic
vehicles
[NASA-CR-112300] N73-20022

SALKIND, H. J.
Fretting fatigue in titanium helicopter components.
A73-25837

SALVETTI, A.
Certain fatigue phenomena in aeronautical
structures with stiffened shells A73-27394

SARGENT, N. B.
Noise measurements for various configurations of a
model of a mixer nozzle externally blown flap
system
[NASA-TN-X-2776] N73-21059

SARKOS, C. P.
Design calculations for a Halon 1301 distribution
tube for an aircraft cabin fire extinguishing
system
[FAA-NA-73-3] N73-20009

SAX, R. I.
Air weather service weather-modification program,
FY 1972
[AD-755659] N73-21533

SCHARTON, T. D.
Reduction of noise generated by flow of fluid over
plate. A73-25386
A preliminary evaluation of noise reduction
potential for the upper surface blown flap
[NASA-CR-112246] N73-20017

SCHERMAN, J.
Analytical investigation of the tilt rotor whirl
instability N73-21004

SCHMIDT, D. K.
An optimal control approach to terminal area air
traffic control. A73-25786

SCHMITT, V. R.
Advanced flight control systems - Power-by-wire
and fly-by-wire. A73-26272

SCHORLING, H.
A nonlinear theory for sonic-boom calculations in
a stratified atmosphere
[NASA-TN-D-7105] N73-20010

SCHRAEDER, E.
International scientific cooperation with AGARD
N73-20958

SCHROEDER, H.
Futuristic viewpoints for managing a major
research facility N73-20968

SCHULER, J. H.
Flight investigation of various longitudinal
short-term dynamics for STOL landing approach
using the X-22A variable stability aircraft
[AD-754840] N73-20029

- SCHULZ, W.
From the WGL to the DGLR: On sixty years of work
for aeronautics
N73-20957
- SCHUMACKER, R. W.
Jet engine burn through investigation. Volume 1:
Sonic analysis
[FAA-RD-72-149-VOL-1] N73-20825
- SCHWARTZ, I. E.
Exhaust noises in jet engines
[NASA-CASE-ARC-10712-1] N73-20826
- SCOGGINS, J. E.
Mountain waves and CAT encountered by the XB-70 in
the stratosphere.
A73-25785
- SEIDLER, F.
Flight-mechanics analysis of various flight
conditions of conventional aircraft. VII -
Mechanical foundations: Dynamic equations of
motion of the translational motion of a rigid body
A73-26725
- SEINER, J. E.
Design and development of the spinning mode
synthesizer
[NASA-CR-2260] N73-21067
- SEVART, F. D.
Design and evaluation of miniature control surface
actuation systems for aeroelastic models.
[AIAA PAPER 73-323] A73-25553
- SPERRINO, V.
Concepts for improvement of airport surveillance
radars
[ATC-14] N73-20183
- SHAH, K. S.
Exhaust emissions from gas turbine engines.
A73-27934
- SHATAEV, V. G.
Creep analysis of a thin-walled wing on the basis
of the plate analogy
A73-27086
- SHCHERBINA, A. A.
Stability and nonlinear oscillations of a helicopter
A73-27791
- SHEAR, W. G.
Synchronized Discrete Address Beacon System
(Synchro-DABS) study
[SD-PR-01] N73-20189
- SHEER, R. E., JR.
Subsonic and supersonic jets and supersonic
suppressor characteristics
[NASA-CR-131297] N73-20006
- SHMETER, S. E.
Turbulence in the free atmosphere.
A73-27134
- SHREEVE, R. P.
A description of the turbopropulsion Laboratory in
the Aeronautics Department at the Naval
Postgraduate School
[AD-754380] N73-20287
- SHUR, G. W.
Turbulence in the free atmosphere.
A73-27134
- SIDFORD, M. J.
A radiating element giving circularly polarised
radiation over a large solid angle.
A73-27656
- SIMODYNES, E. E.
Gradient optimization of structural weight for
specified flutter speed.
[AIAA PAPER 73-390] A73-25519
- SIMPSON, R. W.
Functional error analysis and modeling for ATC
system concepts evaluation
[PB-213148] N73-20730
- SINDLINGER, R. S.
Investigations on the optimization of aided
inertial navigation systems
N73-20694
- SIRAZETDINOV, T. K.
Response-optimum control of the angular and
torsional oscillations of an elastic flying wing.
A73-27459
- SITTLER, R.
ARTS 3 augmented tracking study
[PX-6392] N73-21177
- SKINGLE, C. W.
Flutter technology in the United Kingdom - A survey.
[AIAA PAPER 73-330] A73-25559
- SKRIPKA, M. L.
Design and stability of airplanes and helicopters
A73-26256
- SLATOR, T.
Message organisation in the ground segment of an
aeronautical satellite system.
A73-27668
- SHIGIELSKI, P.
The application of holography to sonic boom
investigations.
A73-26633
- SMITH, P. D.
Inertial system enhancement of flight control
N73-20700
- SMITH, G. C. C.
Development and applications of supersonic
unsteady consistent aerodynamics for interfering
parallel wings.
[AIAA PAPER 73-317] A73-25548
- SMITH, I. G.
How real are the pilot's problems.
A73-27599
- SMITH, L. A.
Design of control and display panels using
computer algorithms.
A73-25180
- SMITH, M. J.
Intercorrelations and selected descriptive
statistics for 96 anthropometric measures on
1549 Naval aviation personnel
[AD-754780] N73-20468
- SMITH, R. E.
Flight investigation of various longitudinal
short-term dynamics for STOL landing approach
using the X-22A variable stability aircraft
[AD-754840] N73-20029
- SMULOWICZ, B.
ARTS 3 augmented tracking study
[PX-6392] N73-21177
- SNYDER, R. L.
On the estimation of the directional spectrum of
surface gravity waves from a programmed aircraft
altimeter.
A73-26347
- SOBIESZCZANSKI, J.
Design oriented structural analysis.
[AIAA PAPER 73-338] A73-25478
- Application of computer-aided aircraft design in a
multidisciplinary environment.
[AIAA PAPER 73-353] A73-25490
- SOLOMONIAN, R. SH.
Nonstationary flow downwash behind a delta wing
during supersonic motion
A73-25046
- SOULEZ-LARIVIERE, J.
Some thoughts on the SA 341 Gazelle speed record
N73-21018
- Rotor stationary flight and large advancement
parameters
N73-21036
- SPANGLER, G. E.
X2048, a high strength, high toughness alloy for
aircraft applications.
[AIAA PAPER 73-385] A73-25514
- SPERK, P. A. P.
Gas-turbine processes with interrupted expansion
and interrupted compression
A73-26371
- SPIEGEL, P.
Regional airport systems study: Final Plan.
A73-26125
- SPIES, J.-P.
Basic aerodynamic parameters of flame stabilizers
A73-26595
- SPIITE, B.
Composite inorganic material for aircraft radomes
A73-25288
- STABE, R. G.
Aerodynamic performance of a core-engine turbine
stator vane tested in a two-dimensional cascade
of 10 vanes and in a single vane tunnel
[NASA-TN-X-2766] N73-20823
- STAICU, S.
Supersonic flow around a delta wing, taking into
account flow separation at the leading edges
A73-27098
- STATLER, I. C.
Progress in rotor-blade aerodynamics
N73-21019

- STEINHEUER, J.
Calculation of the friction effect on the lift of an airfoil section with slotted flap
[DLR-FB-73-04] N73-21001
- STENGEL, R. F.
Some effects of bias errors in redundant flight control systems. A73-25783
- STEPHENS, R. W. B.
Seismic vibrations induced by Concorde sonic booms. A73-26292
- STEPHNER, D. E.
Maximum likelihood identification and optimal input design for identifying aircraft stability and control derivatives
[NASA-CR-2200] N73-21071
- STEWART, E. C.
Economics and terminal area environmental impact of STOL transportation
[NASA-TN-X-62239] N73-20016
- STONE, A. M.
Transportation in the Arctic
[AD-754381] N73-20296
- STONE, H. W., JR.
Wing upper surface flap
[NASA-CASE-LAR-11140-1] N73-20008
- STONE, J. R.
Small-scale noise tests of a slot nozzle with V-gutter target thrust reverser
[NASA-TN-X-2758] N73-21072
- STORAASLI, O. O.
Design oriented structural analysis.
[AIAA PAPER 73-338] A73-25478
Application of computer-aided aircraft design in a multidisciplinary environment.
[AIAA PAPER 73-353] A73-25490
- STORY, A. W.
Display system
[NASA-CASE-ERC-10350] N73-20474
- STRAKHOV, S. V.
Investigation of new elements and equipment configurations in stable-frequency, alternating-current, electrical power supply systems employing primary power plants consisting of engines with varying rotational speed A73-26785
- STRINGHAM, R. S.
The chemistry of fuel deposits and their precursors
[AD-754459] N73-20816
- SUBASH, A. W.
Evaluation of lift and drag of a family of conically cambered wings at off design Mach numbers. A73-27927
- SUMMERFIELD, M.
Research on noise generated by ducted air-fuel combustion systems
[AD-754094] N73-20286
- SUNDARARAJAN, V.
Vibrations of an Euler beam with a system of discrete masses, springs, and dashpots. A73-25788
- SWAIN, R. L.
An optimal control approach to terminal area air traffic control. A73-25786
- SWECKER, G. E.
Greater safety, maintainability, and reliability through improved helicopter flight testing
N73-21013
- SWENSKI, D. F.
Advanced auxiliary power system
[AD-754903] N73-20049
- SWIDZINSKI, J.
Technical problems encountered with the flying laboratory LALA-1 A73-26823
- SYHMANGK, W.
Aquaplaning can be prevented. A73-25209
- T**
- TAIG, I. C.
Optimization of aircraft structures with multiple stiffness requirements. A73-26298
- TAILLET, J.
Description and implementation of a method for characterizing noise sources in jets
[NASA-TT-P-14851] N73-20020
- TALYZINA, V. S.
Application of certain generalized data from wind-tunnel tests with plane-subsonic compressor cascades to the calculation of the characteristic flow regimes in supersonic cascades A73-27480
- TANNER, C. S.
Analysis of operational noise measurements in terms of selected human response noise evaluation measures
[FAA-RD-71-112] N73-21074
Measurement and analysis of noise from seventeen aircraft in level flight (military, business jet, and general aviation)
[TR-S-212] N73-21081
- TANNER, J. A.
Experimental investigation of the cornering of a C40 x 14-21 cantilever aircraft tire
[NASA-TN-D-7203] N73-21058
- TAYLOR, A. S.
A review of comparative theoretical and experimental aerodynamic data relevant to zero- and low-frequency aeroelastic problems
[ARC-R/H-3708] N73-21000
- TAYLOR, J.
Stopped rotor aircraft using circulation controlled rotors N73-21024
- TAYLOR, R. F.
A general method for flutter optimization.
[AIAA PAPER 73-391] A73-25520
- TEPER, G. L.
An assessment of the Paper Pilot - An analytical approach to the specification and evaluation of flying qualities
[AD-755367] N73-21078
- THEISEN, J. G.
Calculation of unsteady transonic aerodynamics for oscillating wings with thickness.
[AIAA PAPER 73-316] A73-25547
- THERY, C.
The application of holography to sonic boom investigations. A73-26633
- THYLEN, B.
The radome situation in Sweden - State of technology. A73-25300
- TONASEZWICZ, M.
Comparison of mobile source emissions from aircraft, automobiles, buses, trucks, railroads, and electric trains (Project Eagle)
[FAA-EQ-73-2] N73-21522
- TOOR, P. M.
Phenomenological approach to low-cycle fatigue fracture of a typical aircraft full scale component static test.
[AIAA PAPER 73-324] A73-25554
- TOWNSEND, D. P.
Elastohydrodynamic principles applied to the design of helicopter components
[NASA-TN-X-68215] N73-21069
- TRAUTWEIN, H.
Duesseldorf airport. A73-25206
- TRENKLE, F.
AGARD flight test instrumentation series. Volume 2: In-flight temperature measurements
[AGARD-AG-160-VOL-2] N73-20499
- TRUBACHEV, V. T.
Investigation of new elements and equipment configurations in stable-frequency, alternating-current, electrical power supply systems employing primary power plants consisting of engines with varying rotational speed A73-26785
- TRUE, H. C.
A comparative study of augmentor wing, ejector nozzle and power jet flap low noise STOL concepts. A73-25385
- TSIKLAURI, G. V.
Method of calculating a two-phase ejector
[AD-754051] N73-20831

- TURNER, R.
Regional airport systems study: Final Plan. A73-26125
- TURNER, R. L.
The provision of ground station facilities for an aeronautical satellite system. A73-27658

U

- UNDERWOOD, R. L.
Climatic impact assessment program: Workshop on Computational Modeling of the Atmosphere [PB-212819] N73-20473
- URDIN, V. I.
Investigation of new elements and equipment configurations in stable-frequency, alternating-current, electrical power supply systems employing primary power plants consisting of engines with varying rotational speed A73-26785
- USHAKOV, V. S.
Design and stability of airplanes and helicopters A73-26256

V

- VALENSI, J.
Aerodynamic efforts on a large wing profile with quick harmonic movement parallel to sieve flow N73-21043
- VALLINI, G.
Propulsion nozzles - Experimental analysis on models A73-27388
- VANDERNAAS, H. I.
Some guidelines on direction, management, and activities of the NLR N73-20960
- VANDERSTOEP, D. R.
A new approach to Doppler-inertial navigation /Doppler Beam Sampling/. A73-27162
- VANDIERENDONCK, A. J.
Practical quadratic optimal control for systems with large parameter variations. A73-27166
- VANHABOST, G.
A 32-cm airborne infrared observatory. A73-26503
- VANNUTELLI, R.
Air cargo transport - When and how much A73-27066
- VAVRA, H. H.
A description of the turbopropulsion Laboratory in the Aeronautics Department at the Naval Postgraduate School [AD-754380] N73-20287
- VECCHIO, E. A.
Noise radiated from a turbulent boundary layer. A73-24979
- VELIKOVSKII, V. A.
Investigation of new elements and equipment configurations in stable-frequency, alternating-current, electrical power supply systems employing primary power plants consisting of engines with varying rotational speed A73-26785
- VELKOFF, H. R.
Electrical charging of a cylinder by a seeded vortex [AD-755282] N73-21080
- VESTYEN, H. A., JR.
A flight investigation of the trailing vortices generated by a jumbo jet transport [NASA-TM-D-7172] N73-21068
- VIAZHNEVSKAIA, L. M.
Noise intensity in the field of subsonic turbulent jets A73-25738
- VINICHENKO, N. K.
Turbulence in the free atmosphere. A73-27134
- VITTEK, J. P., JR.
Airport noise control; Can communities live without it - Can airlines live with it. A73-26350

- VOSKOBOINIK, M. S.
Design and stability of airplanes and helicopters A73-26256

W

- WAGNER, J. M.
Noise measurements for various configurations of a model of a mixer nozzle externally blown flap system [NASA-TM-X-2776] N73-21059
- WAGNER, S. M.
Some aspects of the design of rotor-airfoil shapes N73-21045
- WAIT, J. R.
First order effects of terrain on the radiation pattern of a non-directional LF beacon. A73-26204
- WALKER, E. K.
Crack propagation of aluminum alloys in corrosive environments. A73-25826
- WAN, P. Y. M.
The spatial correlation method and a time-varying flexible structure. [AIAA PAPER 73-406] A73-25535
- WANNER, J.-C.
General guideline for the design of manned aerospace vehicles A73-26589
- WARD, J. F.
A summary of current research in rotor unsteady aerodynamics with emphasis on work at Langley Research Center N73-21041
- WARTZ, G. B.
Annotated bibliography on cumulative fatigue damage and structural reliability models [AD-754062] N73-20027
- WARZYNSKI, R. R.
A new approach to Doppler-inertial navigation /Doppler Beam Sampling/. A73-27162
- The evolution of ESG technology N73-20698
- WATTENDORF, F.
AGARD-German cooperation N73-20959
- WEICKMANN, K. M.
Air weather service weather-modification program, FY 1972 [AD-755659] N73-21533
- WEIKEL, T. D.
Ground support equipment: Low pollutant fuels [AD-755151] N73-20815
- WEISSHAAR, T. A.
Static aeroelasticity and the flying wing. [AIAA PAPER 73-397] A73-25526
- WILBY, J.
A preliminary evaluation of noise reduction potential for the upper surface blown flap [NASA-CR-112246] N73-20017
- WILBY, P. G.
The derivation and verification of a new rotor profile on the basis of flow phenomena; aerofoil research and flight tests N73-21047
- WILCOCK, T.
RAE experience in the use of a piloted ground-based simulator for helicopter handling studies N73-21030
- WILEY, C. A.
Noise radiated from a turbulent boundary layer. A73-24979
- WILLIAMS, C. E.
Optimal and preferred listening levels for speech in aircraft acoustical environments. A73-25387
- WILLIAMS, D. L.
Variations in the detectability of major airports in northeastern Kansas and northwestern Missouri [E73-10471] N73-21308
- WILLIAMS, R.
Recent developments in circulation control rotor technology N73-21050

- WILLIGES, B. H.
Synthetic flight training revisited
[AD-754957] N73-21260
- WILLIGES, B. C.
Synthetic flight training revisited
[AD-754957] N73-21260
- WILLIS, C. H.
Parametric studies of the wing flutter behavior of
a STOL transport.
[AIAA PAPER 73-394] A73-25523
- WILSON, G. J.
Evaluation, development, and advantages of the
helicopter tandem dual cargo hook system N73-21022
- WISHNA, S.
Balloon-aircraft ranging, data, and voice
experiment. A73-27680
- WOLD, H.
ARTS 3 augmented tracking study
[PX-6392] N73-21177
- WOOLEY, J. H.
Flight service evaluation of PRD-49/epoxy
composite panels in wide bodied commercial
transport aircraft
[NASA-CR-112250] N73-20018
- WYNN, H. P.
Varying-temperature test installation for the
interior design of the Concorde A73-25103

Y

- YAGGY, P. F.
Progress in rotor-blade aerodynamics N73-21019
- YASINSKII, P. G.
Determination of optimum parameters of the means
used to protect the compartments of an aircraft
from aerodynamic heat at high speeds and during
a prolonged flight
[AD-754606] N73-20036
- YATES, E. C., JR.
Calculation of unsteady transonic aerodynamics for
oscillating wings with thickness.
[AIAA PAPER 73-316] A73-25547
- YEH, F. C.
An adverse effect of film cooling on the suction
surface of a turbine vane
[NASA-TN-X-68210] N73-21695
- YOUNG, W. H., JR.
A summary of current research in rotor unsteady
aerodynamics with emphasis on work at Langley
Research Center N73-21041
- YURENYA, P. G.
Carbon deposits in jet engines
[AD-754607] N73-20837
- YUSKA, J. A.
Performance characteristics of a model VTOL lift
fan in crossflow. A73-25782

Z

- ZALMANZON, L. A.
Problems in constructing aerodynamically active
elements - Converters of input and output
signals in automatic control systems A73-26769
- ZHARII, IU. I.
Motion of a wing of solid profile at a variable
distance from a screen A73-27815
- ZIMMER, H.
The rotor in axial flow N73-21039
- ZINKHAM, R. E.
I2048, a high strength, high toughness alloy for
aircraft applications.
[AIAA PAPER 73-385] A73-25514
- ZLOCHEVSKII, S. I.
Mathematical simulation of flight dynamics
[AD-755868] N73-21077
- ZUGARO, P. P.
Sleeve bearing materials and lubricants for
advanced airframes
[AD-754759] N73-20540

CONTRACT NUMBER INDEX

Typical Contract Number Index Listing



Listings in this index are arranged alphanumerically by contract number. Under each contract number, the accession numbers denoting documents that have been produced as a result of research done under that contract are arranged in ascending order with the IAA accession numbers appearing first. The accession number denotes the number by which the citation is identified in either the IAA or STAR section.

AF PROJ. 643A N73-21403
 AF PROJ. 649E N73-21554
 AF PROJ. 691A N73-20207
 AF PROJ. 1366 N73-21002
 AF PROJ. 1369 N73-20031
 AF PROJ. 3048 N73-20546
 N73-21079
 AF PROJ. 3145 N73-20049
 AF PROJ. 4150 N73-21557
 AF PROJ. 6065 N73-20034
 AF PROJ. 7071 N73-20027
 AF PROJ. 7343 N73-20837
 AF PROJ. 7605 N73-20675
 AF PROJ. 8219 N73-21078
 AF PROJ. 8624 N73-21382
 AF PROJ. 9778 N73-21260
 AF PROJECT 7381 A73-25827
 ARPA ORDER 1322 A73-25383
 AT (29-1)-789 A73-26405
 N73-21863
 DA PROJ. 1P1-62202-A-96 N73-20731
 DA PROJ. 1P1-62204-A-139 N73-20030
 DA PROJ. 1P1-62204-AA-44 N73-20032
 DA PROJ. 1H1-62202-A-219 N73-20024
 DA PROJ. 1H2-62303-A-214 N73-20283
 DA-31-124-ARO(D)-246 N73-21080
 DAA807-68-C-0084 N73-20726
 N73-20727
 N73-21556
 DAA807-71-C-0156 N73-21556
 DAA801-70-C-0888 N73-20326
 DAA801-72-C-0329 N73-21189
 DAAJ02-67-C-0105 N73-20030
 DAAJ02-70-C-0004 A73-25383
 DAAJ02-71-C-0040 N73-20032

DAHC04-68-C-0004 N73-21044
 DAJA37-72-C-1998 N73-21052
 DOT-FAT2-575 N73-20825
 DOT-FA70WA-2289 N73-21177
 DOT-FA70WA-2374 N73-21081
 DOT-FA70WAI-175 N73-21554
 DOT-FA71WA-2555 N73-21074
 DOT-FA71WA-2626 N73-20280
 DOT-FA72WA-2774 N73-20278
 N73-20722
 DOT-FA72WA-2877 N73-21522
 DOT-FA72WA-2888 N73-20189
 DOT-FA72WAI-242 N73-20183
 DOT-FA72WAI-261 N73-20184
 DOT-FA73WA-3179 N73-21063
 DOT-OS-20082 N73-20447
 DOT-TSC-212 N73-20730
 DOT-TSC-260-2 N73-20719
 DOT-TSC-369 N73-20464
 N73-20465
 N73-20466
 DOT-UT-207 N73-20990
 DRB-9551-13 A73-25853
 FAA PROJ. 022-241-030 N73-21182
 FAA PROJ. 071-312-02X N73-20182
 FAA PROJ. 19180 N73-21177
 P19628-70-C-0230 N73-20184
 P19628-71-C-0002 N73-21557
 P19628-71-C-0139 N73-20675
 P19628-71-C-0221 N73-21554
 P19628-73-C-0001 N73-20207
 P19628-73-C-0002 N73-20183
 P30602-70-C-0162 N73-21227
 P33615-67-C-1922 A73-25827
 P33615-69-C-1100 N73-20049
 P33615-70-C-1272 A73-25542
 P33615-70-C-1282 A73-25520

P33615-71-C-1058 A73-27166
 P33615-71-C-1071 N73-21078
 P33615-71-C-1093 N73-20034
 P33615-71-C-1654 A73-27162
 P33615-71-C-1776 N73-20027
 P33615-71-C-1926 A73-25552
 P33615-71-1324 A73-25506
 P33615-72-C-1275 A73-25520
 P33615-72-C-1429 N73-21002
 P33615-72-M-5008 N73-21079
 P33657-70-C-1052 A73-25787
 P44620-68-C-0036 A73-25526
 P44620-70-C-0105 N73-21260
 P44620-71-C-0080 A73-26385
 HUD-H-1675 N73-20759
 NAONR-15-72 N73-20026
 NASW-1784 N73-20006
 NASW-2481 N73-20019
 NASW-2482 N73-20020
 NAS1-6450 A73-25539
 NAS1-7999 A73-25539
 NAS1-9987 A73-25539
 NAS1-10635-7 A73-25545
 NAS1-10700 N73-21071
 NAS1-10880 A73-25548
 NAS1-11156 A73-25547
 NAS1-11378 A73-25532
 NAS1-11565 N73-21272
 NAS1-11621 N73-20018
 NAS1-11839 N73-20017
 NAS2-6056 A73-21065
 NAS2-6312 N73-20277
 NAS2-6344 N73-19998
 NAS2-6901 N73-21693
 NAS3-10483 N73-21070
 NAS3-14335 N73-21845
 NAS3-15328 N73-20531
 NAS5-21822 N73-21308
 NAS8-11238 A73-25539
 NAS8-20354 A73-25539
 NAS8-28728 N73-20610
 NAS9-10268 A73-25783
 NAS9-11445 A73-25539
 NGL-23-005-010 N73-21006
 NGL-36-008-109 A73-25557
 NGL-39-009-121 N73-21067
 NGR-05-017-031 A73-27168
 NGR-22-004-030 A73-25544
 NGR-33-016-131 N73-20022
 NGR-44-001-081 A73-25785
 NGR-50-007-001 A73-25533
 NR PROJ. 213-096 N73-20026
 NSR-23-005-364 N73-20028
 N00014-67-A-0151-0029 N73-20286
 N00014-67-A-0386-0001 A73-26347
 N00014-69-A-0200-1052 N73-20335
 N00014-72-C-0111 N73-20004

N00017-72-C-4401 N73-20296
 N00019-71-C-0044 N73-20029
 N00019-72-C-0161 N73-20816
 N00019-72-C-0178 N73-20540
 PROJ. 034-241-012 N73-20184
 PROJ. 184-732-03X N73-20009
 SRI PROJ. PYU-1681 N73-20816
 126-13-01-39-00-21 N73-20997
 501-04-01-01 N73-21573
 501-06-05-00-21 N73-20998
 501-06-11-02 N73-20010
 501-24 N73-20823
 N73-21072
 501-24-05-03-00 N73-21693
 501-26-05-00 N73-20013
 501-38-12-02 N73-21006
 N73-21057
 N73-21058
 501-38-13-03 N73-21068
 502-24 N73-19995
 503-35 N73-19997
 741-89 N73-21059
 760-74-01-07 N73-19999

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