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AERONAUTICAL ENGINEERING

A SPECIAL BIBLIOGRAPHY
WITH INDEXES
Supplement 78

JANUARY 1977

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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NASA SP-7037 (78)

AERONAUTICAL ENGINEERING

A Special Bibliography

Supplement 78

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- *Scientific and Technical Aerospace Reports (STAR)*
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INTRODUCTION

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This supplement to *Aeronautical Engineering -- A Special Bibliography* (NASA SP-7037) lists 310 reports, journal articles, and other documents originally announced in December 1976 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*

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

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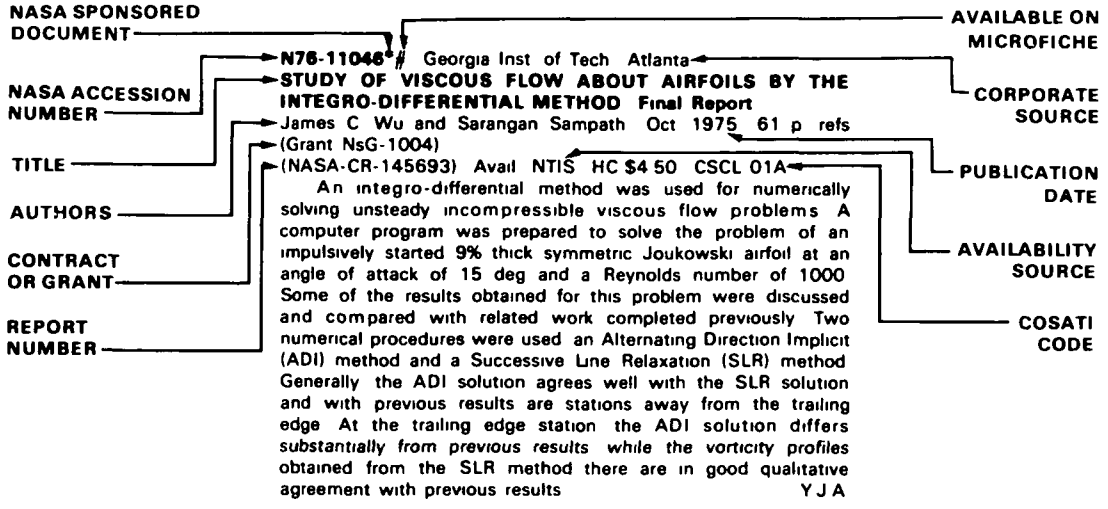

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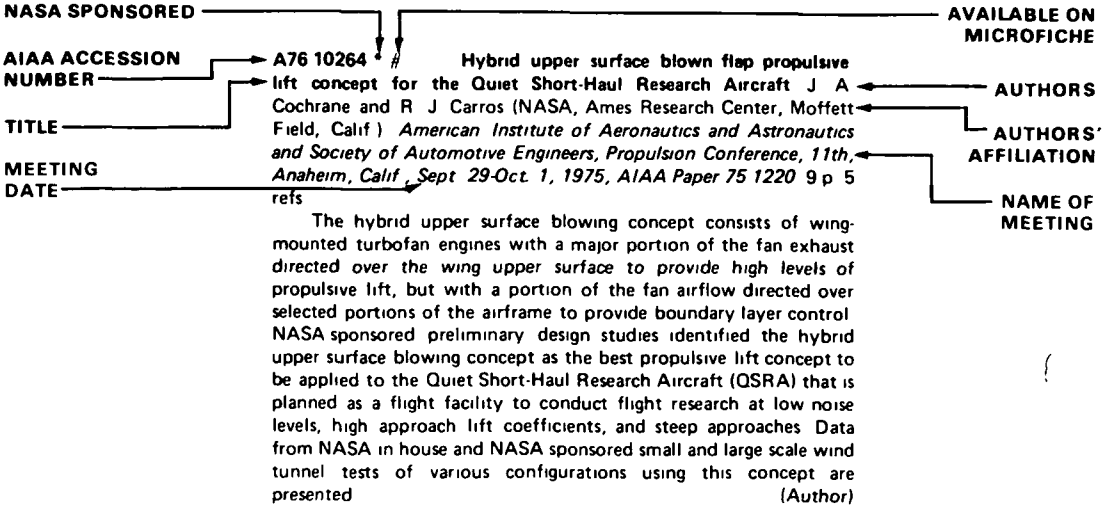

AERONAUTICAL ENGINEERING

A Special Bibliography (Suppl. 78)

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IAA ENTRIES

A76-44765 **Acoustic characteristics of interacting supersonic jets** J F Conly (San Diego State University, San Diego, Calif.) and G Freske (Rohr Industries, Inc., Chula Vista, Calif.) *Journal of Sound and Vibration*, vol 48, Sept 8, 1976, p 83-93 15 refs

This study was intended primarily to reveal more information about the noise producing mechanisms of supersonic jets Two identical, small, cold air supersonic, overexpanded jets were tested at selected angles, varying from parallel to 90 degrees intersecting and at various distances apart Schlieren photographs of the jet structure and far field sound data were obtained Close spacing of the parallel jets caused acoustic attenuation, which reached a maximum at one diameter centerline spacing, where the sound of two jets nearly equals that of a single jet In every case the intersecting jets merged into a single supersonic jet The overall sound power level of intersecting jets is generally higher than that of two independent jets, because of the turbulent mixing of the two jet flows A maximum level is reached when the jets intersect at a point near the middle of the flow region containing repetitive shocks For the parallel jets and intersecting jets at large separation, the sound levels are lower in the plane containing the jet centerlines For intersecting jets at small separation, however, this shielding effect is reversed (Author)

A76-44766 **Sound radiation due to unsteady dissipation in turbulent flows** C L Morfey (Southampton, University, Southampton, England) *Journal of Sound and Vibration*, vol 48, Sept 8, 1976, p 95-111 16 refs

It has been argued by Crighton (1975) and Obermeier (1975) that the hitherto neglected dissipative terms will dominate the radiation produced at low Mach numbers by heated turbulent flows In order to investigate this possibility, a scaling hypothesis for turbulent dissipation noise is developed and applied to turbulent jet mixing noise in the low Mach number limit Both heated and unheated jets are considered, along with the nonreactive mixing of two different fluids A major conclusion is that for unheated jets where energy dissipation is due mainly to viscosity the intensity of dissipation noise varies as the 8th power of the characteristic flow velocity However, when the jet and ambient fluids differ in temperature or composition, normally unimportant thermodynamic properties play a primary role in dissipative sound generation S D

A76-44784 # **Calculation of stresses in the blades of radial-flow turbomachines (Raschet napriazhenii v lopatkakh radial'nykh turbomashin)** V A Pukhlii (Tsentral'nyi Nauchno-Issledovatel'skii Institut Promzdanii, Moscow, USSR) *Prikladnaia Mekhanika*, vol 12, June 1976, p 93-97 6 refs In Russian

A method of stress analysis is proposed for trapezoidal blades of radial-flow blowers and compressors in the inertial centrifugal force field of the blades The stress-strain state of the blades is described by a system of linear equations of shallow shell theory An analytical solution to the problem is obtained by using the Bubnov Vlasov (variational) method in combination with a successive approximation technique A program for the numerical realization of the solution is proposed The procedure of the method is illustrated by an example V P

A76-44906 **Determination of the moments of aerodynamic forces acting on three-dimensional bodies that move under the 'law of locality'** M A Vorotyntsev and N I Sazonova (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR) *(Moskovskii Universitet, Vestnik, Seriia I - Matematika, Mekhanika*, vol 31 Jan.-Feb 1976, p 104-109.) *Moscow University Mechanics Bulletin*, vol 31, no 1-2, 1976, p 30-34 5 refs Translation

A76-44909 **Use of generalized similarity laws in computing the aerodynamic characteristics of three dimensional bodies** A I Bunimovich and A V Dubinskii (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR) *(Moskovskii Universitet, Vestnik, Seriia I - Matematika, Mekhanika*, vol 31, Jan.-Feb 1976 p 89-95.) *Moscow University Mechanics Bulletin*, vol 31, no 1-2, 1976, p 48-53 7 refs Translation

The paper develops the general similarity laws of Bunimovich and Dubinskii (1973) and applies them to the calculation of the aerodynamic characteristics of a three dimensional body when its shape or streamlining conditions are modified The case of a body in hypersonic Newtonian flow or free molecular rarefied gas flow is considered B J

A76-44923 # **Possible means of decreasing helicopter drag (Mozliwosci zmniejszenia oporu smiglowcow)** Z Brodzki *Technika Lotnicza i Astronautyczna*, vol 31, July-Aug 1976, p 17-21 7 refs In Polish

The paper examines some practical means of decreasing the drag characteristics of the main rotor hub, fuselage, undercarriage, and other projecting parts of the helicopter The hub and undercarriage account for about 50% of the total drag, and it is projected that attainable drag reduction can reduce fuel consumption by 30% Some modifications proposed include rounding the front of the cabin, use of hingeless rotors, use of air inlets with rounded edges elimination of fuselage roughness P T H

A76-45030 # **Hydroxsystem - A hydrogen propulsion system for airships (Hydroxsystem - Ein Wassertoffantrieb fur Luftschiffe)** K D Decker *Deutsche Gesellschaft fur Luft und Raumfahrt, Luftschiff-Kolloquium, 3rd, Sprendlingen, West Germany, May 19, 1976, Paper* 16 p In German

A description of an airship design with novel features is presented The size of the considered airship corresponds to that of the last 'Zeppeline' used by Germany before World War II The locations for the propulsion system, the quarters for the crew, and the cargo space, differ from those in the last German airships External dimensions and airship structure are also somewhat different Completely different from the old design are the fuel and engine systems The engines use liquid hydrogen as fuel The advantages of liquid hydrogen for airship operation are discussed Attention is also given to certain problems and the approaches which make it possible to overcome these problems and assure a safe operation of the airship G R

A76-45031 # **The airship - Means of transportation for the future - Its technical concept and the results of economy and marketing studies as projected by the firm Kommanditgesellschaft Flugschiffbau Hamburg GmbH & Co (Das Flugschiff - Verkehrsmittel der Zukunft - Seine technische Konzeption, Ergebnisse der Wirtschaftlichkeits- und Marketing-Untersuchungen, projektiert von der Firma Kommanditgesellschaft Flugschiffbau Hamburg GmbH & Co)** A Schmidt-Klieber (Kommanditgesellschaft Flugschiffbau Hamburg GmbH und Co , Hamburg, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Luftschiff-Kolloquium, 3rd, Sprendlingen, West Germany, May 19, 1976, Paper* 8 p In German

The airship project of an aerospace company in West Germany is discussed The airship development work is conducted in cooperation with the aircraft industry The technical concept considered is concerned with an airship which has a payload of 500 tons and cruising speed of 250 km/hr It is pointed out that the productivity of the airship with 125 000 tkm/hr is about one third more than the productivity of the cargo aircraft version of the Boeing 747 Design and operational details for the airship are discussed An analysis of the economic factors involved shows that for a number of applications an employment of airships has time and cost advantages in comparison to a use of conventional means of transportation Attention is also given to questions of project definition and operational simulation studies G R

A76-45032 # **The aerodynamic concept of hybrid airships (Zum aerodynamischen Konzept von Hybrid-Luftschiffen)** P -A Mackrodt (Aerodynamische Versuchsanstalt, Gottingen, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Luftschiff-Kolloquium, 3rd, Sprendlingen, West Germany, May 19, 1976, Paper* 45 p 22 refs In German

Operational difficulties related to the use of airships can be avoided or reduced in their importance by providing the airship with a wing which can carry aerodynamically a significant part of the weight at takeoff A hybrid airship with the considered properties could have operational characteristics similar to those of an aircraft The incorporation of hybrid airships into air traffic would, therefore, be much easier than a corresponding incorporation of the conventional airship The reported investigation has the objective to determine with the aid of aerodynamic studies the performance of hybrid airships on the basis of realistic assumptions concerning the structural weight and propulsion-system technology G R

A76-45069 # **Study of the statistical characteristics of pulsations of the boundary of the turbulent wake behind bodies of various shapes flying at supersonic velocity (Issledovanie statisticheskikh kharakteristik pul'satsii granitsy turbulentnogo sleda za telami razlichnoi formy, letiashchimi so sverkhzvukovoi skorost'iu)** V G Ivanov, Iu G Krichevskii, and G I Mishin (Akademiia Nauk SSSR, Fiziko-Tekhnicheskii Institut, Leningrad, USSR) *Pis'ma v Zhurnal Tekhnicheskoi Fiziki,* vol 2, June 26, 1976, p 544-550 In Russian

The paper reports on ballistic range investigations of the roughness characteristics of turbulent wakes behind bodies of different shapes traveling at 790 m/sec at Reynolds number of 1,500,000 Root mean square deviations, the intermittency factor, and the microscale factor of wake boundary pulsations in the range of downstream distances from 2 to 10 diameters of the body midsection were obtained It was found that the ratio of pulsation microscale to rms deviation does not depend on body shape, Mach and Reynolds number, or downstream distance, and is approximately equal to 1 8 Hence this ratio may serve as a similarity parameter in experiments of this type P T H

A76-45084 # **For modeling and analysis I - Pilot's practical aerodynamics (Dlia modelirovaniia i analiza I - Letchiku o prakticheskoi aerodinamike)** N Maksimov and V Pakhnenko *Aviatsiia i Kosmonavtika,* June 1976, p 21 23 In Russian

The four diagrams presented for aircraft with variable geometry wings show the speed and Mach number limits, the limits of stable turn at maximum power, the critical speeds, and the increase in 'inertial' spin probability It is shown how the maneuverability and flight-safety limits, and their physical meaning, can be represented analytically in a clear and comprehensive fashion V P

A76-45095 # **Statistical evaluation of econometric air travel demand models** N K Taneja (MIT, Cambridge, Mass) *Journal of Aircraft,* vol 13, Sept 1976, p 662-669 35 refs

The paper discusses the more relevant assumptions in determining the best estimators of the unknown parameters of air travel demand models and presents some formal statistical tests to examine the appropriateness of such models Emphasis is on the statistical evaluation of the common econometric methods and the confidence which can be placed in models which often affect large investments in either fleet acquisition or market planning The discussion is theoretical inasmuch as the currently operating air traffic forecasting models have not been published in sufficient detail to perform the formal statistical evaluation outlined in the paper S D

A76-45097 * # **A wing-jet interaction theory for USB configurations** C E Lan (Kansas, University, Lawrence, Kan) and J F Campbell (NASA, Langley Research Center, Subsonic-Transonic Aerodynamics Div , Hampton, Va) *Journal of Aircraft,* vol 13, Sept 1976, p 718-726 20 refs Grant No NsG 1139

The aerodynamic interaction between the wing and an inviscid upper-surface blowing (USB) thick jet with Mach number nonuniformity is treated within the framework of a linear inviscid subsonic compressible flow theory A two-vortex-sheet model for the jet surface is used to represent the induced flowfields inside and outside the jet Comparison of the predicted results with experimental data shows good agreement in lift, induced drag, and pitching moment It is shown that the thin jet flap theory is inadequate for USB configurations with thick jet S D

A76-45098 # **Symmetrical singularity model for lifting potential flow analysis** B Maskew and F A Woodward (Analytical Methods, Inc , Bellevue, Wash) *Journal of Aircraft,* vol 13, Sept 1976, p 733, 734 7 refs

Previous methods for three-dimensional lifting potential flow problems have a practical difficulty in applying the Kutta trailing edge condition, so that significant variations can occur in surface pressures near the trailing edge and in overall lift coefficient The present paper outlines some thoughts on the reasons for these problems and proposes a possible solution in the form of a modified singularity model for the basic aerodynamic representation Some calculated results are provided from a simple two-dimensional method incorporating the new model where the airfoil surface is represented by an inscribed polygon with an even number of sides or panels The advantages of the proposed method over the widely used surface source/internal doublet or/surface vorticity methods are identified The Kutta condition is satisfied automatically because the loading goes to zero at the trailing edge S D

A76-45099 # **Simplified sculptured surface technique applied to wind-tunnel models** M Roche (Grumman Aerospace Corp , Bethpage, N Y) *Journal of Aircraft,* vol 13, Sept 1976, p 735, 736

Execution of numerical/control (N/C) operations to generate a wind-tunnel model requires a mathematical description of the surface Many N/C machined sculptured surfaces are the result of laborious expensive mathematical modeling programs The paper describes a technique which is less costly and somewhat similar to a low-cost program developed by Simon (1974) The surface definition developed permits simple computations of needed quantities and also facilitates handling changes in surface geometry N/C machining

becomes possible with little additional labor The procedure described is used to machine aerodynamic wind tunnel models, one particular wing is defined by an airfoil section along with a distribution function and a leading and trailing edge with a built in twist distribution Variations of this procedure will allow for a more complex geometrically defined wing S D

A76-45143 # **Dynamics and erosion study of solid particles in a cascade** M F Hussein, W Tabakoff, and A Hamed (Cincinnati, University, Cincinnati, Ohio) In COBEM 75, Brazilian Congress on Mechanical Engineering, 3rd, Rio de Janeiro, Brazil, December 9-11, 1975, Annals Volume B Rio de Janeiro, Universidade Federal, 1976, p 367-382 6 refs Grant No DAHC04-69-C-0016

A theoretical approach to calculating the dynamic behavior of solid particles entrained in a gas flow through a two-dimensional turbine stationary cascade is undertaken The equations of motion of the entrained solid particles are set up with drag force responsible for acceleration of the particles assumed to be the sole force acting upon them Equations of motion of gas flow through the cascade were solved numerically on a square grid Collision and rebound phenomena (particles striking blade walls) are studied on the basis of empirical data The effect of particle mean diameter, material density, and initial velocities of particles and gas stream on the dynamics of the entrained flow through the cascade were investigated Empirical data are obtained on the effects of impinge ment angle, particle velocity, and particle size on blade erosion R D V

A76-45162 # **Estimating the state of nonlinear dynamical systems in the presence of unmodeled accelerations** A Rios Neto (São Paulo, Universidade, São Paulo, Brazil) and B D Tapley (Texas, University, Austin, Tex) In COBEM 75, Brazilian Congress on Mechanical Engineering, 3rd, Rio de Janeiro, Brazil, December 9 11, 1975, Annals Volume D Rio de Janeiro, Universidade Federal, 1976, p 969 982 10 refs

The paper considers the problem of estimating low-altitude satellite orbits under the effect of atmospheric drag when there is insufficient knowledge of the mathematical model governing the dynamics Atmospheric resistance and motion of the satellite about its center of mass are the primary unmodeled effects The estimation procedure employs an extended Kalman filter along with a first order Gauss Markov process to account for model errors This results in a first-order autoregressive estimation procedure which yields a good estimate of the state and furnishes information on the unmodeled effects by estimating the unmodeled accelerations P T H

A76-45199 **The Legendre condition in optimum problems of supersonic gasdynamics** A V Fedorov *(Prikladnaia Matematika i Mekhanika,* vol 39, Nov-Dec 1975, p 1032 1042) *PMM - Journal of Applied Mathematics and Mechanics,* vol 39, no 6, 1975, p 990-1000 9 refs Translation

A76-45203 **Flows of a reacting mixture in Laval nozzles under conditions of a quasi-frozen process** A L Ni *(Prikladnaia Matematika i Mekhanika,* vol 39, Nov-Dec 1975, p 1068-1072) *PMM - Journal of Applied Mathematics and Mechanics,* vol 39, no 6, 1975, p 1023-1028 Translation

A76-45223 # **The US Army's new air cushion lighter** H N Wood (U S Army, Washington, D C) *(Canadian Air Cushion Technology, Symposium, 9th, Ottawa, Canada, Oct 21, 1975) Canadian Aeronautics and Space Journal,* vol 22, July-Aug 1976, p 176-182

The U S Army's new air cushion lighter, the LACV 30, will provide a highly mobile rapid lift capability to move tons of military cargo in the combat service support role This lighter will become the newest major item of amphibious equipment in the U S Army Transportation Corps inventory and will be particularly effective in moving 20-foot containers in a Logistics Over-The-Shore (LOTS) environment Its improved seakeeping and surf crossing capabilities will assure responsive support and increased productivity in the movement of water-borne cargo from vessels standing off-shore, to and across unimproved beaches and to transhipment points inland The LACV-30 program will provide the U S Army with a dynamic new mode of marine transportation to fulfill its near term (and well into the 1980's) requirements (Author)

A76-45242 **Hydrogen energy technology - Update 1976** J B Pangborn and D P Gregory (Institute of Gas Technology, Chicago, Ill) In Energy technology III Commercialization, Pro ceedings of the Third Conference, Washington, D C , March 29 31, 1976 Washington, D C , Government Institutes, Inc , 1976, p 172 182 47 refs

A number of hydrogen production techniques are discussed including thermochemical hydrogen production, hydrogen from the reaction of coal and steam, water electrolysis, and photosynthetic and photochemical hydrogen production Hydrogen storage, transmission, distribution, and materials compatibility with hydrogen in storage and transmission systems are also considered Hydrogen utilization is examined with attention given to automotive, aircraft and industrial applications B J

A76-45371 # **Investigation of the absolute stability of an elastic aircraft during flight on course (Issledovanie absoliutnoi ustoichivosti uprugogo letatel'nogo apparata pri dvizhenii po kursu)** T M Chikhladze (Akademiia Nauk Gruzinskoi SSR, Institut Kibernetiki, Tiflis, Georgian SSR) *Akademiia Nauk Gruzinskoi SSR, Soobshchenila,* vol 82, May 1976, p 445 447 5 refs In Russian

The paper uses the Liapunov vector function method to examine the effect of the elastic properties of an automatically piloted aircraft on its flight on course The dimension of the system of differential equations describing the motion of the aircraft is equal to infinite, and, during bending of the aircraft, there is an unlimited number of degrees of freedom in the form of elastic vibration modes Each mode is represented as a second order differential equation B J

A76-45376 # **Flight test status of the fighter CCV** D J Thigpen (General Dynamics Corp , Fort Worth, Tex) and R A Whitmoyer (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex , Sept 27-29, 1976, Paper 76-884* 8 p USAF-supported research

The Control Configured Vehicle (CCV) Advanced Development Program of the Air Force Flight Dynamics Laboratory is flight testing a modified YF 16 aircraft to investigate CCV concepts applied to fighter aircraft General Dynamics Corporation has modified the YF-16 number 1 prototype with the addition of a CCV auxiliary flight control system to permit flight evaluations of three Direct Lift Control (DLC) modes, three Direct Sideforce Control (DSFC) modes, a Maneuver Enhancement/Gust Alleviation mode, and Relaxed Static Stability conditions An extensive flight test program began in March, 1976 and will continue into 1977 This paper reports the progress of the CCV YF-16 flight test program and includes preliminary test results (Author)

A76-45377 # **The AFTI concept - A new approach to technology transition** A E Preyss, W G Williams, and C J Cosenza (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex , Sept 27-29, 1976, Paper 76-888* 7 p

The Advanced Fighter Technology Integration (AFTI) concept was developed as a cost effective means of providing adequate

demonstration of new technologies in the fighter area The AFTI program, which can be briefly described as the flight demonstration of integrated fighter technologies to facilitate transition to systems application, is primarily intended to effectively evaluate the air-to air and air to-surface weapon delivery systems An analysis of the AFTI selection process scheme is followed by a description of three early alternative near term configurations proposed for demonstration vehicle (AFTI-1), as well as the present projects of technology demonstrators (AFTI 15, 16 and -111 aircraft) S N

A76 45378 # **The fighter CCV program Demonstrating new control methods for tactical aircraft** F R Swortzel and A F Barfield (USAF, Flight Dynamics Laboratory, Wright Patterson AFB, Ohio) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex , Sept 27-29, 1976, Paper 76-889* 10 p 6 refs

The Fighter Control Configured Vehicle (CCV) Advanced Development Program is developing new control methods for tactical aircraft Under contract to the Air Force Flight Dynamics Laboratory, General Dynamics is accomplishing the effort on a modified YF-16 aircraft Control concepts being evaluated include direct lift, direct sideforce, maneuver enhancement and relaxed static stability A total of six manual and one automatic direct force control modes are being evaluated This paper describes the design approach features, and system mechanization Pertinent results of the various simulation efforts and their influence on the system design and flight testing are covered The analyses and ground tests used to validate the mechanization are discussed A summary of the flight test results to date and the possible applications of these new modes are presented (Author)

A76 45379 # **History and development of a system for stall-departure improvement for the A-7 attack aircraft** W C Heald and B B Brassell (Vought Corp , Dallas, Tex) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex , Sept 27 29, 1976, Paper 76-891* 10 p

The automatic maneuvering flap (AMF) system for stall departure improvement is described functionally, aerodynamically, and in its historical development Stall departure boundaries for the A-7 aircraft are significantly improved with the AMF system, and post-departure gyrations and altitude loss accompanying departure are reduced Maneuvering and handling are improved The A-7 exhibits high resistance to spin but low resistance to departure when maneuvered into the stall region Many hours of flight testing and simulation show that releasing the controls as soon as post stall gyration starts results in immediate recovery to controlled flight The effect of automatically activated leading-edge and trailing-edge flaps in the AMF system, and the effect of a protruding fuselage strake, on stall behavior and recovery are analyzed R D V

A76-45380 # **Fifty years of technical progress in aviation and a look ahead** J L Atwood *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex , Sept 27-29, 1976, Paper 76-893* 12 p

This paper reviews some key elements that led to the progress in aircraft design and efficiency of the past five decades in United States aviation history Technical challenges and their progressive solutions are examined in light of several parallel threads that run through the fabric of aircraft development The interdependency of these threads coalesced in the development of certain aircraft that are bench marks in aeronautical history The interaction of the technical pioneering within a unique financial and political climate resulted in advancements almost unparalleled in American industry The paper suggests that if application of the principles that guided past successes were continued even in today's socioeconomic environment, an optimistic projection can be made for civil aviation in the United States As in the past, current challenges present technical barriers, but it is in overcoming these barriers that progress is made (Author)

A76-45381 # **More effective aircraft stability and control flight testing through use of system identification technology** R A Burton and D E Bischoff (U S Naval Air Test Center, Patuxent River, Md) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex , Sept 27-29, 1976, Paper 76-894* 17 p 12 refs

The development of system identification technology was undertaken to provide for more effective aircraft flight testing by reducing the time required to conduct specific tests and/or to provide for a more comprehensive data analysis F-14A and TA-4J flight test results presented demonstrate that the flight time required to obtain stability and control data can be significantly reduced without loss in accuracy of conventional flight test derived pa rameters Presentation of S-3A and EA-6B system identification results demonstrate that this technology can be successfully used to update the aerodynamic data bases of modern jet aircraft from flight test data These system identification results are compared with wind tunnel data and flight test derived parameters to demonstrate the accuracy of this new technology Applications of this technology to integrate several areas of aircraft flight testing are discussed (Author)

A76-45382 # **The layered weather correction for flyover noise testing** H C True (FAA, Systems Research and Development Service, Washington, D C) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex , Sept 27-29, 1976, Paper 76-895* 9 p 5 refs

This paper describes results of an FAA/NASA flyover noise test program conducted to investigate the effect of anomalous meteoro logical conditions on flyover noise measurements and to develop criteria and procedures for correcting the noise data to standard conditions This program demonstrated that the use of the layered weather correction procedure combined with frequent and detailed meteorological measurements enables valid acoustic testing to be conducted over a wide variety of meteorological conditions with nonuniform temperature and humidity altitude profiles The success of the layered correction procedure is attributed to detailed consideration of the temperature and relative humidity at each altitude increment of the noise propagation path and basing the correction for atmospheric absorption on these values as opposed to those existing at some arbitrarily defined single point (Author)

A76-45383 * **Civil helicopter flight research** W J Snyder (NASA, Langley Research Center, Hampton, Va) and M B Schoultz *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex , Sept 27 29, 1976, Paper 76-896* 13 p 16 refs

The paper presents a description of the NASA CH 53 Civil Helicopter Research Aircraft and discusses preliminary results of the aircraft flight research performed to evaluate factors and require ments for future helicopter transport operations The CH-53 equipped with a 16 seat airline type cabin and instrumented for flight research studies in noise, vibration, handling qualities, passenger acceptance, fuel utilization, terminal area maneuvers, and gust response Predicted fuel usage for typical short haul missions is compared with actual fuel use Pilot ratings for an IFR handling quality task for three levels of stability augmentation are presented, and the effects of internal noise, vibration, and motion on passenger acceptance are discussed Future planned CH-53 flight research within the Civil Helicopter Technology Program is discussed S N

A76-45384 # **New developments and accuracy limits in aircraft flight testing** H L Jonkers and J A Mulder (Delft, Technische Hogeschool, Delft, Netherlands) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex , Sept 27-29, 1976, Paper 76-897* 19 p 27 refs

When estimating aircraft performance, stability and control characteristics from steady or nonsteady maneuvering test flight data the accuracy of the results is limited due to measurement errors,

atmospheric disturbances and mathematical modelling errors This paper studies the effects of the different error sources on the maximally achievable accuracies of the aircraft flight test results It is shown which error sources are most relevant for accuracy limitations in present day flight testing, taking account of aerodynamic and inertial aircraft properties Conclusions drawn from theoretical analyses are compared with results obtained by processing digitally simulated and actual flight test data The material presented is an extension of earlier material published by Gerlach, Hosman, Mulder and Jonkers (Author)

A76-45387 # **Computer interactive graphics in aerospace engineering design education** H W Smith (Kansas, University, Lawrence, Kan) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex , Sept 27-29, 1976, Paper 76 900* 12 p 12 refs

A comprehensive systematic procedure for designing airplanes is described The system takes advantage of the human capability to make decisions and the computer capability to store, analyze and display the large quantities of data and information The ambitious objective of this project was to collect and compile an exhaustive set of design procedures in all identifiable engineering disciplines, and to assemble them into a complete system From an educational point of view, an interactive graphic system of this completeness allows the students to see connections between the topics in a curriculum (Author)

A76-45388 # **Computer methods in aircraft design at the Air Force Academy** W A Edgington, G T Matsuyama, and R J Stiles (U S Air Force Academy, Colorado Springs, Colo) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex , Sept 27 29, 1976, Paper 76-901* 8 p

A description of the Aircraft Design course at the USAF Academy is presented including a discussion of the philosophy behind the course and how it has evolved over recent years The design process is divided into 11 tasks - Analysis of Mission Requirements, Preliminary Vehicle Sizing, Wing Selection, Fuselage Sizing, Initial Configuration Determination, Aerodynamic Parameter Estimates, Inlet Design, Refined Weight Estimate, Stability and Control Analysis, Refined Performance Analysis, and Design Iteration An example of a trade study is presented with wing design as the subject Four computer programs which are used in the course are discussed The first, DIGITAL DATCOM, is used to compute aerodynamic coefficients and stability derivatives as a function of vehicle geometry The other three programs are used to 'fly' the vehicle through required mission profiles in order to obtain component and fuel weights as well as performance contours (Author)

A76-45390 # **Damage tolerance assessment of F-4 aircraft** R E Pinckert (McDonnell Aircraft Co , St Louis, Mo) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex , Sept 27-29, 1976, Paper 76-904* 12 p 6 refs

The damage tolerance-assessment phase of two F-4 aircraft structural-integrity programs has been completed Methods were developed to determine the operational limits of the fracture critical areas and to incorporate initial flaw assumptions, crack-growth computations, and operational limits into the F 4 fleet tracking program In this paper, the following subjects are covered (1) development of fatigue spectra to represent service usage, (2) development of a crack growth prediction technique, (3) determination of the initial quality of F 4 aircraft structure represented by equivalent initial flaw sizes, (4) establishment of baseline aircraft assumptions and the prediction of operational limits, (5) the development of a 'damage index' system to track crack growth at one critical location on an aircraft and determine the damage at other locations, and (6) the development of stress life curves to convert counting accelerometer data into damage related to crack growth (Author)

A76-45391 * # **A structural design for a hypersonic research aircraft** L R Jackson (NASA, Langley Research Center, High Speed Aerodynamics Div , Hampton, Va) and A H Taylor (Vought Technical Center, Hampton, Va) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex , Sept 27 29, 1976, Paper 76-906* 10 p 8 refs

A research aircraft is being studied that has potential for large-scale demonstration of advanced propulsive, structural, and aerodynamic technologies for hypersonic application Versatility is achieved through a large removable payload bay with removable thermal protection, by removable wings, and by the configuration, which considers engine-airframe integration Design criteria have been applied to an effective heat-sink structure of Lockalloy (Be-38Al), wherein thermal stress alleviation is a prime consideration in the design Structural analyses are being performed with the SPAR computer program Results indicate that no critical problems exist and the resulting structural weight is within initial estimates (Author)

A76-45392 # **Flight certification testing for the A-7D advanced composite outer wing panel** J H Pimm (Vought Corp , Dallas, Tex) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex , Sept 27-29, 1976, Paper 76-907* 11 p

The A-7D Advanced Composite Outer Wing is primary, critical-to flight-safety structure and will be flown on in service aircraft with no imposed flight restrictions There are no military specifications such as MIL STD-1530 and MIL-A-83444 for flight qualification of composite primary structure Vought and the Air Force have worked closely together to arrive at a mutually agreeable plan to fulfill the intent of the latest Air Force acceptance philosophy This paper itemizes testing done on the outer wing, tells how it was accomplished and gives a summary of results (Author)

A76-45393 * # **Automated optimization techniques for aircraft synthesis** G N Vanderplaats (NASA, Ames Research Center Advanced Vehicle Concepts Branch, Moffett Field, Calif) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex , Sept 27 29, 1976, Paper 76 909* 11 p 32 refs

Application of numerical optimization techniques to automated conceptual aircraft design is examined These methods are shown to be a general and efficient way to obtain quantitative information for evaluating alternative new vehicle projects Fully automated design is compared with traditional point design methods and time and resource requirements for automated design are given The NASA Ames Research Center aircraft synthesis program (ACSYNT) is described with special attention to calculation of the weight of a vehicle to fly a specified mission The ACSYNT procedures for automatically obtaining sensitivity of the design (aircraft weight, performance and cost) to various vehicle, mission, and material technology parameters are presented Examples are used to demonstrate the efficient application of these techniques S N

A76-45394 # **High speed aerodynamic design of an innovative V/STOL canard wing configuration** L Mark and J H DeHart (Rockwell International Corp , Columbus, Ohio) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex , Sept 27 29, 1976, Paper 76-910* 12 p 8 refs

The design and flight characteristics of the XFV 12A, a high-performance VTOL supersonic fighter prototype with thrust augmenters integrated in the lifting surfaces are analyzed Compactness combined with high maneuverability and a wide operational range are achieved through the use of a low canard, high wing configuration with tip mounted vertical tails The wing endplates provide directional stability for the aircraft as well as a significant increase in longitudinal stability and effective aspect ratio The multiple interactions of the canard wing, and endplates permit

significant configuration tradeoffs The XFV 12A configuration was developed through a series of wind tunnel tests, and a finite element analysis based on the Woodward theory was used to fill in subsonic and supersonic aerodynamic characteristics and to verify component air loads The theory demonstrates good agreement with experimental force and pressure data S N

A76-45395 * # **Response analysis of flexible aircraft with active control** R B Noll (Aerospace Systems, Inc , Burlington, Mass) and L Morino (Boston University, Boston, Mass) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex , Sept 27-29, 1976, Paper 76-913* 8 p 15 refs Contract No NAS1-13371

The small-perturbation equations of motion of a flexible aircraft with an active control technology (ACT) system are developed to evaluate the stability and performance of the controlled aircraft The total aircraft system is formulated in state vector format and the system of equations is completed with fully unsteady and low frequency aerodynamics for arbitrary, complex configurations based on a potential aerodynamic method The ACT system equations are incorporated in the digital computer program FCAP (Flight Control Analysis Program) which can be used for the analysis of complete aircraft configurations, including control system, with either low frequency or fully unsteady aerodynamics The application of classical performance analyses including frequency response, poles and zeros, mean-square response, and time response in FCAP in state vector format is discussed (Author)

A76-45396 # **YC-14 propulsion system ground rig test** W J Hirt (Boeing Co , Seattle, Wash) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex , Sept 27-29, 1976, Paper 76 918* 10 p 8 refs

This paper describes full-scale ground tests conducted to evaluate the propulsion system designed for the YC 14 STOL military transport airplane The tests employed a specially designed ground test rig and balance system installed at Boeing's Tulalip, Washington, engine test facility The test objectives were to confirm system safety to fly and to obtain data to be used in evaluating airplane inflight performance Test results are presented showing that all test objectives were successfully accomplished Data verifying engine acceptability in terms of airflow match and turbine pressure distortion are presented for both forward and reverse thrust operation Nozzle performance and flow turning data, along with a limited amount of flap temperature data, also are presented (Author)

A76-45397 # **An evaluation of very large airplanes and alternative fuels** W T Mikolowsky (Rand Corp , Washington, D C) L W Noggle (USAF, Wright Patterson AFB, Ohio), and W L Stanley (Rand Corp , Santa Monica, Calif) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex , Sept 27-29, 1976, Paper 76-920* 13 p 22 refs

The paper examines the potential of very large airplanes (VLA) in the context of existing and possible future Air Force missions, and determines the most attractive fuel for airplanes of this type The description of alternative VLA conceptual designs includes the desired aircraft characteristics, results of a screening analysis which identifies the most promising candidate fuels, and some characteristics of the alternative VLA projects, such as life cycle cost and energy consumption Synthetic jet fuel, liquid methane, liquid hydrogen, and nuclear propulsion are the fuel alternatives selected for detailed analysis The effectiveness of the alternative airplanes is analyzed in strategic airlift and station-keeping missions It is shown that for most military applications, VLA with gross weight exceeding one million pounds promise to be superior to contemporary vehicles in terms of cost- and energy effectiveness The conventional jet fuel (made from coal, oil shale or crude oil) appears to be the most effective at least up to year 2000 Nuclear propulsion is attractive only for station-keeping missions requiring larger station radii (greater than about 4000 nautical miles) S N

A76-45398 # **Status Report - Subsonic aircraft noise reduction Update Sept 1976** R E Russell and J W Little (Boeing Commercial Airplane Co , Seattle, Wash) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex , Sept 27-29, 1976, Paper 76-921* 10 p

Progress, current status and prospects in the aircraft noise reduction problem is considered using recent full scale test results Based on a Boeing balanced aircraft design study, incorporating advanced technology 20,000 lb thrust class high bypass ratio engines, the role of acoustic requirements in engine cycle selection for new airplanes is analyzed The discussion covers noise component analysis for takeoff and approach stages, noise suppression design, relationships between noise reduction and airplane performance requirements, including payload ratio and fuel usage, and allowance for uncontrollable noise factors It is shown that noise reduction is not as sensitive to subsequent bypass ratio increase as might be expected, and that core noise, jet noise and airframe noise represent floors preventing further practical noise reduction Attention is paid to the recent estimates of potential progress that might be expected in 1990, and it is concluded that near-term prospects show some promise for small additional noise reductions, but larger advances require intensive research and development of additional technology S N

A76-45399 # **Future air cargo transportation system - A national need** J M Norman and J H Burnett (Lockheed-Georgia Co , Marietta, Ga) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex , Sept 27-29, 1976, Paper 76-922* 7 p

This paper describes the air cargo system requirement as it has been identified in a hardware prototype test program funded by the private sector In that program, standard 40 foot marine containers and standard highway trailers containing actual enroute cargo were loaded aboard military aircraft designed for cargo and transported transcontinental Prototype hardware was used to accomplish the surface-to-air loading interface That test program is described along with its participants, its organization, the hardware used, and the results The technology and type of hardware needed to proceed are identified, and the way the development of such a system will enable the United States to maintain its position as the world leader in aerospace development and exports is discussed (Author)

A76-45400 * # **A hybrid airship concept for Naval missions** M Harper (NASA, Ames Research Center, Moffett Field, Calif) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex , Sept 27-29, 1976, Paper 76-923* 11 p 7 refs

A preliminary analysis of a hybrid semibuoyant delta-planform airship was performed using a computer synthesis program The delta-planform hull shape was studied parametrically to determine the effects on vehicle performance for two Navy antisubmarine missions The effects of buoyancy ratio, design speed, and altitude were also studied The results suggest that long-range mission vehicles require a near buoyant or fully buoyant design and that there is no special advantage to the use of a lifting body hull shape For shorter range missions, hybrid vehicles may have merit, and optimum vehicle buoyancy varies depending on whether a minimum-weight or minimum fuel-consumption design is desired As compared with conventionally shaped airships, the benefits, if any, from a lifting-body configuration will be limited to missions requiring relatively higher flight speeds (Author)

A76-45401 # **Parametric design and analysis of large advanced military transports** F J Verginia, E A Barber, and I H Rettie (Boeing Co , Seattle, Wash) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex , Sept 27-29, 1976, Paper 76-924* 11 p 6 refs

An analysis intended to examine the application of large transport aircraft to the problem of strategic military airlift is presented The effects of airplan size, payload, configuration, and advanced technology on the capability and life cycle costs of a

suitable fleet are studied using the results of an Airplane Responsive Engine Selection (ARES) computer aided analysis Based only on life cycle costs and fuel efficiency, the optimum size of transport appears to be in the range of 1 5 to 1 75 million pounds Consideration of fuel- and range optimized designs has shown substantial differences in design approach, with fuel efficient designs requiring lower wing loading and thrust to weight ratio than the range optimized designs A fuel cost of about $2 00/gallon would be required to make the fuel-efficient design competitive with the minimum gross weight designs The impact of advanced technology appears potentially very significant, particularly in the area of weight reduction from advanced structures and active controls S N

A76-45402 # **Concorde systems in airline operation** R M McKinlay (British Aircraft Corp , Ltd , Commercial Aircraft Div , Fairford, Glos , England) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex , Sept 27-29, 1976, Paper 76-925* 8 p

This paper describes the approach which was taken to Concorde system testing using the flying control system and air intake control system as examples It describes the airline operations so far both as simulated for type certification and as flown by British Airways and Air France and assesses the behavior of the aircraft using the normal criteria It concludes that while there have been problems they are not beyond what was expected, the current situation is satisfactory and the approach taken to systems testing was adequate (Author)

A76-45404 , **Flight test development and evaluation of a multimode digital flight control system in an A-7D** L M Damman (USAF, Flight Test Center, Edwards AFB, Calif) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex , Sept 27-29, 1976, Paper 76-927* 12 p

A flight test development and evaluation of a multimode Digital Flight Control System (DFCS) installed in an A-7D was conducted by the Air Force Flight Test Center This system used dual minicomputers to duplicate standard A-7D analog flight control system modes as well as provide two additional advanced control modes This paper will summarize the ground and flight test techniques used and some specific results In addition, features which proved beneficial for this type of development program will be highlighted The results will be extracted from the 92 hour flight test program which was the first Air Force test and evaluation of a digital flight control system in a tactical fighter aircraft (Author)

A76-45405 # **Flight evaluation of a digital data broadcast technique as an aid to area navigation operations** D W Richardson, M Hughes, and R A Elliott (Champlain Technology Industries, West Palm Beach, Fla) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex , Sept 27-29, 1976, Paper 76-928* 9 p 6 refs U S Department of Transportation Contract No FA75WA 3634

Preliminary analysis has indicated that a Digital Data Broadcast System (DDBS) concept could be applied as a potential solution to the problems of cockpit workload, pilot blunders, and airborne data storage when considered in terms of the utilization of Area Navigation (RNAV) within our National Airspace System (NAS) The basic philosophy of the program described in this paper was to concurrently evaluate both the operational impact of the DDBS concept under a set of flight evaluations, and the technical feasibility of a DDBS Engineering Model The principal conclusion of this program substantiates and amplifies the original goals of the DDBS development effort, namely a reduction of cockpit workload, pilot blunders and steering errors (Author)

A76-45406 , **Investigation of decelerating approaches of a twin engined jet transport aircraft** C F G M Hofman (Nationaal Luchtvaartlaboratorium, Amsterdam, Netherlands) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex , Sept 27 29, 1976, Paper 76 929* 12 p 14 refs

Aircraft noise perceived on the ground can be reduced by decelerating the aircraft during landing approach, with reduced fuel consumption and added benefit Investigations were conducted to examine this noise reduction technique, consisting of a preliminary study with a fixed base flight simulator, an exploratory in-flight investigation, and a study with a moving base flight simulator It was found that constant deceleration (0 5 kt/s) initiated at a speed above the final approach speed was executed with an increasing flap detection B J

A76-45408 * # **Prediction methods for jet V/STOL propulsion aerodynamics** M F Platzer (U S Naval Postgraduate School, Monterey, Calif) and R J Margason (NASA, Langley Research Center, Hampton, Va) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex , Sept 27-29, 1976, Paper 76-932* 28 p 105 refs

The current status of prediction methods for propulsive flows and propulsion-induced effects which occur on jet V/STOL aircraft is reviewed Among the major topics studied are flows in propulsive ducts, propulsion-induced ground and thermal effects, aerodynamic loads induced during V/STOL and transition flight, flow vectoring devices, and thrust augmented ejector and lift fan studies The current predictive capability in jet V/STOL propulsion aerodynamics is assessed Future research needs are identified, with particular reference to activities that can improve the usefulness of prediction methods for jet V/STOL aircraft V P

A76-45409 # **A wind tunnel study of a circulation-controlled elliptical airfoil** T A Stevenson, M E Franke, W E Rhynard, Jr (USAF, Institute of Technology, Wright Patterson AFB, Ohio), and J R Snyder (USAF, Aeronautical Systems Div , Wright-Patterson AFB, Ohio) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex , Sept 27-29, 1976, Paper 76-933* 6 p 10 refs

A circulation control method for increasing the low speed lift characteristics of an elliptically shaped airfoil is investigated in wind tunnel tests Circulation control is achieved from a jet of air that exits through a 0 02-in spanwise slot along the upper surface of the airfoil near the trailing edge The lift is shown to increase with increase in blowing rates The added lift is attained at small or even negative angles of attack with relatively small amounts of blowing air A splitter plate attached to the lower surface of the airfoil is shown to reduce the drag and improve the lift to-drag ratio (Author)

A76-45410 * # **Prediction of longitudinal aerodynamic characteristics of STOL configurations with externally blown high lift devices** M R Mendenhall and S B Spangler (Nielsen Engineering and Research, Inc , Mountain View, Calif) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex , Sept 27 29, 1976, Paper 76-934* 11 p 9 refs Contracts No NAS1 13158, No NAS1-14086

A theoretical method has been developed to predict the longitudinal aerodynamic characteristics of engine wing flap combinations with externally blown flaps (EBF) and upper surface blowing (USB) high lift devices Potential flow models of the lifting surfaces and the jet wake are combined to calculate the induced interference of the engine wakes on the lifting surfaces The engine wakes may be circular, elliptic, or rectangular cross sectional jets, and the lifting surfaces are comprised of a wing with multiple slotted trailing edge flaps or a deflected trailing-edge Coanda surface Results are presented showing comparisons of measured and predicted forces, pitching moments, span load distributions, and flow fields (Author)

A76-45411 # **Low and intermediate temperature application of composite materials to aircraft engines** A P Adamson and S Wakefield (General Electric Co , Cincinnati, Ohio) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex , Sept 27-29, 1976, Paper 76-936* 6 p

The story at General Electric on low and intermediate temperature application of composite materials to aircraft engines is one of

guarded optimism The present limited use of composites in the CF6 and other engines is described Projected uses for such components as fan blades and engine frames are examined in some detail, as are some of the internal and government-funded programs which are bringing this advanced technology to successful application Fabrication and testing equipment of general interest is also discussed Additional potential applications of composite materials in aircraft engines are outlined (Author)

A76-45413 # **Directional structures for advanced aircraft turbine blades** D N Duhl and E R Thompson (United Technologies Corp , East Hartford, Conn) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex , Sept 27-29, 1976, Paper 76-938* 11 p 20 refs

To achieve the performance and durability requirements of advanced gas turbine engines, high pressure turbine blade materials with directional structures will be required Directional structures can be obtained by liquid solid (solidification), by solid solid (recrystallization) reactions or by composite fabrication techniques Currently, directional solidification is utilized to produce columnar grained superalloy turbine airfoils This production process can be modified to provide single crystal superalloys or directionally solidified eutectic, turbine blades Directional superalloy structures can also be obtained by a solid state recrystallization process referred to as directional recrystallization In addition, directional composite structures are fabricated by reinforcing a superalloy matrix with high strength, refractory metal wires These five directional turbine blade materials are compared for use in advanced gas turbine aircraft engines The present status of each advanced material is reviewed and the advantages and limitations of each is assessed (Author)

A76 45414 * , **Prospective markets and design concepts for civilian remotely piloted aircraft** W P Nelms, Jr , T J Gregory (NASA, Ames Research Center, Moffett Field, Calif), and J R Aderhold (Lockheed Missiles and Space Co , Inc , Sunnyvale, Calif) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex , Sept 27-29, 1976, Paper 76 939* 10 p

This paper summarizes a study that examines the technical economic and environmental aspects of remotely piloted vehicles (RPVs) in the civil environment A market survey was conducted in which 35 civil applications of RPVs were identified For a number of these uses, vehicle and system concepts were defined, benefit and cost comparisons were made with present methods, and the influence of safety and environmental implications was assessed The results suggest a sizable potential demand for the use of RPVs in the civil sector, and some of the applications show promising cost savings over established methods A focussed technology effort could provide the safety assurances needed for routine civilian operation of RPVs (Author)

A76-45415 # **Integrated flight control system design for CCV** J A Boudreau (Grumman Aerospace Corp , Bethpage, N Y) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex , Sept 27-29, 1976, Paper 76 941* 15 p 5 refs

The advent of Controlled Configured Vehicle (CCV) design approaches has imposed severe reliability and fault tolerance requirements on aircraft flight control and supporting systems This paper establishes the requirements for, and develops the configuration of an integrated Fly By-Wire (FBW) flight control system suitable for an unstable CCV fighter/attack aircraft design The hydraulic and electric power systems are an integral part of the design problem, since their functions are essential to safety of flight A three-channel FBW system configuration was chosen as optimum The system features in line monitored active/on line secondary actuators, skewed rate gyros and triplex digital computers, accelerometers and pilot input transducers (Author)

A76-45416 , **Wrap around fins Design considerations** R D Meyer (Vought Corp , Systems Div , Dallas, Tex) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex , Sept 27-29, 1976, Paper 76-942* 8 p

Design problems for missile wrap around fins in several configurations arising in a study of a tube-launched cruise missile constrained in length and optimized for range are reported Tail fins are responsible for roll and pitch control in the absence of ailerons Major problems tackled are optimizing fin geometry for maximum roll control, and minimizing control cross couplings induced by the fin curvature Roll control is aided by placing the missile C G such that tail load during pitch trim is minimized, and by utilizing the available circumference with the smallest number of fins (three) providing greatest aspect ratio, longest moment arm, and least interference between fins The optimum C G location renders the tail off configuration neutrally stable Fins on and fins-off neutral stability is compared R D V

A76-45417 * # **Applications of oblique-wing technology - An overview** W P Nelms, Jr (NASA, Ames Research Center, Moffett Field, Calif) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex , Sept 27-29, 1976, Paper 76-943* 23 p 33 refs

A summary of oblique-wing technology programs, including system studies and experimental activities, is presented Oblique-wing civil transports were studied and compared with conventional configurations at design cruise Mach numbers of 0 95 and 1 2 Studies of military configurations employing oblique-wing technology considered aircraft concepts, remotely piloted vehicles, and a cruise missile Experimental activities included wind-tunnel tests of high and low aspect ratio oblique wings, flight tests are planned using unmanned and manned vehicles The research program suggests that oblique-wing technology offers improved performance over conventional concepts for aircraft operating in the transonic speed range (Author)

A76 45418 , **Central Integrated Test Sub System F101 engine in B-1 aircraft** V W Lawson (General Electric Co , Evendale, Ohio) and T A Hait (Rockwell International Corp , Los Angeles, Calif) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex , Sept 27 29, 1976, Paper 76 944* 4 p

The Central Integrated Test System (CITS) of the B 1 aircraft continually tests the operability of aircraft subsystems, identifying faults and displaying malfunction data to the aircrew for evaluation of mission capability and recording data to facilitate aircraft maintenance The four F101 turbofan engines form one of the B 1 subsystems monitored by CITS The test system consists of a digital computer, data acquisition units, a control and display for the man/machine interface, a clear text printer to provide immediate post-flight maintenance data, and a magnetic tape digital recorder to provide overall maintenance data for ground processing equipment The paper presents system description, the selected parameters, samples of in flight and on ground computer logic, and results of CITS tests S N

A76-45419 # **Performance of a new positive-displacement air cycle machine** R E Smolinski and L L Midolo (USAF, Flight Dynamics Laboratory, Wright Patterson AFB, Ohio) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex , Sept 27-29, 1976, Paper 76-946* 8 p 11 refs

A new design in rotary-vaned positive-displacement air cycle machines (ACM) has been evolving and will soon compete with the conventional turbomachine designs presently used throughout military and commercial aircraft environmental control systems (ECS) The latest ACM, designed to meet advanced fighter aircraft

mission cooling requirements is being tested and evaluated in the AF Flight Dynamics Laboratory facilities A performance map has been generated for both the compressor and expander components of the machine Several 'closed-loop' and 'open-loop' refrigeration cycles are being analyzed by computer with the positive-displacement ACM in the loop The results of the analysis are compared with conventional aircraft ECS performance (Author)

A76-45420 # **Air cycle ground air conditioners for aircraft support** G E Martin (USAF, Aeronautical Systems Div , Wright-Patterson AFB, Ohio) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex , Sept 27-29, 1976, Paper 76-947* 5 p

The paper presents the principal design objectives of the development programs for air cycle air conditioners used to support U S Air Force tactical aircraft The design selected to meet the objectives of these programs will be discussed The history of the development programs will be reviewed to illustrate the gradual evolution of this type ground air conditioner A summary of the proposed development program to further enhance the capability of air cycle air conditioners, while reducing noise level and fuel consumption, will be provided (Author)

A76-45469 **A near wake model for the aerodynamic pressures exerted on singing trailing edges** W K Blake (U S Naval Material Command, David W Taylor Naval Ship Research and Development Center, Bethesda, Md) *Acoustical Society of America, Journal*, vol 60, Sept 1976, p 594-598 11 refs Navy-supported research

Periodic vortex streets are formed in the wakes of blunted trailing edges on airfoils and struts The pressures generated on the shedding struts by the vortices in these wakes are periodic in time with a frequency that is set by the shedding rate for the vortices A simple analytical formulation is derived to relate wake-induced pressures to the characteristics of the wake near the edge The chordwise distribution and magnitude of the pressure is shown as a function of the circulation of shed vortices, as well as the formation distance and the spacing of the vortices in the street (Author)

A76-45474 **International bibliography of Air Law Supplement 1972-1976** Edited by W P Heere (Utrecht, Rijksuniversiteit, Utrecht, Netherlands) Leiden, A W Sijthoff International Publishing Co , 1976 191 p 2415 refs $22

The bibliographical supplement contains entries in a variety of languages and a table of contents and a subject index in English, French and Spanish Air law is covered in relation to such subjects as the administration of national and international aviation, the aviation industry, aircraft, airports, air transport, accidents, insurance, military aviation, and acts on board aircraft B J

A76-45476 **Buckling of shells, Meeting on Shell Buckling, Braunschweig, West Germany, June 19, 20, 1975, Lectures and Discussion Contributions (Beulen von Schalen, Schalenbeultagung, Braunschweig, West Germany, June 19, 20, 1975, Vorträge und Diskussionsbeitrage)** Meeting sponsored by the Deutsche Forschungs- und Versuchsanstalt fur Luft- und Raumfahrt Braunschweig, Deutsche Forschungs- und Versuchsanstalt fur Luft- und Raumfahrt, 1975 302 p In German

A survey of the buckling and postbuckling behavior of thin-walled circular cylinders is considered along with the question of the postbuckling load of cylinders in plastic buckling, buckling tests involving thin-walled circular cylinder shells in the wind tunnel, the effect of imperfections on the buckling load of spherical shells, and the computation of the buckling loads of ring-reinforced cylinders with stepwise variable wall thickness Attention is also given to orthotropic cylindrical shells in the practice of space technology, the determination of the stability of reinforced plates of shells, stability tests involving aircraft structural components, and the effect of curvature and of geometrical imperfections on the stability characteristics of the shells

Individual items are announced in this issue G R

A76-45485 # **Stability tests involving aircraft structural components (Stabilitatsversuche an Flugzeugbauteilen)** L Schwarmann In Buckling of shells, Meeting on Shell Buckling, Braunschweig, West Germany, June 19, 20, 1975, Lectures and Discussion Contributions Braunschweig, Deutsche Forschungs- und Versuchsanstalt fur Luft- und Raumfahrt, 1975, p 283 290 In German

An experimental investigation was conducted of the stability of fuselage components for the Airbus A 300 B The components studied were weakly curved shell parts connected by rivets to reinforcing elements Compressive load conditions and shear stresses were considered Attention is also given to static tests conducted with a static cell of the airliner F 28 in connection with studies of the bearing strength of the cell G R

A76-45487 # **Application and employment of RPV's in Central Europe (Anwendung und Einsatz von RPV's in Mitteleuropa)** J Spintzyk and G Harms (Dornier GmbH, Friedrichshafen, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Symposium on Remotely Piloted Vehicles, Porz-Wahn, West Germany, May 13, 1976, Paper 76 061* 44 p In German

The considered employment possibilities are related to air reconnaissance, attack missions, and air defense suppression Mission and system concepts for the considered applications are discussed and the technological requirements are examined A more detailed description is presented of RPV's for directing artillery fire and of RPV's for ground attack missions An analysis is conducted of RPV related objectives of the armed forces of West Germany, taking into account general problems of the defense of Central Europe and specific tasks of the army and the air force G R

A76-45488 # **Means and procedures for obtaining an adequate survival probability in the case of RPV (Mittel und Verfahren bei RPV zur Erzielung ausreichender Uberlebenswahrscheinlichkeit)** H J Beisenherz and V Schlenkrich (Vereinigte Flugtechnische Werke-Fokker GmbH, Bremen, West Germany) *Deutsche Gesellschaft fur Luft und Raumfahrt, Symposium on Remotely Piloted Vehicles, Porz Wahn, West Germany, May 13, 1976, Paper 76 065* 32 p In German

An investigation is conducted concerning the dangers and hazards to which an RPV is exposed during ground attack missions, taking into account approaches for enhancing the chances of RPV survival RPV design concepts for implementing these approaches are considered and the meaning of the term 'adequate survival probability' is discussed Attention is given to tactical measures, including a flight close to the ground, and to RPV design characteristics which will make the detection and tracking of the RPV by the enemy more difficult G R

A76-45489 # **Existing RPV programs (Existente RPV-Programme)** H J Weiss *Deutsche Gesellschaft fur Luft- und Raumfahrt, Symposium on Remotely Piloted Vehicles, Porz Wahn, West Germany, May 13, 1976, Paper 76-060* 21 p In German

The article surveys declassified material on remotely piloted vehicles and their functions, primarily Canadian and US developments The West German CL89 reconnaissance drone is discussed RPV system requirements and various RPV functions are reviewed target designation, spotting and fire control, loiter time in target area, automatic operation, low radar profile, vulnerability to hostile counteraction, testing and maintenance Retrievable and reusable RPVs, midair retrieval techniques, drogue and parachute landing, operation from road launchers or from ship decks, and high flying standoff RPVs are discussed The use of one-way one-shot RPVs for ECM missions or kamikaze strikes is also discussed R D V

A76-45494 # **Functional and reliability requirements concerning RPV's from the point of view of traffic safety and military cost effectiveness (Forderungen an Funktion und Zuverlassigkeit von RPV's aus der Sicht der Verkehrssicherheit und der militarischen Kosteneffektivitat)** H Kaschutz (Bundesamt fur Wehrtechnik und Beschaffung, Bundeswehr fur Luftfahrtgerat, Munich, West Germany) and B Krogull (Messerschmitt-Bolkow-Blohm GmbH, Ottobrunn, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Symposium on Remotely Piloted Vehicles, Porz-Wahn, West Germany, May 13, 1976, Paper* 15 p In German

The employment of unmanned aircraft for military objectives provides a possibility to perform certain operations more efficiently or at lower cost than with alternate manned systems However, the differences in the characteristics of unmanned and manned systems have to be taken into account in considering the implications of RPV operation on peace-time air traffic conditions Questions regarding the application of the regulations of the air law on RPV operation are discussed A reliability analysis of RPV's is conducted and aspects of cost effectiveness are investigated G R

A76-45496 **A unified signal processor for TACAN navigation sets** B E Bjerede (General Dynamics Corp , Electronics Div , San Diego, Calif) *(Institute of Navigation, Annual Meeting, 31st, Washington, D C , June 24, 25, 1975) Navigation,* vol 23, Summer 1976, p 119 127

A unified signal processor (USP) handles both digital and analog functions, using a time-shared microprocessor controlled by a ROM-stored program The USP is incorporated in the AN/ARN-119 TACAN navigation set, with improved performance, a twofold improvement in parts count and reliability (compared to conventional TACAN signal processors) Flight, qualification, and reliability tests have been completed on the integrated system The USP extracts and displays range and bearing, performs AGC and automatic tests, and switches antennas Analog/digital signal conversion interfaces, range and bearing acquisition algorithms, and circuitry of phase-locked loops and digital filters are covered Chief advantages of the USP are high reliability, flexibility, freedom from drift and adjustments, low parts count, low cost, unlimited precision in signal processing, and ease of microelectronic implementation R D V

A76-45501 # **Evaluation of Advanced Naval Vehicles Concepts** T L Meeks (U S Navy, Arlington, Va) and P J Mantle (Mantle Engineering Co , Inc , Arlington, Va) *American Institute of Aeronautics and Astronautics and Society of Naval Architects and Marine Engineers, Advanced Marine Vehicles Conference, Arlington, Va , Sept 20-22, 1976, AIAA Paper 76-846* 19 p 15 refs

The Advanced Naval Vehicles Concepts Evaluation (ANVCE) Project was set up within Chief of Naval Operations (CNO) Office with the designated code OP 96V The ANVCE Project is specifically directed to evaluate nine general concepts (air loiter aircraft, LTA craft, sea loiter aircraft, WIG, ACV, hydrofoils, planing craft, SES and SWATH) to determine their military worth, technical feasibility and cost The growing concern for the cost of these high performance vehicles and the need to meet increased technological threats has led to the need for this evaluation The current paper provides a summary of the military needs, project formulation and technical status to date The paper summarizes major items germaine to the state-of-the-art technology assessment and the specific analyses and model testing presently underway to improve the technological data base Emphasis is given to the need for technology to be directed toward meeting defined operational requirements (Author)

A76-45508 # **Interference effects on lateral forces and moments on high L/B SES arrangements** M B Wilson (U S Naval Material Command, David W Taylor Naval Ship Research and Development Center, Bethesda, Md) *American Institute of Aeronautics and Astronautics and Society of Naval Architects and Marine Engineers, Advanced Marine Vehicles Conference, Arlington, Va , Sept 20-22, 1976, AIAA Paper 76-859* 15 p 20 refs

A method based on slender wing theory is developed for the prediction of interference effects due to both thickness and incidence on the side force and yaw moment acting on the two hulls of a surface-effect-ship configuration moving with a constant yaw angle The result is a low aspect ratio biplane theory wherein the hulls together comprise a compound slender wing Free surface and cushion effects are ignored Attached flow properties are modeled using slender body versions of spanwise distributed sources and doublets Nonlinear hydrodynamic reactions due to separated flow are estimated by a method using the leading edge suction analogy developed by Polhamus, Lamar, and others at NASA Langley Results of this work show that due to interference, there are reductions in the magnitudes of the total side force and moment on the combination of hulls compared with twice the isolated hull values (Author)

A76-45517 # **Recent advances in wing-in-ground effect technology** R W Gallington, H R Chaplin, F W Krause (U S Naval Material Command, David W Taylor Naval Ship and Research Development Center, Bethesda, Md), J A Miller (Logicon, Inc , Bedford, Mass), and J C Pemberton (Scani Valve Corp , San Diego, Calif) *American Institute of Aeronautics and Astronautics and Society of Naval Architects and Marine Engineers, Advanced Marine Vehicles Conference, Arlington, Va , Sept 20 22, 1976, AIAA Paper 76-874* 22 p 19 refs

The Power Augmented Ram Wing (PAR) phenomena in which the efflux from forward-mounted propulsors is directed into the open-fronted cavity formed by the wing, water surface, end plates, and trailing edge flap can be used to lift and accelerate Wing in Ground Effect (WIG) vehicles at relatively high wing loading The performance limits of PAR are theoretically and experimentally described A factor of two reductions in tail volume has been achieved through improved understanding of the flow around WIG vehicles The vortex sheet shed from the bottom of the ride plates is illustrated in wind tunnel flow visualization photographs and in film of man-carrying flights An optimally designed active control system applied to WIG pitch and heave motions is shown to cause recovery from an upset in about one-quarter the time required for a stable but uncompensated vehicle (Author)

A76-45519 # **A review of sea loiter aircraft technology** B S Papadales, Jr and D W Taylor (U S Naval Material Command, David W Taylor Naval Ship Research and Development Center, Bethesda, Md) *American Institute of Aeronautics and Astronautics and Society of Naval Architects and Marine Engineers, Advanced Marine Vehicles Conference, Arlington, Va , Sept 20-22, 1976, AIAA Paper 76-876* 12 p 36 refs

Takeoff and landing hydrodynamics, sea loitering hydrodynamics, and propulsor-water (spray) interaction are singled out as the major technologies to be developed for sea loiter capability Availability of efficient ASW equipment renders sea loiter craft concepts more practicable The article reviews developments in hydroskis, hydrofoils, vertical floats presenting limited waterplane area (to decouple wave motions and hull motions), air cushion landing systems and surface effect takeoff and landing (SETOL), and various hull configurations Landing impact and wave slamming loads, stability afloat or submerged, effect of sea states (calm, choppy), disadvantages of a submerged mode, nonplaning configurations, and amphibious capability are also discussed R D V

A76-45521 # **Practical considerations regarding wing-in-ground-effect aircraft** E H Handler (U S Navy, Carderock, Md) *American Institute of Aeronautics and Astronautics and Society of Naval Architects and Marine Engineers, Advanced Marine Vehicles Conference, Arlington, Va , Sept 20-22, 1976, AIAA Paper 76-878* 10 p 37 refs

It is demonstrated, using seaplane technology and experience,

that hydrodynamic configurations permitting water operations are, for the most part, incompatible with aerodynamic features required for extended flight in ground effect The installed thrust specified for wing-in ground-effect aircraft (WIGs) frequently is inadequate to accelerate the craft from rest to take-off Furthermore, the aircraft must fly high enough to avoid catastrophic encounter with 'rogue' waves which are up to three times as high as 'significant' waves of the existing sea state Rogues are infrequent, but inevitable It is concluded that it is not feasible either to design WIGs for operations from the water or to fly in ground effect over the open ocean (Author)

A76 45696 # **The development phase, design, manufacture and quality control of the MRCA-radome** H Bertram, G Wandel (Telefunken AG, Hamburg, West Germany), P Bini (Aeritalia S p A , Turin, Italy), T Cook, and W Kendall (British Aircraft Corp , Ltd , Stevenage, Herts , England) In International Conference on Electromagnetic Windows, 3rd, Ecole Nationale Superieure de Techniques Avancees, Paris, France, September 10 12, 1975, Proceedings Volume 1 Paris, Delegation Ministerielle pour l'Armement, 1976, p 329, 331, 333-349 (14 ff)

Basic considerations concerning the design and manufacturing of the MRCA radome are presented Structural analysis of the radome when subjected to aerodynamic loads was based on structural tests (pressure measurements, strain gaging, etc), and NASTRAN finite element analysis A computer program for radome electrical design is described, and materials selection (an 'E' glass woven reinforcement in an epoxy matrix was selected) is examined The manufacturing of the radome is considered with a description of the mold and the molding process, and the IPD spray correction equipment B J

A76-45699 # **Inventory of possibilities that a weaver offers to radome manufacturers (Inventaire des possibilites offertes par un tisseur aux fabricants de radômes)** J Brochier (Societe J Brochier et Fils, Villeurbanne, France) In International Conference on Electromagnetic Windows, 3rd, Ecole Nationale Superieure de Techniques Avancees, Paris, France, September 10 12, 1975, Proceedings Volume 2 Paris, Delegation Ministerielle pour l'Armement, 1976, p 195-198 In French

The paper reviews various aspects of fiber weaving and how new weaving techniques can lead to the improved performance of radomes The weaving of such fibers as glass, quartz, and Kevlar for the reinforcement of radome cores is considered B J

A76 45700 # **Rain erosion characteristics of Concorde** A A Fyall and R B King (Royal Aircraft Establishment, Farnborough, Hants , England) In International Conference on Electromagnetic Windows, 3rd, Ecole Nationale Superieure de Techniques Avancees, Paris, France, September 10 12, 1975, Proceedings Volume 2 Paris, Delegation Ministerielle pour l'Armement, 1976, p 209 235, 237, 239 (13 ff) 5 refs

The paper examines the rain erosion characteristics of the Concorde and the research aimed at validation of the aircraft in rain Civil Aviation Authority requirements are outlined and flight profile analyses are summarized Experimental data from tests with a whirling arm, with a rocket sled and from flight in rain by a Phantom are presented Conclusions based on all of these tests are given and recommendations are made for the certification of the Concorde in rain, together with possible in service inspection procedures B J

A76-45702 # **Evolution of the technology of broadband radomes for supersonic aircraft (Evolution de la technologie des radômes a large bande pour avion supersonique)** R Berland (Thomson CSF, Malakoff, Hauts-de-Seine, France) In International Conference on Electromagnetic Windows, 3rd, Ecole Nationale Superieure de Techniques Avancees, Paris, France, September 10-12, 1975, Proceedings Volume 2 Paris, Delegation Ministerielle pour l'Armement, 1976, p 307, 309, 311 317 (5 ff) In French

The paper examines the rain erosion response of an ECM type conical radome for supersonic aircraft, where the antenna is characterized by a wide open radiation pattern in a frequency band of 1-18 GHz A broadband hemispherical radome is considered with attention paid to structural properties, the protective coating resistant to rain erosion, the internal adaptation layer, and phases of radome molding The future prospects of supersonic radome technology are examined with the feasibility of extending the operating temperature to 250 C discussed B J

A76 45703 # **B-1 forward radome microwave test range** J M Carter (Carco Electronics, Menlo Park Calif) In International Conference on Electromagnetic Windows, 3rd, Ecole Nationale Superieure de Techniques Avancees, Paris, France, September 10 12, 1975, Proceedings Volume 2 Paris, Delegation Ministerielle pour l'Armement, 1976, p 329, 331 333, 336 (9 ff)

The B-1 radome test system was installed in a flat area near Weedpatch, California, with about 1 2 x 10 to the 6th sq m of land flattened to maintain a controlled ground plane The test system consists of the radome positioning fixture, a five antenna null seeking system, and a control console Measurements were made of the radiation pattern, radome reflection, and tracking accuracy B J

A76-45704 # **Polyaminobismaleimides in high performance radomes and new possibilities of utilizing them (Les polyaminobismaleimides dans les radômes de hautes performances et des possibilites nouvelles pour la mise en oeuvre)** G Pouzols (Rhone Poulenc Industries, Division Chimie Fine, Paris, France) In International Conference on Electromagnetic Windows, 3rd, Ecole Nationale Superieure de Techniques Avancees, Paris, France, September 10-12, 1975, Proceedings Volume 2 Paris, Delegation Ministerielle pour l'Armement, 1976, p 355-361, 363 In French

Polyaminobismaleimides (PABM) used as radome core materials display good mechanical properties, resistance to thermal fatigue and to lightning and chemical attack PABM is suitable for use in supersonic aircraft radomes (Mach 3 and 3 5) when the temperature can reach as high as 220 250 C Various PABM resins are considered as radome materials including Kerimid 601, 607 and 353 and Kinel 5504 B J

A76-45760 # **Measured pressure distributions on an airfoil with oscillating jet flap** J M Simmons (Queensland, University, Brisbane, Australia) *AIAA Journal*, vol 14, Sept 1976, p 1297 1302 12 refs Australian Research Grants Committee Grant No F70/17452

The experiments described, in conjunction with an earlier study by the author, comprise a set which enables the prediction of aerodynamic forces and moments on a two dimensional airfoil undergoing general motions involving small displacements The magnitude and phase angle of aerodynamic derivatives generated on a fixed airfoil by small oscillations of a jet flap at the trailing edge have been measured in incompressible flow The measurements reported agree well with the majority of other experimental data The trends are predicted by the theory of Potter, but not by the theory of Spence which should be applied only for much higher dimensionless frequencies than those used in the experiments (Author)

A76-45776 * The future of aeronautical transportation, Proceedings of the Princeton University Conference, Princeton, N J , November 10, 11, 1975 Conference supported by the Boeing Co , Grumman Corp , McDonnell Douglas Corp , NASA, Northrop Corp , and United Technologies Corp Princeton, N J , Princeton University, 1976 480 p $20

Papers are presented on first and second generation supersonic transports, the Supersonic Cruise Aircraft Research Program, wide-body subsonic transports and vertical and short takeoff and landing transports Aspects of aircraft design are examined including the airframe, propulsion and electronics Government regulation, cost/benefit analysis of research and development, airline economics and aircraft financing are also considered The environmental impact of air transportation is discussed with emphasis on atmospheric emissions (including stratospheric pollution) and noise pollution
B J

A76-45777 # **First generation supersonic transports** P Poisson Quinton In The future of aeronautical transportation, Proceedings of the Princeton University Conference, Princeton, N J , November 10, 11, 1975 Princeton, N J , Princeton University, 1976, p 1 1 to 1-57 27 refs

The major events of supersonic transport research and development are reviewed The development of supersonic transports in Europe and in the Soviet Union is considered, focusing on aerodynamic, propulsion and structural aspects The Concorde in flight is examined with emphasis on flight testing and flight operations (noise, airworthiness, and operational regularity) B J

A76-45778 # **Towards a second generation of supersonic transport** P Lecomte and G Cormery (Societe Nationale Industrielle Aerospatiale, Toulouse, France) In The future of aeronautical transportation, Proceedings of the Princeton University Conference, Princeton, N J , November 10, 11, 1975 Princeton, N J , Princeton University, 1976, p 2 1 to 2 36

The paper reports on studies of second generation supersonic transports focusing on such aspects as fuel capacity limitations and runway strength limitations, margin definition, the weighted efficiency criterion and lift/drag improvement with a canard configuration Also considered are minimum flyover noise, and the bypass ratio effect on lateral noise Aerodynamic, structural and noise reduction design of the second generation Concorde is considered
B J

A76-45779 * # **Recent developments in NASA's Supersonic Cruise Aircraft Research /SCAR/ Program** V R Mascitti and F E McLean (NASA, Langley Research Center, Hampton, Va) In The future of aeronautical transportation, Proceedings of the Princeton University Conference, Princeton, N J , November 10, 11, 1975 Princeton, N J , Princeton University, 1976, p 3-1 to 3-21 12 refs

The paper reviews the SCAR program with emphasis on research in the areas of propulsion system, structures and materials, aerodynamic performance, stratospheric emissions, and stability and controls Specific results relate to multicycle engine progress, coannular jet noise relief, blended wing-body configuration progress, powered lift progress, and progress in structural design methodology
B J

A76-45780 * # **Goals for a future SST** A Ferri (New York University, New York, N Y) In The future of aeronautical transportation, Proceedings of the Princeton University Conference Princeton, N J , November 10, 11, 1975
Princeton, N J , Princeton University, 1976, p 4-1 to 4 25 8 refs
Grants No NGL-33 016-119, No NGR-33-016 131

The paper attempts to define a desirable and reachable goal for a second generation SST Justifications for the need of an SST are considered as is the ecological impact of a second generation SST project Required technology advances to reach the range of 6500 nautical miles are examined along with structural weight reduction and drag reduction Possible performance improvements due to design modifications are discussed, and environmental problems are discussed in detail with emphasis on sonic booms B J

A76-45781 # **Advanced subsonic aircraft - The technological response to future air transportation needs** R S Shevell (Stanford University, Stanford, Calif) In The future of aeronautical transportation, Proceedings of the Princeton University Conference, Princeton, N J , November 10, 11, 1975
Princeton, N J , Princeton University, 1976, p 5-1 to 5-26

The history of transport aircraft is reviewed as are technological advances - drag reduction, weight reduction, improvement in lift coefficient, etc Some developments in air transportations which raised great expectations, but have failed to have a significant impact are reviewed laminar flow control, nuclear powered aircraft, STOL and the supersonic transport The feasibility of hydrogen-fueled aircraft is discussed B J

A76-45782 # **Future of VTOL and other radical concepts** R H Miller (MIT, Cambridge, Mass) In The future of aeronautical transportation, Proceedings of the Princeton University Conference Princeton, N J , November 10, 11, 1975
Princeton, N J , Princeton University, 1976, p 6 1 to 6-25

The paper considers the future of short and long haul air transportation from the economic, social and technical points of view The use of VTOL for short haul and suburban transportation is examined, as is the use of suborbital hypersonic transport for long (up to antipodal) distances B J

A76-45783 * # **Overview of research and development** A M Lovelace (NASA, Office of Aeronautics and Space Technology, Washington, D C) In The future of aeronautical transportation, Proceedings of the Princeton University Conference, Princeton, N J , November 10, 11, 1975 Princeton, N J , Princeton University, 1976, p 8 1 to 8 10

A review of current NASA air transportation programs is presented Attention is paid to propulsion research, aviation safety and human factors Six programs for subsonic transports have been recommended, three in propulsion, two in aerodynamics and one in structures Supersonic transportation is discussed, as is VTOL research B J

A76-45784 # **Future trends in transport aircraft propulsion** W H Sens (United Technologies Corp , Pratt and Whitney Aircraft Group, East Hartford, Conn) In The future of aeronautical transportation, Proceedings of the Princeton University Conference Princeton, N J , November 10, 11, 1975
Princeton, N J , Princeton University, 1976, p 10 1 to 10 2 '

Twenty one charts on possible future trends in transport aircraft propulsion technology are presented Attention is paid to future engine requirements, airline economics, engine related costs subsonic transport fuel consumption, potential turbofan fuel consumption, advanced technology long range quadjet fuel use trends, fan efficiency improvement, technology advancements in fan blade design, compressor efficiency improvement, turbine airfoil alloys, coatings on turbine airfoils, progress in compressor airfoil reduction, lower aspect ratio blading, fabrication technology for lower cost, digital electronic engine control, a variable stream control engine (VSCE-502B), and the VSCE relative to the first generation SST turbojet B J

A76-45785 # **The electronic environment - A major discipline in the future growth of aeronautical transportation** G B Litchford In The future of aeronautical transportation, Proceedings of the Princeton University Conference, Princeton, N J , November 10, 11, 1975 Princeton, N J , Princeton University, 1976, p 11-1 to 11 14, Discussion, p 11 15 8 refs

The paper examines current methods of using electronics in aviation systems and in air traffic control Traffic delays are plotted vs aviation system capacity, and a table is presented studying the impact of aviation systems on the future of air transportation Pilot participation in ATC functions is considered, and it is shown that more direct pilot involvement improves air safety A table is presented on pilot control of proximity B J

A76-45786 # **On the future of aeronautical transportation** F E Moss (U S Senate, Washington, D C) In The future of aeronautical transportation, Proceedings of the Princeton University Conference, Princeton, N J , November 10, 11, 1975
Princeton, N J , Princeton University, 1976, p 13-1 to 13-11

The future of air transportation is discussed with emphasis on fuel costs, consumption and efficiency The roles of NASA and ERDA in developing a fuel efficiency program are examined B J

A76-45787 # **Governmental regulation** G C Eads (National Commission on Supplies and Shortages, Washington, D C) In The future of aeronautical transportation, Proceedings of the Princeton University Conference, Princeton, N J , November 10, 11, 1975
Princeton, N J , Princeton University, 1976, p 14-1 to 14-15, Discussion, p 14-15, 14 16

The paper discusses the possible effects of the current effort at regulatory reform on the aircraft industry The view is put forth that keeping governmental regulation the way it is or strengthening it would lead to the death of airlines and of the aircraft industry B J

A76-45789 # **Airline economics, whence, hither and yon** E A Beamish (United Air Lines, Inc , Chicago, Ill) In The future of aeronautical transportation, Proceedings of the Princeton University Conference, Princeton, N J , November 10, 11, 1975
Princeton, N J , Princeton University, 1976, p 16-1 to 16-19, Discussion, p 16 20, 16-21

The future of air transportation is discussed from the point of view of airline economics Attention is paid to regulation vs deregulation, fares, the 1975 airline recession, and economic comparisons concerning the state of the airlines for the periods 1953-1961, 1961-1969, and 1969-1974 B J

A76-45790 # **The future of aeronautical transportation** F W Bradley, Jr (New York, City Bank, New York, N Y) In The future of aeronautical transportation, Proceedings of the Princeton University Conference, Princeton, N J , November 10, 11, 1975
Princeton, N J , Princeton University, 1976, p 17 1 to 17-12, Discussion, p 17-13

Aircraft financing is examined with emphasis on the financing of aircraft sold to U S domestic and international airlines and the financing of U S manufactured aircraft sold to foreign air carriers Three sources of funds for such financing are considered commercial bank loans, long term loans from institutional lenders, and the sale of equity and convertible subordinated debentures in the public market B J

A76-45793 # **Overview of noise** K M Eldred (Bolt Beranek and Newman, Inc , Cambridge, Mass) In The future of aeronautical transportation, Proceedings of the Princeton University Conference, Princeton, N J , November 10, 11, 1975
Princeton, N J , Princeton University, 1976, p 22 1 to 22-14, Discussion, p 22-14 to 22-16

Aircraft noise pollution is discussed with emphasis on the reactions of individuals and communities, and possible solutions (e g , relocating airports or relocating people who live near airports) are suggested The measurement of noise levels is examined and government (EPA) standards governing noise levels are touched upon B J

A76-45794 # **Noise technology requirements for future aircraft powerplants** J Kester (United Technologies Corp , Pratt and Whitney Aircraft Group, East Hartford, Conn) In The future of aeronautical transportation, Proceedings of the Princeton University Conference, Princeton, N J , November 10, 11, 1975
Princeton, N J , Princeton University, 1976, p 23-1 to 23 32 6 refs

Reduction of noise from current powerplants and derivatives of current powerplants are considered Noise reduction for new design powerplants - high bypass ratio designs, new design CTOL power plants, supersonic powerplants and the advanced fuel conservative engine is also examined Various noise sources are considered with reference to generation and propagation including fan noise, jet noise, turbine noise and combustion noise B J

A76-45796 **Integrated aircraft navigation** J L Farrell (Westinghouse Electric Corp , Systems Development Div , Baltimore, Md) New York, Academic Press, Inc , 1976 365 p 79 refs $35

An integrated textbook drawing upon elements required from various science and engineering disciplines contributing to aircraft navigation systems Material is drawn upon from theoretical dynamics, inertial measurements, radar, radio navaids, celestial observations, statistical estimation techniques, avionics, gravity measurements, error analysis, Kalman filters, computer tracking techniques Problem exercises are appended to each chapter Strapdown coordinates, air-to-air tracking, gyrodynamics, rotational transforms, point nav mode, and suboptimal damping are among the topics treated The underlying functional similarity of aircraft navigation and tracking, spheroidal earth navigation, gimballed platform and strapdown inertial navigation, space stable, geographic, and wander azimuth coordinate references, damped and undamped inertial navigation systems, radio/radar/optical updating, and block or recursive estimation algorithms for updating, is pointed out R D V

A76-45798 **Design to Cost Conference, Boston, Mass , May 27, 28, 1976 and Palo Alto, Calif , June 14, 15, 1976, Abridged Proceedings** Conference sponsored by the American Institute of Aeronautics and Astronautics Los Angeles, Calif , American Institute of Aeronautics and Astronautics, Inc , 1976 134 p

Data primarily in the form of tables and diagrams is presented on design-to-cost/life cycle cost as applied to weapon system development and procurement An overview is presented of Department of Defense policies with respect to design-to-cost and life cycle costs Attention is given to such specific topics as the Advanced Attack Helicopter design to-cost, Global Positioning Systems alternate user equipment design to cost, the Tomahawk missile, the F-16 radar, the electronic warfare suite program, and the design of weapon locating radars for low production cost B J

A76-45861 † **The significance of high work quality in aircraft maintenance as a contribution to the improvement of safety and efficiency in aircraft operations (Die Bedeutung einer hohen Arbeitsqualitat in der Flugzeuginstandhaltung als Beitrag zur Verbesserung der Sicherheit und Effektivitat beim Einsatz von Verkehrsflugzeugen)** W Zinnert (Staatliche Luftfahrtinspektion, Berlin, East Germany) *Technisch okonomische Information der zivilen Luftfahrt,* vol 12, no 3, 1976, p 142 149 5 refs In German

A76-45862 † **Possibilities for improvements in the planning and control of maintenance processes involving commercial aircraft (Moglichkeiten zur Verbesserung der Planung und Steuerung des Instandhaltungsprozesses von Verkehrsflugzeugen)** W Apitzsch (Gesellschaft fur internationalen Flugverkehr mbH, Berlin, East Germany) *Technisch okonomische Information der zivilen Luftfahrt,* vol 12 no 3, 1976, p 150 154 In German

Certain problems regarding the planning of maintenance operations in the case of commercial aircraft of the German Democratic Republic are examined and approaches are discussed for overcoming occurring difficulties with the aid of a new short term planning method A description is presented of the available instruments for an optimization of maintenance planning and control procedures Attention is given to the approaches for the implementation of the required processes G R

A76-45866 # **Aerodynamic analysis of different flight attitudes of conventional aircraft XVIII - Aerodynamic principles (Flugmechanische Analyse verschiedener Flugzustande konventioneller Flugzeuge XVIII - Aerodynamische Grundlagen)** F Seidler (Dresden, Hochschule fur Verkehrswesen, Dresden, East Germany) *Technisch okonomische Information der zivilen Luftfahrt,* vol 12, no 3, 1976, p 176 184 In German

The effect of air compressibility on the pitching moment of the wing in the case of large flight Mach numbers is illustrated with the aid of an example The pitching moment of the wing is compensated by the pitching moment of the elevator assembly The effect of air compressibility on the pitching moment coefficient in the case of zero lift is considered and attention is given to the influence of air compressibility on the position of the aerodynamic center G R

A76-45868 **The turbofan jet engine at optimal and nonoptimal design (Das Zweistromtriebwerk bei optimaler und nichtoptimaler Auslegung)** N Gasparovic (Berlin, Technische Universitat, Berlin, West Germany) *Forschung im Ingenieurwesen,* vol 42, no 5, 1976, p 157 168 11 refs In German

Operational conditions for a turbofan jet engine and a turbojet engine are examined and the thrust relations are considered An investigation is conducted concerning the relation between the theoretical effective work and the partition ratio A description is presented of the parameter characteristics for optimum conditions of operation It is pointed out that in many cases practical reasons will make it impossible to obtain optimal operational conditions Operational parameter relations are, therefore, also studied for a nonoptimal design G R

A76-45876 **Environmental effects on advanced composite materials, Proceedings of the Symposium, Montreal, Canada, June 22-27, 1975** Symposium sponsored by the American Society for Testing and Materials and American Society of Mechanical Engineers Philadelphia, Pa , American Society for Testing and Materials (ASTM Special Technical Publication, No 602), 1976 102 p Members, $8 00, nonmembers, $10 00

The papers deal with specific research studies concerning effects of aerospace environments on advanced composite materials containing fibers such as glass, boron, and graphite in matrices such as epoxy, polyimide, and aluminum Topics include preliminary results of a program to determine the effects of long-term exposures on advanced composites for supersonic cruise aircraft applications, flight-simulation testing equipment for composite-material systems, effects of thermal-cycling environment on graphite/epoxy composites, effects of graphite/epoxy composites on the corrosion behavior of aircraft alloys, effects of natural weathering on the mechanical properties of graphite/epoxy composites, and effects of outdoor weathering on the dynamic mechanical properties of a glass/epoxy laminate

F G M

A76-45877 * **Program definition and preliminary results of a long-term evaluation program of advanced composites for supersonic cruise aircraft applications** J R Kerr, I F Haskins (General Dynamics Corp , Convair Div , San Diego, Calif), and B A Stein (NASA, Langley Research Center, Materials Research Branch, Hampton, Va) In Environmental effects on advanced composite materials, Proceedings of the Symposium, Montreal, Canada, June 22 27 1975 Philadelphia, Pa , American Society for Testing and Materials, 1976, p 3 22 8 refs Contract No NAS1 12308

Advanced composites will play a key role in the development of the technology required for the design and fabrication of future supersonic vehicles A program is in progress to determine the time-temperature stress capabilities of several high-temperature composite materials Tests included in this study are thermal aging, ambient aging, fatigue, creep, fracture, tensile, and real time flight simulation exposure The program has two parts The first includes all the material-property determinations and aging and simulation exposures up through 10,000 h The second continues these tests up to 50,000 cumulative h The program is currently in the midst of the 10,000 h phase Some of the results obtained to date and the status of the various tests are discussed (Author)

A76-45878 * **Flight simulation testing equipment for composite material systems** J F Haskins (General Dynamics Corp , Convair Div , San Diego, Calif), D J Wilkins (General Dynamics Corp , Fort Worth, Tex), and B A Stein (NASA, Langley Research Center, Materials Research Branch, Hampton, Va) In Environmental effects on advanced composite materials, Proceedings of the Symposium, Montreal, Canada, June 22-27, 1975 Philadelphia, Pa , American Society for Testing and Materials, 1976, p 23-36 9 refs Contract No NAS1 12308

A test program is discussed which aims at establishing the time-temperature-stress characteristics of several classes of high-temperature composite materials in order to determine their suitability for applications in supersonic cruise aircraft Five advanced composite materials (a boron epoxy, a boron polyimide, a graphite epoxy, a graphite polyimide, and diffusion bonded boron aluminum) are being evaluated using a flight-test simulator capable of long term automatic testing based on random loading and realistic flight temperature profiles The design, construction, and checkout of this simulator are described along with the digital load programmer, load magnitude controllers, the hydraulic pumping system, the heating and cooling systems, the control console, and the data recording system Typical results for short term tests performed at constant temperatures and accelerated load rates are presented in terms of a random-load spectrum and a wearout model F G M

A76-45938 **FAA's five-year environmental plan, 1976-1980 - Noise** F A Meister *(International Conference on Noise Control Engineering, Washington, D C , Apr 5-7, 1976) Noise Control Engineering,* vol 6, May June 1976, p 92 100

The FAA noise reduction plan is considered with attention given to system analysis to develop future civil aviation noise certification goals, noise reduction at the source (the vehicle), noise reduction through aircraft and ATC operational procedures, noise reduction through airport operational procedures and noise reduction through airport environs use and construction measures A land use compatibility program is described B J

A76-45939 **Scale model studies of the effects of wind on acoustic barrier performance** R DeJong (MIT, Cambridge, Mass) and E Stusnick (Calspan Corp , Buffalo, N Y) *Noise Control Engineering,* vol 6, May June 1976, p 101 109 8 refs NSF-sponsored research

Barrier experiments were conducted in a low speed wind tunnel in which the flow simulates the mean and fluctuating components of the turbulent velocity of the atmospheric boundary layer over uniform terrain The tests consisted of 1 32 scale model experiments of sound propagating over grassland, both with and without an acoustic barrier, and also with and without the presence of turbulent winds Results show two effects of the wind on the performance of barriers (1) the barrier attenuation is increased for upwind propagation and decreased for downwind propagation, and (2) the fluctuations in the measured levels of the wind reduction were of the same order as the mean value B J

A76-46171 # **Delta wings with leading edge separation** J K Nathman (Texas A & M University, College Station, Tex) *International Astronautical Federation, International Astronautical Congress, 27th, Anaheim, Calif , Oct 10 16, 1976, Paper ST 76 06* 12 p 26 refs Navy supported research

The analysis of delta wings in incompressible flow is treated by a numerical lifting surface theory based upon a velocity potential formulation This theory includes the spanwise velocity effects and leading edge separation associated with delta wings The numerical

technique makes use of both fixed and free wakes In the fixed wake model the analytical results of Brown and Michael are used to position the leading-edge vortex In the more refined free-wake model, the leading edge separation is modeled as a discrete number of vortices attached to the leading-edge, which are allowed to align themselves with streamlines The iteratively determined position of these vortices resembles the experimentally observed spiral form, while computed lift coefficients reflect the added vortex lift

(Author)

A76-46263 # **RPV developments plumb the field's potential** T W Knacke *Astronautics and Aeronautics* vol 14, Oct 1976, p 37 41

Problems in the design and acceptance of remotely pilotec vehicles (RPV) as military systems are surveyed Major development programs of RPVs and mini-RPVs are described briefly RPV applications in reconnaissance, strike missions, laser target designation, night sensor or weather sensor operations, ECM, and data link service, as tactical warfare systems and carriers of area weapons supplementing both manned systems and standoff missiles, are examined Command, control, communications, allocation of workload in military theaters, and RPV reliability, survivability, plus special problems to be resolved in the landing, launch, and retrieval of RPVs are discussed R D V

A76-46265 # **Designing the 1985 VATLIT** J Roskam (Kansas, University, Lawrence, Kan) *Astronautics and Aeronautics* vol 14, Oct 1976, p 50 61 35 refs

Commuter, business, and personal aircraft have been drawing greater attention with the fuel crisis and suspension of services to small communities by major airlines Ten avenues of exploiting technological advances in the design of small aircraft are enumerated and discussed These include enhanced lift via airfoil and flap technology, drag reduction by utilizing winglets, thicker airfoils, and greater wing span, improvements in structures and crashworthiness, abatement of cabin noise and external noise, fly by wire and stability augmentation systems, improved propulsion systems and auxiliary advances (carburetor de-icing, turbofans, propeller design), better handling and maneuvering, improved cockpit displays and avionics An aircraft embodying such advances is conjectured, without attempting cost analysis R D V

A76-46278 **C 5 Galaxy - An operational appraisal** D W Traynor (USAF, 22nd Military Airlift Squadron, Travis AFB, Calif) *Shell Aviation News*, no 436, 1976, p 16 21

The outstanding features of the C 5 Galaxy military aircraft provided with sophisticated interdependent systems and built to carry heavy outsize payloads are outlined Advances in the aircraft's capability over its predecessors are adequately matched by advances in crew-oriented cockpit design and displays Emphasis is placed on an operational appraisal of the aircraft The discussion covers landing gear features, unlimited flight range, and approach to landing at destination The 28-wheel landing gear geometry minimizes ramp pressure at large weights Aerial refueling gives the compounded advantages of virtually unlimited range and increased payload due to the lighter fuel requirement for departure Any of a number of options are available for an effective approach to landing, including an instrument landing system S D

A76-46279 **Trends in engine design** R M Denning, S C Miller, and G Wright (Rolls Royce /1971/, Ltd , Aero Div , Derby, England) *Shell Aviation News*, no 436, 1976, p 28 31

Potential fields for improving aircraft propulsion efficiency, in particular possibilities of further development for the high bypass fan engine are outlined In considering the effect of changes in engine characteristics on the operating cost of the aircraft, the particular importance of fuel consumption is stressed Advances in component efficiency and an increase in airflow by using a larger-diameter fan are shown to promise a reduction of specific fuel consumption of about 20% with respect to current large fan engines (RB 211) Currently developed models and future prospects are examined for large (above 40,000 lb), intermediate (15,000 30,000 lb), and small thrust (under 10,000 lb) engines Some recent approaches to fan engine design are described which permit reduction of fuel consumption, noise and cost, and provide better aircraft flight characteristics They include designs involving variable cycle and variable pitch fan engines for supersonic propulsion, and for subsonic speeds the propfan and geared fan engines, and the heat exchanger engine The adoption of these designs could decrease the fuel consumption by 25 30% as compared to the RB 211 engine S N

A76-46367 # **Rain erosion - A serious problem for slip-cast fused silica radomes** D Balageas and A Hivert (ONERA, Châtillon-sous Bagneux, Hauts-de-Seine, France) *(Symposium sur les Fenêtres Electromagnétiques, 13th, Atlanta, Ga , Sept 21-23, 1976) ONERA, TP* no 1976-98, 1976 6 p 9 refs

Test data on the rain erosion resistance of radomes made of slip cast fused silica (SCFS) indicate that pure SCFS is characterized by an inacceptably high impact erosion damage even at subsonic velocities It is shown how, by using a hot-pressed silicon nitride (HPSN) rain erosion cap, it proved possible not only to obtain satisfactory erosion resistance but also to improve the X-band transmission efficiency of the radome as compared to identical radome with a steel cap V P

A76-46368 # **Simulation of the effects of forward velocity on jet noise in an open circuit wind tunnel** J Bongrand (Centre d'Essais des Propulseurs, Saclay, Essonne, France), A Julienne, and M Perulli (ONERA, Châtillon-sous-Bagneux, Hauts-de Seine, France) *(Réunion de Travail sur les Effets de la Vitesse d'Avancement sur le Bruit de Jet, Hampton, Va , Jan 15, 16, 1976) ONERA, TP* no 1976-6E, 1976 14 p 15 refs

The Cepra-19 reverberation- and echo-free open-circuit wind tunnel being developed to study the influence of forward velocity on jet noise is discussed The test section is shaped as a quarter sphere with a radius of 9 6 m, the free jet is 2 m in diameter at a maximum low rate of 100 m/sec, an exit section measuring 3 m in diameter can be installed Means of overcoming some problems associated with refraction and diffusion effects resulting from the mean profile of the flow and the turbulence in the mixing zone are examined V P

A76-46533 **A solution to airport noise** K G Wilkinson (Rolls Royce /1971/, Ltd , Derby, England) In The challenging future, Proceedings of the Fifth World Airports Conference, Brighton, England, May 5 7, 1976 London, Institution of Civil Engineers, 1976, p 8/1 8/7

The development of noise abatement techniques is reviewed, starting from the alarming noise levels of earlier jet aircraft to the newer low-noise aircraft engine types The advances in noise abatement are demonstrated by the example of the RB 211 engine which, in addition, provides a reduction in fuel consumption by up to 25% It is seen that replacing the British Airways current European Division fleet with newer, quieter, more fuel efficient aircraft would greatly reduce the noise around airports and save about 16 million gallons of fuel a year V P

A76-46534 **Operational techniques for reducing noise** O B Saint John (Civil Aviation Authority London, England) In The challenging future, Proceedings of the Fifth World Airports Conference, Brighton, England, May 5 7, 1976 London, Institution of Civil Engineers, 1976, p 9/1-9/6

This paper reviews various operational techniques for reducing noise nuisance Of these, some have already been implemented and, where there is no associated penalty in terms of operational safety, further improvement can be confidently expected In other cases, significant cost is involved and it is necessary to demonstrate conclusively that safety standards will not be impaired The provision of adequate data to demonstrate the safety of these operations and,

in some cases, the development of new equipment, means that such techniques can only be introduced, if ever, on a protracted time scale Perhaps the most promising technique, which is applicable even to the latest 'quiet' aircraft involves continuous descent from the stack to touchdown This is already being adopted by many airlines and, together with the proper management of drag which is closely associated with this procedure, could result in some alleviation in the comparatively near future (Author)

A76-46535 **Airports and community design considerations for aircraft noise alleviations** J B Large (Southampton, University Southampton, England) In The challenging future, Proceedings of the Fifth World Airports Conference, Brighton, England, May 5-7, 1976 London, Institution of Civil Engineers, 1976, p 10/1 10/10 10 refs

In addition to the primary noise problem created by overflying aircraft, there are other noise problems within the airport and adjacent communities due to aircraft ground operations and maneuvers prior to take off and after touch down The present discussion concerns the noise characteristics of such ground operations as taxiing and holding, engine run ups, and auxiliary power unit operation during cargo and passenger handling Attention is given to take-off problems resulting from maximum thrust procedures prior to take-off roll and lose of ground effects at lift-off The methods of noise control discussed include also the special noise problems created due to thrust reversal operations after touch-down, together with the variation in noise levels produced by changes in thrust levels, particularly apparent during automatic landings V P

A76-46544 **Fire-fighting and rescue techniques and equipment** P Nash (Joint Fire Research Organization, Fire Research Station, Boreham Wood, Herts , England) and J E Lodge (Civil Aviation Authority, London, England) In The challenging future, Proceedings of the Fifth World Airports Conference, Brighton, England, May 5 7, 1976 London, Institution of Civil Engineers, 1976, p 21/1 21/8

Part I of the paper deals primarily with the development of fire extinguishing materials to deal with the high potential fire risks presented by modern aircraft The aim is to achieve major control of the fire within a very short time in order to effect rescue The advantages and disadvantages of water based foams, dry powders, inhibiting liquids or gases and water sprays are discussed In Part II the practical aspects are dealt with, particularly in relation to the recommendations of the International Civil Aviation Organization Both parts of the paper emphasise that speed and efficient deployment of staff and equipment are essential, and that airports must have emergency plans for instant implementation (Author)

A76-46630 **Coherent structures in subsonic coaxial jets** A S H Kwan and N W M Ko (University of Hong Kong, Hong Kong) *Journal of Sound and Vibration*, vol 48, Sept 22, 1976, p 203 219 24 refs Research supported by the University of Hong Kong

Hot wire and microphone measurements were performed on the initial region of subsonic coaxial jets and the large scale coherent structures within this region The jets investigated had an area ratio of 2 67 and were run at three different velocity ratios The axial distribution of pressure and turbulence intensity along the jet axis, the growth or decay of vortices in the intermediate zone, and pressure measurements within the jets all validate a proposed model which consists of two arrays of vortex ring structures convecting downstream in the mixing regions The study may have relevance to jet engine noise B J

A76-46631 **Effect of phase angle on multibladed rotor flutter** V R Murthy (Old Dominion University, Norfolk, Va) and G A Pierce (Georgia Institute of Technology, Atlanta, Ga) *Journal of Sound and Vibration*, vol 48, Sept 22, 1976, p 221 234 14 refs

A theoretical technique for predicting the flutter characteristics of a helicopter rotor is presented The effect of phase angle on flutter speed of a two bladed rotor in hovering and axial flight is determined For this purpose, a uniform and untwisted rotor blade with coupled flapwise bending and torsional degrees of freedom is considered* The transmission matrix method is used to obtain the natural vibration characteristics of the system An unsteady aerodynamic theory is used to obtain the aerodynamic loading in compressible flow (Author)

A76 46723 **Investigation of unsteady wave structure in turbine nozzle blade cascades** M E Deich, Iu A Laukhin, and G A Saltanov (Moskovskii Energeticheskii Institut, Moscow, USSR) *(Teploenergetika,* vol 22, no 8, 1975, p 21 23) *Thermal Engineering,* vol 22, Aug 1976, p 30 32 Translation

Unsteady flows in nozzle blade cascades due to interaction of shocks with the boundary layer, and to periodical boundary layer separation, are discussed The experiments were staged using S 9012A blade profiles segments under static conditions Flow becomes unsteady with increase in pressure differentials across the blade cascade to values close to critical Analogies with under expansion phenomena (in the case of convergent divergent nozzles) and local overexpansion (of nozzle transonic flow or transonic flow through a blade row) are pointed out Effects of finely disperse liquid phase on the separated turbulent boundary layer, and of periodic changes in the position and intensity of the shocks, are considered R D V

A76-46750 # **Maintaining Concorde on the line A look at British Airways and Air France** B Clarke *Aircraft Engineering,* vol 48, Sept 1976, p 4-6, 9 (3 ff)

French and British approaches to Concorde service spares inventory and turnaround operations are contrasted Since the two lines have no common air terminal at this writing (except Washington), separate stores of spares are inevitable Hangar modification and repair dock and overhead gantry construction at Heathrow to accommodate Concorde are described briefly British Airways maintains spares stocks and six spare Olympus 593 610 engines at different terminals Air France prefers flying in a fresh Concorde, if engine replacement is required, to avert service delays while the engine repair and return to home base proceed leisurely R D V

A76-46817 **An exponential investigation of the behaviour of conical diffusers in turbulent flow** V K Sharan (Forum International, Stockholm, Sweden) *Zeitschrift fur angewandte Mathematik und Physik,* vol 27, July 25, 1976, p 447 462 44 refs

The parameters which affect diffuser performance are considered, taking into account geometrical and dynamic parameters Geometrical parameters include diffuser angle, shape of cross section, and area ratio Dynamic parameters include the Reynolds number or the Mach number for high speed flow, inlet boundary layer thickness, displacement and momentum thickness, and the turbulence characteristics of the flow at the inlet A description is given of an experimental investigation in which the performance of angle diffusers was studied Attention is given to the performance parameters and tests to improve diffuser performance G R

A76-46818 **Second-order thermal boundary-layer on a blunted wedge** S C Raisinghani (Indian Institute of Technology, Kanpur, India) and N Afzal (Aligarh Muslim University, Aligarh, India) *Zeitschrift fur angewandte Mathematik und Physik,* vol 27, July 25, 1976, p 471-482 7 refs

The reported investigation considers a flow past a blunted wedge, taking into account a case in which the second-order effects present are related to the longitudinal curvature and the displacement speed The investigation makes use of the series method described by Gortler (1957) Attention is given to second-order equations for nonsimilar flows, a study of momentum transfer conditions and the heat transfer problem, and the numerical solutions of the system equations G R

A76-46825 **A quick, graphical way to analyze rotor whirl** H D Nelson (Arizona State University, Tempe, Ariz) and D A Glasgow *Machine Design,* vol 48, Oct 7, 1976, p 124 130

Mechanisms rotating at high speeds can vibrate violently when operated at certain critical speeds Since the normal operating speed is too low to excite flexural whirl modes, the rotor can be modeled as a rigid body, which greatly simplifies the mathematics involved A technique for graphical analysis of rotor whirl is presented based on a simplified model with undamped bearings The whirl speed map obtained shows how the whirl speeds of a rotor change with the spin speed Commonly, only the right half-plane (positive spin speeds) is drawn as it contains all the information needed to analyze the system It is shown that the first forward mode can be excited at least three different ways, and the second forward mode can be excited at least one way Backward modes are not excited in this system, but they could be in other systems Also, for simplicity, excitations from outside sources are not considered S D

A76-46851 ***Managing safety, Proceedings of the Twenty eighth International Air Safety Seminar, Amsterdam, Netherlands, November 2-6, 1975*** Seminar sponsored by the Flight Safety Foundation Arlington, Va , Flight Safety Foundation, Inc , 1975 295 p

Topics discussed include the world jet accident picture, the corporate/business air jet aircraft accident picture in the United States, and an analysis of U S air carrier jet accidents for 1974 Also considered are the management and economics of aviation safety, pilots organization for safety, and airline safety organization in Europe and North America The physiological index as an aid in developing airline pilot scheduling patterns, safety management from *the cockpit IATA's contribution to flight safety, and the establish* ment of safe separations between aircraft in flight are also considered

Individual items are announced in this issue B J

A76-46852 **Corporate/business accident picture /USA/** R E Breiling (Associated Aviation Underwriters, New York, N Y) In Managing safety, Proceedings of the Twenty eighth International Air Safety Seminar, Amsterdam, Netherlands, November 2 6, 1975 Arlington, Va , Flight Safety Foundation, Inc , 1975, p 14 20

Accidents involving corporate/business jet aircraft accidents in the United States are examined The core of the paper is three charts the first showing a plot of corporate pilot experience in terms of hours of those pilots involved in accidents, the second showing the overall corporate/executive accident picture from 1968 through 1974, and the third comparing corporate and air carrier jet accidents B J

A76-46853 **An analysis of U S air carrier jet accidents for 1974** H A Sherman (Flight Safety Foundation, Inc , Arlington, Va), G P Jones, and M Klempa (Southern California, University, Los Angeles, Calif) In Managing safety, Proceedings of the Twenty eighth International Air Safety Seminar, Amsterdam, Netherlands, November 2-6, 1975 Arlington, Va , Flight Safety Foundation, Inc , 1975, p 21 35

A number of tables of air carrier jet accidents for 1974 are presented including tables on types of accidents and accident briefs, broad and detailed cause/factor tables, and tables for accident and personnel cause/factor for air carrier jet accidents from 1969 through 1973 vs 1974 A specific analysis carried out on the tables presented has led to the conclusion that 1974 was a year in which the accident profile was very predictable B J

A76-46854 **Management and product safety** W J Quinlivan (Lockheed-California Co , Burbank, Calif) In Managing safety, Proceedings of the Twenty eighth International Air Safety Seminar, Amsterdam, Netherlands, November 2 6, 1975 Arlington, Va , Flight Safety Foundation, Inc , 1975, p 55 70

Various aspects of the product safety program at Lockheed are reviewed Attention is given to safety engineering (design reviews, equipment requirements, on the board design surveillance, failure mode testing, etc), manufacturing with respect to safety standards, quality assurance, flying operations, airline customer support, industrial safety, technical training, program planning, and the safety board and reviews B J

A76-46856 **The establishment of safe separations between aircraft in flight** A Pool (Nationaal Luchtvaartlaboratorium, Amsterdam, Netherlands) In Managing safety, Proceedings of the Twenty-eighth International Air Safety Seminar, Amsterdam, Netherlands, November 2 6, 1975 Arlington, Va , Flight Safety Foundation, Inc , 1975, p 197-204

The paper presents a historical review of attempts to establish a rational approach to safe separations between aircraft Work done by the ICAO Vertical Separation Panel (1956 1958), the North Atlantic System Planning Group (1965-1975), and the Panel for the Review of the General Concept of Separation formed in 1970 by ICAO is discussed The model - giving a statistical description of the process by which collisions between aircraft on parallel tracks occur - used by the two latter panels mentioned above is discussed The future work of these panels is considered B J

A76-46857 **Civil aviation air safety trends and comparisons, 1974** C W Smith (British Airways, London, England) In Managing safety, Proceedings of the Twenty-eighth International Air Safety Seminar, Amsterdam, Netherlands, November 2 6, 1975 Arlington, Va , Flight Safety Foundation, Inc , 1975, p 205 230

A detailed examination of air safety in 1974 is presented based on preliminary worldwide air safety statistics for 1974 published by ICAO, and on a report published by IATA in October 1975 on safety data relating to their member airlines It is suggested that the only logical way to assess personal hazard is to evaluate individual exposure to risk A number of charts and tables are presented *containing information which includes a summary analysis of world* air safety statistics (excluding the USSR and the People's Republic of China), a comparison of world air safety results 1970-1974 on scheduled services by aircraft type, passenger fatality rates on scheduled services 1961 1974, relative improvements in air safety of IATA and non IATA member airlines 1963 1974, and a comparison of mortality risks for air transport and other activities B J

A76-46891 **Two- and three-dimensional flows around blunt bodies with special regard to transonic free-stream Mach numbers (Zwei- und dreidimensionale Umstromungen stumpfer Korper unter Berucksichtigung schallnaher Uberschallanstromungen)** C Weiland (Deutsche Forschungs und Versuchsanstalt fur Luft und Raumfahrt, Institut fur angewandte Gasdynamik, Porz Wahn, West Germany) *Zeitschrift fur Flugwissenschaften,* vol 24, Sept Oct 1976, p 237 245 18 refs In German Research supported by the Gesellschaft fur Weltraumforschung and Deutsche Forschungsgemeinschaft

Flow fields of ideal inviscid gases with free-stream Mach numbers greater than 1 around blunt bodies are calculated The integration of the Euler equations is effected by means of a difference algorithm For illustration, flow fields around bodies of revolution with and without angle of attack are computed The theoretical results are compared with experimental data Particular attention is paid to flow fields with free-stream Mach numbers slightly larger than 1 (1 1 and 1 054) (Author)

A76-46892 **Paraglider wings of small conical camber in supersonic flow (Theorie konischer Paragleiter mit schwacher Wolbung in Uberschallstromung)** B Wagner (Darmstadt, Technische Hochschule, Darmstadt, West Germany) *Zeitschrift fur Flugwissenschaften,* vol 24, Sept Oct 1976, p 246-258 35 refs In German

Using the linearized supersonic wing theory a calculation method is developed for unyawed parawings with subsonic and supersonic leading edges Conical configurations with and without keel are treated and the canopy surface is assumed to be an inextensional flexible membrane A linear integral equation is established on which the solution of the problem is based A special approximation with orthogonal polynomials is used for solving the integral equation in the elliptic regions similar to usual quadrature methods in lifting wing theory The integral equation for the hyperbolic region can be transformed in a differential equation which is integrated in closed form (Author)

A76-46895 **On the off-design operation of bypass-engines with variable nozzles and turbines (Zum Betriebsverhalten von Verbund-Zweistrom-Turboluftstrahltriebwerken mit verstellbaren Dusen und Turbinen)** H Rick and J Kurzke (Munchen, Technische Universitat, Munich, West Germany) *Zeitschrift fur Flugwissenschaften*, vol 24, Sept Oct 1976, p 268 275 14 refs In German

Based on the performance characteristics of the turbo components a calculation method for theoretical investigations of multiflow, multispool engines with variable geometry is described Furthermore, this paper outlines as an example for a wide range of flight conditions the effects of variable nozzles and turbines on the off design performance of a typical low bypass engine (Author)

A76-46973 # **Experimental investigation of the discrete component in the noise spectrum of supersonic jets (Eksperimental'noe issledovanie diskretnoi sostavliaiushchei v spektre shuma sverkhzvukovykh strui)** A N Antonov, S P Shalaev, and M Ia Iudelovich *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza*, July Aug 1976, p 163 166 6 refs In Russian

A76-46974 # **Generation of free-molecular flow for special aerodynamics research (Sozdanie svobodnomolekuliarnogo potoka, prednaznachennogo dlia spetsial'nykh aerodinamicheskikh issledovanii)** Iu E Kuznetsov and Ia Sh Flaksman *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza*, July-Aug 1976, p 166-171 5 refs In Russian

A procedure devised for generating free molecular flow capable of simulating full-scale flow and intended for air intake investigations is presented The parameter to be simulated is the angular distribution of the streams of molecules The feasibility of shaping the simulating flow with the aid of a contoured and perforated axisymmetric free-molecular nozzle is analyzed A tapered unperforated nozzle designed for simulation of free-molecular flow at velocity ratio ten is investigated in detail by way of illustration Data on experimental studies of the characteristics of the free-molecular tapered conical unperforated model and a free-molecular cylindrical air intake are cited and compared with theoretical prediction The procedure developed furnishes a suitable model for velocity ratios 5 20 R D V

A76 46989 # **Equilibrium temperature distribution of blades situated in high-speed flow (K opredeleniiu ravnovesnoi temperatury lopatok pri obtekanii ikh potokom s bol'shoi skorost'iu)** S Z Kopelev and S V Gurov *Akademiia Nauk SSSR, Izvestiia, Energetika i Transport*, July-Aug 1976, p 127 132 5 refs In Russian

Some aspects of the experimental determination of the equilibrium temperature of the gas flow, having a high longitudinal velocity gradient, through a turbine cascade of air cooled blades are examined An experimental procedure for determining the recovery factor of turbine cascades within the actual range of gas flow parameters is described It is shown that the recovery factor at the turbine blades is a unequivocal function of the flow Reynolds number and that it can deviate substantially from unity This fact should be given careful consideration in the determination of the local heat transfer coefficients at the blades V P

A76-47001 **Atmospheric electricity (Atmosfernoe elektrichestvo)** Edited by V P Kolokolov and L G Makhotkin Leningrad, Gidrometeoizdat (Glavnaia Geofizicheskaia Observatoriia imeni A I Voeikova, Trudy, No 358), 1975 168 p In Russian

The papers deal with the development and application of instrumental observation techniques capable of providing physical and operational information on nearby thunderstorms Several observation techniques, well suited for solving actual problems, are described, and their development on the basis of the characteristics of nearby atmospherics is discussed Some problems associated with atmospheric electricity and the electrification of aircraft through atmospheric aerosols are examined V P

A76-47011 # **Static electrification of aircraft and trial bodies under various meteorological conditions (Staticheskaia elektrizatsiia samoletov i probnykh tel v razlichnykh meteorologicheskikh usloviiakh)** Iu F Ponomarev In Atmospheric electricity Leningrad, Gidrometeoizdat 1975, p 140 144 In Russian

The charge imparted to aircraft of various type through static electrification by cloud aerosols is evaluated The contribution of static electrification through cloud particles to the overall surface charge of the aircraft is determined by comparing it with the charge (or potential) measured at a 3-cm in diam trial body that is screened from the electric fields of the aircraft and the atmosphere The charges measured at the surface of a TU 104 aircraft and the surface charges measured at a trial body during flight through the upper stratus level are diagrammed It is shown that by comparing these measurements, it is possible to differentiate between physical factors and technological and operational factors V P

A76-47016 **YF 16 pilot report** J G Rider (USAF, Flight Test Center, Edwards AFB, Calif) *Air Force Magazine*, vol 59, Oct 1976, p 32 37

A test pilot's report on the handling and flying qualities of the YF 16 test prototype and on its combat performance The performance and feel of the quadraplex fly by-wire system, pilot's response to the nonmoving (force-sensitive) sidestick, and pilot's response to high-G flight maneuvers are reported The combat envelope and loiter and-fight capability of the YF 16 are described, along with its ability to execute supersonic combat maneuvers A self-testing system accessible to either pilot or maintenance technician is described, and the program of full scale development testing is reported Head-up display features, including reselect and deselect of air to-surface and air-to air modes head-up, are described R D V

A76-47017 **USAF's crusade to streamline industrial production** E Ulsamer *Air Force Magazine*, vol 59, Oct 1976, p 62 67

The anomaly of a lag in the modernization of manufacturing plants and their technology in the production of aerospace parts and the sophistication of aerospace systems is examined Possible carrot and stick incentives are considered tax credits, termination liability, guaranteed amortization, interest credits, and value engineering USAF promotion of adaptive numerical control of machine tools, laser welding, diffusion bonding, hot isostatic pressing, isothermal forging, and future merged computer-aided design and integrated computer-aided manufacturing are discussed In the drive for superior advanced systems at reduced costs, 'firms that fail to replace obsolescence and inefficiencies are going to feel the results' in USAF procurement and contracting policies R D V

A76-47114 # **Basics of the planning of modern aircraft technical maintenance systems (Podstawy projektowania wspolczesnych systemow obslugi technicznej samolotow)** A Slodownik *Technika Lotnicza i Astronautyczna*, vol 31, Sept 1976, p 27 29 In Polish

Approaches to systematization and classification of flight safety

and reliability of aircraft equipment in flight are discussed broadly Safety operational reliability, and technical reliability are defined, and quantitative approaches to reliability are mentioned A YES NO questionnaire on craft safety aspects of equipment maintenance and checkout is outlined and the system of functionally significant items is discussed extensively, along with aircraft turnaround time between flights R D V

A76-47115 # **Causes of breakage of centrifugal compressor blading in Lis type engines (Przyczyny urywania sie zabierakow sprezarek odsrodkowych w silnikach typu Lis)** E Gruszczynski, M Stukonis, and H Ziemba *Technika Lotnicza i Astronautyczna*, vol 31, Sept 1976, p 29 32 *In Polish*

Examples of the most frequent compressor blade failures in Lis type bypass engines with a single stage double entry centrifugal compressor are examined and analyzed The impeller and blades are made of refractory aluminum alloys (grades AK4 1 AK6, AK6 1), and the microstructure of fracture surfaces is investigated Trans granular corrosion accounts for 27% of the failures, assembly errors for 22%, irregular microstructure for 22%, of the cases investigated Nonuniform tension on the two sides of the impeller, uneven flow through blade passages, changes in blade cross sections, and behavior of notched test pieces were studied Enamel anticorrosion and antiscratch coatings, and tighter tolerances on tension at blade tips and blade-impeller fastenings, are recommended R D V

A76-47122 **Gust load regulations** C B F Bon (Delft, Technische Hogeschool, Delft, Netherlands) *Delft Progress Report, Series C Mechanical and Aeronautical Engineering and Shipbuilding*, vol 1, Aug 1976, p 93 104 6 refs

The required static strength for gust loads in present airworthiness regulations is defined by a 'design envelope' method in terms of the most severe flying conditions expected In this paper, flight data for various types of aeroplanes are analyzed in terms of the probability of the limit load being exceeded, with the object of testing the practicability of defining gust loads by a 'mission analysis' method in future regulations (In this 'mission analysis' method, a maximum permissible frequency with which the limit load may be exceeded is prescribed, together with some standard operating conditions) It is concluded that the 'mission analysis' method is not likely to represent an improvement on the present approach It is concluded further that the new generation of jumbo jets has a much higher static resistance to gust loads than the older generation of jets (Author)

A76 47125 **How quickly will the aircraft noise problem subside** M J T Smith (Rolls Royce /1971/, Ltd , Derby, England) *Interavia*, vol 31, Oct 1976, p 989 991

The likely trend in the future, and measures which can be taken to solve the aircraft noise problem are outlined Some of recent predictions are compared and a rate of noise reduction of around 0 5 dB per year is considered to be the most likely value for the period up to the year 2000 A discussion of the existing technology base, particularly the latest models of high bypass ratio engines, e g RB 211, is followed by an examination of the possibilities of further noise reduction It is shown that further increase in bypass ratio would only reduce take-off noise by 1 to 2 dB and possibly even increase the approach noise The major aspects of the problem including the basic cycle and the acoustic treatment are examined from the technological and economic points of view, along with the trends in noise legislation for airplanes and airports S N

A76-47147 **Evaluation of the noise emitted by a single profile encountering a wake (Evaluation du bruit emis par un profil isole intercepte par un sillage)** H Arbey, M Sunyach, and G Comte Bellot (Ecole Centrale Lyonnaise, Ecully, Rhône, France) *Academie des Sciences (Paris), Comptes Rendus, Serie B Sciences Physiques*, vol 283, no 4, Sept 13, 1976, p 95 98 5 refs In French

Noise emitted from different regions of a two dimensional airfoil profile passing through a wake is examined on the basis of a space time analysis of the instantaneous pressure field on the surface of the profile The wake is shown to produce a momentary deviation of the flow incident on the airfoil A radiated sound intensity of 90 dB is computed by integration B J

A76-47199 # **Periodic control and the optimality of aircraft cruise** E G Gilbert and M G Parsons (Michigan, University, Ann Arbor, Mich) *Journal of Aircraft*, vol 13, Oct 1976, p 828-830 12 refs

Results are presented for a study showing that the periodic control formulation extends to analysis of the dynamics of aircraft cruise, with main emphasis on energy state model The relaxed cruise mentioned by Zagalsky et al (1971) is proved to be a relaxed steady state optimum of the type described in the literature of periodic control Two examples are considered the F-4 aircraft and an idealized model of an aircraft When the maximum altitude is suitably constrained, both examples demonstrate that oscillatory aircraft motion is likely to reduce fuel consumption in cruise Aircraft with high thrust to drag ratios and low wing loading are favored S D

A76 47200 * - **Aeroelastic stability and control of an oblique wing Wind tunnel experiments** R T Jones (NASA, Ames Research Center, Moffett Field, Calif) *Journal of Aircraft*, vol 13, Oct 1976, p 832

Results are presented for wind tunnel tests of an elastic wing model to verify the theoretical predictions for the aeroelastic instability of an oblique wing The model wing has an elliptic planform of 10 to 1 axis ratio and a symmetrical airfoil section of 7 1/2% thickness/chord ratio The wing is of wood and as may be seen in the photographs presented, slack wires are used to limit the amplitude of unstable motions The fuselage is mounted on bearings permitting freedom of roll, but provision is made to clamp the fuselage for some of the tests It is found that freedom in roll increases the dynamic pressure at which aeroelastic instability first appears With the model free in roll, the effectiveness of the ailerons in maintaining trim is not noticeably affected by passage through the speed at which the wing would become unstable if clamped S D

A76 47271 **The Mystère-50** J Morisset *Air et Cosmos*, vol 14, Oct 2, 1976, p 21 28 In French

A progress report is presented on the development of the Mystere 50 medium haul trijet passenger craft The article covers performance data, mass and range data, computer simulation tests, wind tunnel tests, and flight tests with prototypes Component fabrication subcontracted to various companies is discussed, along with details of the TFE 731 3 Garrett turbine engine, and brief data on some subsystems (avionics, autopilot, communications, air conditioning, and the Garrett GTCP 36 100 auxiliary propulsion unit) R D V

A76 47280 # **Study of startup regimes of the GT-35 gas turbine installation (Issledovanie rezhimov puska gazoturbinnoi ustanovki GT 35)** G G Ol'khovskii, L V Povolotskii, M P Kaplan, A O Bumarskov, A I Belov, L I Chernomordik, and P I Korzh (Khar'kovskii Turbogeneratornyi Zavod, Kharkov, Ukrainian SSR, Vsesoiuznyi Nauchno-Issledovatel'skii Teplotekhnicheskii Institut, Moscow, USSR) *Teploenergetika*, Aug 1976, p 57 60 In Russian

The paper reports on the results of tests on the startup characteristics of the GT 35 gas turbine installation forming part of a steam gas installation, and on various factors that effect the startup characteristics The gas turbine installation is characterized by a compressor with compression ratio of 6 5-7 and by significant pressure losses in the cycle (about 16% in nominal regime) A steam turbine consisting of a double rimmed velocity wheel rotating at the same frequency as the main turbine shaft is used for turning the shaft

during startup The trends of the turbine and compressor efficiency under various startup regimes were plotted It was found possible to have cold turning without ignition of the fuel up to rotational frequencies of 900 rpm at startup turbine shaft power of 900 1000 kW and up to 1250 1300 rpm at 2300 kW Power balances for these and other regimes are shown P T H

A76-47281 , **Testing the annular combustion chamber of the NK 8 aircraft engine using natural gas (Ispytanie kol'tsevoi kamery sgoraniia aviatsionnogo dvigatelia NK-8 na prirodnom gaze)** A G Tumanovskii, V N Kovalev, V G Skuridin, and F M Mingaleev *Teploenergetika,* Aug 1976, p 60-64 In Russian

The conditions in the annular combustion chamber of a turbofan engine were studied during combustion of natural gas The front part of the chamber consists of a block of injectors arranged in two staggered rows, forming part of the annular head of the chamber Each injector has its own swirler and stabilizer, and air is introduced gradually into the chamber Although one of the characteristics of ignition of natural gas in highly forced combustion chambers is the loss of combustion stability as the fuel becomes richer, rich flameout was not attained in the present experiments even at air temperature at burner inlet of 30 50 C and air velocity at inlet of 120 130 m/sec The measurements include the burnup coefficient and temperature field characteristics as influenced by inlet conditions P T H

A76-47350 **Helicopter dynamics** A R S Bramwell (City University, London, England) New York, Halsted Press, 1976 416 p 140 refs $38 50

The present work gives an updated account of most important branches of the dynamics and aerodynamics of the helicopter Simple assumptions are adopted, yet they enable substantial results to be obtained for calculating induced velocity, rotor forces and moments, performance, and the static and dynamic stability and control in both hovering and forward flight Particular attention is given to the complicated problem of calculating the induced velocity and the rotor blade forces when vortex wakes from individual blades are taken into account Aerofoil characteristics under conditions of high incidence and high Mach number for steady and unsteady conditions are discussed Methods are presented for calculating the mode shapes and frequencies for flapwise, lagwise, and torsional displacements for both hinged and hingeless flexible blades Other topics include helicopter vibration and the problem of aeroelastic coupling between the modes of vibration of the blade and between those of the blade and fuselage S D

A76 47355 # **Developments in transonic steady and unsteady flow theory** J R Spreiter (Stanford University, Stanford, Calif) and S S Stahara (Nielsen Engineering and Research, Inc , Mountain View, Calif) *International Council of the Aeronautical Sciences, Congress, 10th, Ottawa, Canada, Oct 3-8, 1976, Paper 76-06* 16 p 73 refs Contract No N00014-73 C-0379 NR Project 061 215

A broad overview is presented of theoretical progress in transonic steady and unsteady flow analysis through brief accounts of the theoretical basis of the various methods employed Particular attention is given to transonic flows past wings and bodies, wing-body combinations, helicopter rotors, and internal flow through rotating turbomachinery Two dimensional flows and the Navier-Stokes representation are first discussed, so that the initial results may provide a standard with which the approximate theories can be judged The salient features and results of the more significant methods are reviewed Under favorable circumstances, the various methods yield similar results, with the effects of viscosity being confined to limited regions, so that the results of the small disturbance theory agree with those of the more accurate theories Some of the discrepancies stem directly from differences in computational details and could be reduced at the expense of greater computing time or with the development of more effective algorithms S D

A76-47356 # **Optimum design of composite primary structure aircraft components** D M Purdy and C G Dietz (Douglas Aircraft Co , Long Beach, Calif) *International Council of the Aeronautical Sciences, Congress, 10th, Ottawa, Canada, Oct 3 8, 1976, Paper 76-07* 11 p 6 refs

The application of advanced composite materials to aircraft structures holds the potential for significant improvements in the aircraft system The application of these materials in primary structures is evaluated and a methodology discussed for determining the optimum configurations of the primary structure components The procedure goes beyond establishing optimum laminate patterns and determines the appropriate size, shape, and spacing of any stiffener materials Constraints which may be applied to the optimization process include manufacturing, strain, and stiffness requirements The impact on the structural weight of various potential constraints is examined Comparisons are made between optimized advanced composite structure and existing metal structure for those cases for which practical constraints include stiffnesses, strain levels, and manufacturing requirements (Author)

A76-47357 # **Evaluation study of composite reinforced wing panel construction** J J Cools (Fokker-VFW, Shiphol Airport, Netherlands) and G Bartelds (Nationaal Lucht- en Ruimtevaart laboratorium, Amsterdam, Netherlands) *International Council of the Aeronautical Sciences, Congress, 10th, Ottawa, Canada, Oct 3 8, 1976, Paper 76-08* 10 p

The application of HTS carbon-epoxy composite material in hybrid laminates and as reinforcement to aluminum wing panel construction is studied Basic properties and compressive buckling behavior of aluminum/carbon-epoxy hybrid laminates are determined using flat plate strips, folded short column sections and hat stiffened panel specimens It appears that a 30% weight saving as compared to all metal short column can be achieved It has not yet been fully evaluated what portion of this saving can be preserved in actual compression panel construction but 20% appears to be feasible The application of composite reinforcement to improve fail-safe characteristics of stiffened and sandwich panels is shown to be very promising also Although crack growth rates in aluminum parts are adversely affected by tensile pre stress the crack arrest and residual strength characteristics are improved very significantly (Author)

A76-47358 # **The application of advanced composites to military aircraft** R N Hadcock (Grumman Aerospace Corp , Bethpage, N Y) *International Council of the Aeronautical Sciences, Congress, 10th, Ottawa, Canada, Oct 3 8, 1976, Paper 76-09* 11 p 13 refs Research supported by the Grumman Independent Research and Development Program, Contracts No F33615 68 C 1301, No F33615 71 C 1605, No F33615 73 C-5173, No F33615 75 C 3124, No N00019 73 A 0070, No N62269 74 C 0535

The evolutionary development of advanced composites for use in aircraft structures is described The design approach for boron/epoxy composite material is discussed Later programs have focused on the use of mixtures of graphite/epoxy, boron/epoxy, and glass epoxy to achieve both weight and cost savings Projected benefits of the extensive application of advanced composites to new aircraft systems are also presented The predicted weight, cost, and performance benefits of fully integrated and wide application of composites to future high performance aircraft are truly significant S D

A76-47359 # **A new type of attachment for B/Al compressor blades** R Kochendorfer (Deutsche Forschungs und Versuchsanstalt fur Luft- und Raumfahrt, Institut fur Bauweisen- und Konstruktionsforschung, Stuttgart, West Germany) *International Council of the Aeronautical Sciences, Congress, 10th, Ottawa, Canada, Oct 3 8, 1976, Paper 76-10* 13 p 13 refs

A loop type attachment for B/Al compressor blades is developed using a J79 first stage blade as a demonstrator The attachment is realized by connecting two blades at the root end by a loop in such a way that all or most of the fibers are running continuously from one

blade tip to the other B/Al material is selected because it offers advantages of temperature stability, erosion and foreign object damage resistance over organic matrix composites The technology of realizing this twin blade design using B/Al is described The reached high stress levels combined with low density of B/Al material allow realization of a hollow blade-loop concept A possible weight saving of 23% is calculated in a feasibility study by redesigning a three-stage low-pressure titanium compressor of a modern engine according to the requirement of a B/Al twin blade concept S D

A76-47360 # **Advanced aerodynamics for transonic flight** A Eberle, W Staudacher, and A Zech (Messerschmitt-Bolkow-Blohm GmbH, Ottobrunn, West Germany) *International Council of the Aeronautical Sciences, Congress, 10th, Ottawa, Canada, Oct. 3-8, 1976, Paper 76-12* 11 p 18 refs Research supported by the Bundesministerium der Verteidigung

Theoretical and experimental research on supercritical airfoils and hybrid wing planforms, maneuver flap systems, and wing body integration is reviewed Effects of nose strakes, short coupled canards, and wing tip modifications, and of various slat and flap configurations, on transonic flight performance and on lift/drag ratio in maneuvers are discussed Some wing-tip modifications such as the rounded Bagley type configuration and various wing strakes were also tested, as well as clean wings (without strakes) and variable camber wings R D V

A76-47361 # **Analysis of two-element high lift systems in transonic flow** B G Arlinger (Saab-Scania AB, Linkoping, Sweden) *International Council of the Aeronautical Sciences, Congress, 10th, Ottawa, Canada, Oct 3-8, 1976, Paper 76-13* 10 p 13 refs

A calculation method has been developed for the two dimensional inviscid transonic flow around two-element airfoil systems, such as an airfoil with a leading-edge slat or a trailing edge flap Using a conformal mapping sequence the flow field is mapped to an annular domain where the two circles represent the two airfoil contours The full potential equation is solved in this domain using a symmetric successive line overrelaxation procedure Calculated results are presented for various configurations and Mach numbers Comparisons are also made with some available experimental results which, however, show large viscous effects (Author)

A76-47362 # **The design of transonic airfoils under consideration of shock wave boundary layer interaction** H Sobieczky and E Stanewsky (Aerodynamische Versuchsanstalt, Gottingen, West Germany) *International Council of the Aeronautical Sciences, Congress, 10th, Ottawa, Canada, Oct 3-8, 1976, Paper 76-14* 16 p 16 refs

A hodograph method for the design of transonic airfoils in inviscid shock free flow is developed The method with its initial and boundary value problems is then extended to flow with shocks, focusing on physical boundaries which arise from the displacement of a turbulent boundary layer interacting with a transonic recompression shock Transonic wind tunnel tests were carried out to measure the structure of the boundary layer as well as the outer flow B J

A76-47363 * # **An experimental and computational investigation of the flow field about a transonic airfoil in supercritical flow with turbulent boundary-layer separation** M W Rubesin, A F Okuno, L L Levy, Jr , J B McDevitt, and H L Seegmiller (NASA, Ames Research Center, Moffett Field, Calif) *International Council of the Aeronautical Sciences, Congress, 10th, Ottawa, Canada, Oct 3-8, 1976, Paper 76-15* 11 p 20 refs

A combined experimental and computational research program for testing and guiding turbulence modeling within regions of separation induced by shock waves incident on turbulent boundary layers is described Specifically, studies are made of the separated flow over the rear portion of an 18% thick circular-arc airfoil at zero angle of attack in high Reynolds number supercritical flow The measurements include distributions of surface static pressure and local skin friction The instruments employed include high frequency response pressure cells and a large array of surface hot-wire skin-friction gages Computations at the experimental flow conditions are made using time dependent solutions of ensemble-averaged Navier-Stokes equations, plus additional equations for the turbulence modeling (Author)

A76-47367 # **The Franco-German experimental program for the evaluation of a supercritical wing for a combat aircraft application** M Lotz (Dornier GmbH, Friedrichshafen, West Germany) and B Monnerie (ONERA, Châtillon-sous Bagneux, Hauts-de-Seine, France) *International Council of the Aeronautical Sciences, Congress, 10th, Ottawa, Canada, Oct 3-8, 1976, Paper 76-21* 11 p 9 refs Research supported by the Bundesministerium der Verteidigung

The program has the purpose to investigate the practical applicability of supercritical wings to subsonic combat aircraft using the Franco-German Alpha Jet as a test vehicle Specific points of interest are (1) 3 D effects on moderate aspect-ratio wings, (2) performance of a supercritical wing in a broad CL M region, (3) effectiveness of maneuver flaps on a supercritical wing, and (4) the behavior beyond the buffet boundary and at the maneuver limit The paper first describes the theoretical and experimental work which preceded the flight test program Following that, the time plan of the program is shown Results of the first design cycle are presented as well as the resulting improvements in performance (Author)

A76-47368 # **Recent explorations in relaxation methods for three-dimensional transonic potential flow** W Schmidt (Dornier GmbH, Friedrichshafen, West Germany) and S Hedman (Flygteknıska Forsoksanstalten, Bromma, Sweden) *International Council of the Aeronautical Sciences, Congress, 10th, Ottawa, Canada, Oct 3-8, 1976, Paper 76-22* 10 p 18 refs Research supported by the Defence Materiel Administration of Sweden, Bundesministerium der Verteidigung Contract No TR 720-R-7600 42-009

Earlier work is extended in a development of a three dimensional transonic design relaxation method Mach number and lift coefficient are assigned for the design point in (planform) wing design A chordwise target pressure distribution is derived from two dimensional design studies The PT7 transonic wing body configuration was tested, the design pressures checked in wind tunnel experiments The transonic potential equation is solved by locally varied applications of relaxation techniques Further improvements are suggested for speeding up numerical calculations, for application to highly loaded swept and tapered wings, and for pressure distributions corresponding to improved aft loading and improved nose shape R D V

A76-47369 # **Wing-body interference on a generalized load distribution on the body due to triangular wings at supersonic speeds** E S Larson (Flygtekniska Forsoksanstalten, Stockholm, Sweden) *International Council of the Aeronautical Sciences, Congress, 10th, Ottawa, Canada, Oct 3-8, 1976, Paper 76 23* 13 p 26 refs Research supported by the Defence Materiel Administration of Sweden

A generalized load distribution on the body due to interference from triangular wings with supersonic trailing edges and with sufficiently long root-chords is developed by means of an approximate analyses for wing-body combinations without an afterbody at small angles of attack By an empirical approach the loading on the afterbody has also been predicted with reasonable accuracy and the whole interference load distribution on the body can therefore be condensed into a kind of an approximate similarity law The generalized load distribution is compared with a large number of experiments and with the panel method result The correlation is quite satisfactory (Author)

A76-47370 # **Supersonic flow past a slender delta wing - An experimental study** J L Stollery and I C Richards (Cranfield Institute of Technology, Cranfield, Beds , England) *International Council of the Aeronautical Sciences, Congress, 10th, Ottawa,*

Canada, Oct 3-8, 1976, Paper 76 24 7 p 9 refs Research sponsored by the Ministry of Defence (Procurement Executive)

A detailed survey of the flow around a delta wing with 70 deg of leading-edge sweep has been performed at a Mach number of 2 5 Both leeside and windward surfaces have been studied over the incidence range from -5 to 50 deg The measurements include upper- and lower surface pressure distributions, schlieren photographs, vapour screen pictures, and surface oil-flow visualization The results are compared with thin shock-layer theory The agreement is generally good, but the conjecture that the theory can be used to predict the occurrence of leading-edge separation needs further investigation (Author)

A76-47373 # **A new method for measuring the modal shapes of aircraft structures (Une nouvelle methode de mesure des formes modales des structures aeronautiques)** J J Angelini (ONERA, Châtillon-sous Bagneux, Hauts de Seine, France) *International Council of the Aeronautical Sciences, Congress, 10th, Ottawa, Canada, Oct 3-8, 1976, Paper 76-27* 6 p In French

A harmonic vibration test setup for determining the modal shapes of aircraft structures is described Vibration is induced by electromechanical exciters controlled by a digital frequency synthesizer, and vibration measurements are controlled and processed by a Hewlett Packard 2100 computer The modal shape identification is accomplished in two steps (1) the frequency response after sweep is recorded automatically allowing the determination of natural modes, and (2) eigenvalues are visualized B J

A76-47374 # **A general approach to supersonic aeroelastic vibrations problems** P Santini and R Barboni (Roma, Universita, Rome, Italy) *International Council of the Aeronautical Sciences, Congress, 10th, Ottawa, Canada, Oct 3 8, 1976, Paper 76 28* 19 p 8 refs

A generalized Galerkin method is used to treat the problem of the supersonic flutter of a three-dimensional panel, taking account of the coupling of out of-plane bending and in plane stretching Linear aerodynamic theory is utilized and the nonlinear membrane forces induced by panel flutter are included in the analysis Attention is paid to the effects of in plane boundary conditions on the amplitude and frequency of the limit cycle and on the stress distribution B J

A76-47375 **The accuracy of thrust in flight derived from engine calibrations in an altitude test facility** J C Arcough (National Gas Turbine Establishment, Farnborough, Hants , England) *International Council of the Aeronautical Sciences, Congress, 10th, Ottawa, Canada, Oct 3 8, 1976, Paper 76 30* 17 p 6 refs

Thrust in flight is derived from readings of engine parameters which are preferably calibrated in an altitude test facility A new refined theory is proposed for estimation of engine calibration uncertainty and its transfer to the in flight thrust calculations of a multi-engined aircraft The older simpler theory is shown to over estimate the in flight uncertainties Examples are given of various possible arrangements for the engine calibrations using both an altitude test facility, and a sea level static test bed and of the application of these calibrations to flight measurements (Author)

A76-47377 **Design techniques for high by pass ratio powerplant nozzle systems** A R Seed (National Gas Turbine Establishment, Farnborough, Hants , England) *International Council of the Aeronautical Sciences, Congress, 10th, Ottawa, Canada, Oct 3-8, 1976, Paper 76 32* 9 p 7 refs

Theoretical and experimental techniques used to identify and prove high efficiency gas generator afterbodies for high by pass ratio turbofan installations are outlined The theoretical method of characteristics is used to predict afterbody flows on axisymmetric afterbodies The value of this method in predicting 'shock free' flows is demonstrated A model technique giving accurate comparisons between a range of axisymmetric isolated nozzle arrangements up to high subsonic Mach numbers is described Results are presented which demonstrate the accuracy and repeatability of the model technique, and the applicability of the theoretical and experimental approaches to identifying improved afterbody designs (Author)

A76-47379 # **The effect of wake thickness on the rolling-up process in two dimensions** H Portnoy (Technion - Israel Institute of Technology, Haifa, Israel) *International Council of the Aeronautical Sciences, Congress, 10th, Ottawa, Canada, Oct 3 8, 1976 Paper 76 34* 11 p 15 refs Grant No AF AFOSR-71 2045

A numerical method is developed for calculating the flow field due to a two dimensional distribution of vorticity over a given area A distribution of vorticity over a long thin ellipse is then used to model the flow about the unrolled cross section of a thick wake far downstream of the wing trailing-edge The distribution is now allowed to distort under the action of its own induced velocity field, (which is calculated by the aforementioned numerical method), thus simulating roll-up of a wake with thickness The influence of viscosity is neglected and two different span loadings are studied (Author)

A76-47380 # **Theory and experiments on the hypersonic source flow over long, slender bodies in a conical nozzle** M Yasuhara, S Watanabe, H Mitome, and M Ikeda (Nagoya University, Nagoya, Japan) *International Council of the Aeronautical Sciences, Congress, 10th, Ottawa, Canada, Oct 3-8, 1976, Paper 76-35* 11 p 14 refs Research supported by the Ministry of Education

Inviscid nonlinear quasi-similarity theory is applied to a long body in a hypersonic source flow, and linearized theory for a pointed body is treated by the method of source distribution These source flow results show a large decrease in the surface pressure distribution compared with the parallel ones in the rear part of the body if the distance from the nose to the body surface, normalized by the source-nose distance, increases beyond about 0 1 It is shown that there exists one-to-one correspondence between the source-flow problem and the parallel one in slender-body theory when the ratio of specific heats of gas is equal to 2 Pressure distributions along power-law bodies measured in the conical nozzle of a hypersonic shock tunnel are compared with the nonlinear theory and also with the source-parallel conversion result, giving essentially good agreement (Author)

A76-47381 # **Unsteady and steady aerodynamic forces of slender delta wings according to Newtonian theory** H T Hemdan and W H Hui (Waterloo, University, Waterloo, Ontario, Canada) *International Council of the Aeronautical Sciences, Congress, 10th, Ottawa, Canada, Oct 3-8, 1976, Paper 76-36* 10 p 10 refs Research supported by the National Research Council of Canada

The problems of hypersonic flow past a stationary and an oscillating conical delta wing at high angles of attack with detached shock waves are studied using the thin shock layer theory In the stationary wing case an accurate perturbation solution is obtained thus improving and extending Messiter's and other existing theories for flat and curved wings For the pitching delta wings with small amplitude, simple analytic formulae are derived for the aerodynamic derivatives The effects of wing curvature on its stability were studied systematically and it is found that the pitching motion of a hypersonic delta wing is always stable aerodynamically (Author)

A76-47382 # **Optimization of the rotor-wing system from helicopter performance point of view** K Szumanski (Instytut Lotnictwa, Warsaw, Poland) *International Council of the Aeronautical Sciences, Congress, 10th, Ottawa, Canada, Oct 3-8, 1976, Paper 76-37* 12 p

The subject dealt with by this paper is the optimization of geometric parameters of the helicopter lifting system in the form of the rotor and wing units Considering the numerous couplings of the parameters of the aforesaid lifting system with the remaining parameters of the helicopter, it may be said that the problem lies in the optimization of the entire helicopter, equipped with an auxiliary wing, and with particular attention paid to the rotor and to the wing Efforts have been undertaken to obtain a multi objective estimate of the quality of the helicopter, while recognizing a multi parameter set of design variables Considering the significant volume of the problem, the proceedings were limited to an outline of the course of

optimal projecting, while illustrating the selected fragments of the process (Author)

A76-47385 * # **Aerodynamic performance of two variable-pitch fan stages** R D Moore and G Kovich (NASA, Lewis Research Center, Cleveland, Ohio) *International Council of the Aeronautical Sciences, Congress, 10th, Ottawa, Canada, Oct. 3-8, 1976, Paper 76-41* 8 p 11 refs

NASA Lewis Research Center is investigating a variety of fan stages applicable for short haul aircraft These low-pressure-ratio low-speed fan stages may require variable-pitch rotor blades to provide optimum performance for the varied flight demands and for thrust reversal on landing A number of the aerodynamic and structural compromises relating to variable-pitch rotor blades are discussed The aerodynamic performance of two variable pitch fan stages operated at several rotor blade setting angles is evaluated for both forward and reverse-flow application Detailed radial surveys are presented for both forward and reverse flow (Author)

A76-47386 # **Noise generated wavelike eddies in a turbulent jet** Y Y Chan (National Aeronautical Establishment, Ottawa, Canada) *International Council of the Aeronautical Sciences, Congress, 10th, Ottawa, Canada, Oct 3-8, 1976, Paper 76-42* 13 p 29 refs

Experimental and theoretical studies of the wavelike disturbances in an axisymmetric turbulent jet are presented It is demonstrated that the jet can support a helical wave train with azimuthal mode equal to or greater than unity in addition to the plane wave mode The disturbance wave grows rapidly along the jet to a maximum and then decays gradually further downstream for three modes considered, m = 0, 1 and 2 The disturbance waves of all modes are well modelled by a wave theory with the local properties of the wave described by a linear stability solution of a divergent shear flow The nonlinear development of the wave along the jet is calculated by an energy integral method The predicted results are in good agreement with the experimental data (Author)

A76-47388 # **Operational experience on Concorde** R M McKinlay (British Aircraft Corp , Ltd , Filton, Bristol, England), G R I Heaton (British Aircraft Corp , Ltd , Fairford, Glos , England), and J Franchi (Societe Nationale Industrielle Aerospatiale, Toulouse, France) *International Council of the Aeronautical Sciences, Congress, 10th, Ottawa, Canada, Oct 3-8, 1976, Paper 76-44* 10 p

The paper summarizes the 7 year (over 7,000 hours of flying) operational experience of the supersonic Concorde aircraft in service with Air France and British Airways Statistics on the Certification Program development flights, including endurance flights intended to assess aircraft airworthiness, are followed by information on Concorde's airline service Main features of the aircraft operation are analyzed, taking a flight phase by phase The discussion covers aircraft loading, thrust checking, takeoff characteristics, subsonic climb, acceleration, supersonic climb, cruise, supersonic operations over the sea and land, descent, approach, and landing Information is given on the influence of atmospheric conditions on aircraft operation, including radiation, turbulence, temperature and wind shear effects at cruise altitude, as well as on some problems of ATC and communications An operational assessment of the aircraft from the pilot's point of view is given, along with some information on training program for Concorde's pilots S N

A76-47389 **The art and science of modern flight testing - A personal view** D Lean (Royal Aircraft Establishment, Flight Dynamics Div , Bedford, Hants , England) *International Council of the Aeronautical Sciences, Congress, 10th, Ottawa, Canada, Oct. 3-8, 1976, Paper 76-45* 10 p 16 refs

Some examples of flight research undertaken by the RAE in the field of aerodynamics, stability and control, and handling are used to illustrate the view that this type of flight testing is still very much a mixture of art and science The advances made in the capabilities of instrumentation, data recording and processing facilities are acknowledged but many of the chosen examples necessarily used very modest resources yet succeeded in producing valuable results often of wider significance than originally foreseen The value of this type of flight test is partly in increasing confidence in predictions based on wind tunnel and simulator tests but in many instances the flight result is unique (Author)

A76-47390 # **Accuracy limits in nonsteady flight testing** H L Jonkers and J A Mulder (Delft, Technische Hogeschool Delft, Netherlands) *International Council of the Aeronautical Sciences, Congress, 10th, Ottawa, Canada, Oct 3-8, 1976, Paper 76-46* 16 p 27 refs

When estimating aircraft performance, stability, and control characteristics from steady or unsteady maneuvering test flight data, the accuracy of the results is limited due to measurement errors, atmospheric disturbances, and mathematical modeling errors This paper studies the effects of various error sources on the maximally achievable accuracies of the aircraft characteristics derived from unsteady maneuvering flight test data It is shown which error sources are most relevant for accuracy limitations in present day flight testing, taking account of aerodynamic and inertial aircraft properties Conclusions drawn from theoretical analyses are compared with results obtained by processing digitally simulated and actual flight test data (Author)

A76-47391 # **Ground run maneuvering qualities of aircraft with nose wheel control** S Luthander, L Wickstrom, and S Oberg (Lutab Prof Sten Luthander Ingenjorsbyra AB, Bromma, Sweden) *International Council of the Aeronautical Sciences, Congress, 10th, Ottawa, Canada, Oct 3-8, 1976, Paper 76-47* 16 p 6 refs Research supported by the Defence Materiel Administration of Sweden

Based on the existing framework of vehicle dynamics theory a structure is suggested for the ground run maneuvering qualities problem combining two related areas referred to as response and phase optimization A survey simulation program covering mainly the response problem area has been conducted in the FOSIM research simulator adapted to ground run tests at a constant speed of 50 m/s Emphasis has been on fighter type aircraft of the 10-15 ton class with the aim to define vehicle parameter values corresponding to satisfactory respectively unacceptable pilot rating of the ground run maneuvering qualities (Author)

A76-47392 # **External noise of light propeller driven aircraft** F W J van Deventer and G J J Ruijgrok (Delft, Technische Hogeschool, Delft, Netherlands) *International Council of the Aeronautical Sciences, Congress, 10th, Ottawa, Canada, Oct 3-8, 1976, Paper 76-48* 15 p 19 refs

This paper describes an experimental research program set out to investigate basic sound characteristics of light propeller driven airplanes and to quantify actual observed noise levels The method of data reduction makes it possible to calculate sound time histories and peak noise levels at any point on the ground Some results are presented of systematic noise measurements during level and climbing flyovers of two types of light airplanes Also the effect of variation of some operational parameters and of airframe drag reduction on observed noise levels is indicated Finally, measured data are compared with results of calculations, using a well known empirical propeller noise prediction method The need for improved prediction methods is stressed, since basic sound signatures show poor agreement (Author)

A76-47393 # **New developments in blown flap noise technology** J S Gibson (Lockheed Georgia Co , Marietta, Ga) *International Council of the Aeronautical Sciences, Congress, 10th, Ottawa, Canada, Oct 3-8, 1976, Paper 76-49* 11 p 37 refs

There is considerable effort underway in the development of blown-flap powered lift systems of the lower surface blowing (LSB) and upper surface blowing (USB) types The noise technology relating to blown flap systems is reviewed There are three general sources of noise turbomachinery, airframe, and the interaction noise of the jet blowing on the flaps Characteristics of LSB and USB

systems are described, including noise spectra, directivity, jet velocity characteristics, aircraft geometric-variation effects, and aircraft forward speed effects Noise reduction concepts are described, including slowing down the jet flow field by devices and engine cycle modifications, structural geometry and shielding modifications, local flow-field modifications of the passive and active type, and absorption of noise It is concluded that low noise characteristics in blown flap aircraft must be largely 'built in' by better application of low-noise principles during the design (Author)

A76-47394 # **Opportunities for future improvements in aircraft noise** R P Gerend (Boeing Commercial Airplane Co , Seattle, Wash) *International Council of the Aeronautical Sciences, Congress, 10th, Ottawa, Canada, Oct 3-8, 1976, Paper 76-50* 13 p 24 refs

Current status of theoretical understanding, experimental techniques and potential future noise reductions are examined for fan source noise, low frequency core engine noise, jet exhaust noise and airframe noise components Potential future improvements in acoustic linings are also reviewed It is concluded that there are a number of interesting possibilities for advancement of noise technology, but that energy, emissions and cost constraints will limit future noise reductions to relatively modest increments below the current wide body fleet (Author)

A76-47395 # **Tornado - An advanced STOL fighter-bomber design** O Friedrich (Messerschmitt Bolkow Blohm GmbH, Munich, West Germany) and B Young (British Aircraft Corp , Warton, England) *International Council of the Aeronautical Sciences, Congress, 10th, Ottawa, Canada, Oct 3-8, 1976, Paper 76-51* 10 p 6 refs

Tornado represents an aircraft incorporating design features such as variable wing sweep, variable supersonic inlet, sophisticated primary and secondary flying controls, advanced structural design with modern materials, and a high-technology afterburning bypass engine specifically designed for it Flight testing of Tornado started in 1974, and eight aircraft are flying at three industry flight test centers at this time The paper highlights the design philosophy, with emphasis on the overall integrated function and performance of the airframe achieved by synthesis of all systems (Author)

A76-47396 **Resume of steep gradient research at RAE Bedford** A D Brown (Royal Aircraft Establishment, Bedford, Hants , England) *International Council of the Aeronautical Sciences, Congress, 10th, Ottawa, Canada, Oct 3-8, 1976, Paper 76 52* 14 p 20 refs

Results are presented for an R/STOL (reduced/short takeoff and landing) research program including airfield facilities and various steep approach techniques applied to six aircraft The discussion covers noise benefits, approach performance in terms of pitch and azimuth maneuver, flares and landings, all weather operations, and alternative approach techniques It is shown that the success of R/STOL operations strongly depends on the effective introduction of MLS (microwave landing system) guidance Improvement in approach accuracy coupled with suitable development in engine and airframe design should result in safe operation down to realistic heights in all weathers with real benefits measured in terms of approach success rate S D

A76-47397 # **The Canadian STOL demonstration - The data collection, the findings and their applications** H P Rosewarne and D D Spruston (Canadian Air Transportation Administration, Ottawa, Canada) *International Council of the Aeronautical Sciences, Congress, 10th, Ottawa, Canada, Oct 3-8, 1976, Paper 76-53* 14 p

The paper describes the data collection and monitoring exercise conducted by the Canadian Air Transportation Administration on the Canadian government-sponsored STOL Demonstration Service to commercial air carrier standards between Montreal and Ottawa from August 1974 to March 1976 The aim of data collection was to provide information required to establish the technical standards and operational procedures for STOL transportation Demonstration operating concepts and data collection exercises are described and results are presented B J

A76-47399 # **Conflict detection and resolution in the Netherlands ATC system SARP II** J M ten Have and C G H Scholten (Nationaal Luchtvaartlaboratorium, Amsterdam, Netherlands) *International Council of the Aeronautical Sciences, Congress, 10th, Ottawa, Canada, Oct 3-8, 1976, Paper 76 55* 10 p 6 refs

The paper focuses on two conflict detection methods which are developed for overflying aircraft in the Netherlands airspace and are based on long-term trajectory predictions The aim is that the conflict detection programs produce few 'false alarms' and consume very little on line processing time This is met by the so-called 'block method', which is described in this paper Also investigations are discussed with respect to a more complicated method, known as the 'critical-distance method' The latter method will reduce the false alarm rate to its minimum value, set by the uncertainties in the trajectory predictions in the ATC-computer system and by the lateral deviations from track of the aircraft (Author)

A76-47400 # **Evaluation of a new flight path command control concept** V Adam and R Onken (Deutsche Forschungs und Versuchsanstalt fur Luft und Raumfahrt, Institut fur Flugfuhrung, Braunschweig, West Germany) *International Council of the Aeronautical Sciences, Congress, 10th, Ottawa, Canada, Oct 3-8, 1976, Paper 76-56* 8 p 6 refs

The introduction of digital electric flight control systems as well as new theoretical techniques in multivariable control synthesis open new ways in overall control system design In particular, the developments of advanced command control systems offers great promise A digital command control system, which follows independent commands in change of glide slope angle and speed in the sense of 4 D-guidance, has been designed and evaluated in simulator tests The commands are fed in by the pilot by means of control column or side grip controller deflection The influence of certain control loop modifications has been investigated Test results show the tracking performance, achieved by use of an optimized control law and suitably modified pilot interfaces (Author)

A76-47401 * # **Research in ground-based near-terminal area 4D guidance and control** C L Britt, Jr , C M Davis (Research Triangle Institute, Research Triangle Park, N C), L Credeur (NASA, Langley Research Center, Hampton, Va), and W Capron (Vought Corp , Hampton, Va) *International Council of the Aeronautical Sciences, Congress, 10th, Ottawa, Canada, Oct 3-8, 1976, Paper 76-57* 10 p 6 refs

This paper describes work being done at NASA, Langley Research Center and at the Research Triangle Institute on advanced, ground-based guidance and control for the near terminal area Large-scale computer traffic simulations in conjunction with flight experiments with a Boeing 737 aircraft will be used to evaluate various concepts for automated terminal area metering and spacing The all digital real-time air traffic simulation model is described Facilities for aircraft tracking and for interfacing the aircraft with the digital simulation are discussed, along with possible application to other types of experiments (Author)

A76-47402 # **Lightning protection of low density aircraft structures** F Cicci and P H Bootsma (de Havilland Aircraft of Canada, Ltd , Downsview, Ontario, Canada) *International Council of the Aeronautical Sciences, Congress, 10th, Ottawa, Canada, Oct 3-8, 1976, Paper 76-58* 10 p 8 refs

Lightning protection techniques which may be incorporated to protect low density aircraft structures from the hazards of a lightning strike are reviewed The discussion covers the lightning strike phenomenon, lightning strike protection of wing fuel tanks, and indirect effects of lightning discharge Design features permitting safe lightning current transfer through the various joint components of a fuel tank are examined It is recommended not to rely on screws to carry the bulk of the lightning current Surfaces with insulative

coatings increase the dwell time of an arc by necessitating a higher arc voltage to breakdown the dielectric coatings at a new attachment point It is desirable to have a treatment which is anticorrosive, esthetically pleasing, and readily applicable Aluminum mesh would be the more acceptable system to be used in composite structures
S D

A76-47403 # **Climatic impact assessment program - Conclusions and recommendations** A J Grobecker (U S Department of Transportation, Office of the Secretary of Transportation, Washington, D C) *International Council of the Aeronautical Sciences, Congress, 10th, Ottawa, Canada, Oct 3-8, 1976, Paper 76-59* 16 p 14 refs

This report assesses the impact of climatic changes which may occur from operation of aircraft in the stratosphere The effects considered involve the geophysics of the stratosphere and the troposphere, the propulsion effluents, the impacts of climatic change on the biosphere, and the economic and social measures of biological and climatic changes Technical measures for the improvement of aircraft engines and fuels, by which adverse environmental effects may be avoided, are described (Author)

A76-47404 # **Predictive adaptive control of a non-linear time-varying aircraft system** P Studer (Swiss Federal Aircraft Factory, Emmen, Switzerland) *International Council of the Aeronautical Sciences, Congress, 10th, Ottawa, Canada, Oct 3-8, 1976, Paper 76-60* 10 p 5 refs

An aircraft that is described by a non-linear, time-varying system is transferred from an initial state to a final state in a certain number of steps which result from the discretization of the entire (time-, fuel or energy optimized) trajectory in a sequence of points defining elementary trajectories The aircraft is guided from one point to another by a finite-time control vector obtained for linear systems with a quadratic performance criterion The control time interval is chosen such that the set of accessible states of the aircraft almost always lies in the set that may be obtained by freezing the linearization in the initial point of the elementary trajectory At the end of the control interval the state is measured and then allows the determination of the control vector, provided that the difference between the aircraft's state and the predetermined state lies inside a tolerable error window If this condition is not met a parameter identification is carried out An application is made to the in plane, accelerated climb of a hypothetical supersonic aircraft (Author)

A76-47552 # **Induced side forces at high angles of attack** A B Wardlaw, Jr and A M Morrison (U S Navy, Naval Surface Weapons Center, Silver Spring, Md) *Journal of Spacecraft and Rockets,* vol 13, Oct 1976, p 589-593 17 refs Navy-sponsored research

Linear regression techniques are used to establish a quantitative description of side forces on bodies of revolution at high incidence and zero side slip A data base is assembled concerning the key side force characteristics of maximum measured side force, angle of attack at which it occurs, and minimum angle of incidence at which a side force is observed (onset angle) This information is examined to determine the important trends, and a linear regression model is developed for these quantities to include only those variables which are statistically significant Results indicate that the peak side force coefficient is a function of Mach number, and only slightly of Reynolds number Nose fineness is the critical model dimension which suggests that peak side forces are a product of the nose flowfield Blunting of the nose reduces the magnitude of the side force but the degree of bluntness does not appear to be important The angle at which the maximum side force occurs is found to be dependent on model length and Mach number, while the onset angle is a function of model length only (Author)

A76-47571 # **Winter thunderstorms in Japan - A hazard to aviation.** E T Pierce (Stanford Research Institute, Menlo Park, Calif) *Naval Research Reviews,* vol 29, June 1976, p 12-16 10 refs

Meteorological and electrical characteristics of wintertime severe thunderstorms and lightning activity on the Hokuriku coast of Honshu (on Sea of Japan, extending roughly from Wakasa Bay to Toyama Bay) are described The winter storm season constitutes an anomalous secondary yearly maximum (in addition to the late summer seasonal maximum) Lightning flashes are few and not readily visible, but can be triggered by intrusion of aircraft into the thunderclouds The main positive charge center may lie below the negative center Single stroke leaders seem to discharge positive electricity to ground, and wreak greater destruction on transmission lines and structures than do conventional flashes Snow gush phenomena (in the wake of storms) and triggering of lightning by aircraft and rockets penetrating the thundercloud are recommended as research problems
R D V

A76-47678 # **B-1 flight test - Progress report** C C Bock, Jr (Rockwell International Corp, B-1 Div, Los Angeles, Calif) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex, Sept 27 29, 1976, Paper 76-886* 5 p

The phase 1 (1974-1976, 56 flights) of the B-1 supersonic aircraft flight tests is discussed The test program was developed according to the fly before-buy concept with targeted minimum flight time of over 250 hr, with primary aircraft mission being low altitude, high speed subsonic penetration to a target The airplane will also have the capability for high-altitude supersonic penetration In 300 total flying hours the B 1 spent 8 hr at supersonic speed and 24 hr at 5000 feet above 0 80 Mach number Good reliability of the major subsystems was established, and air refueling was a routine operation The handling qualities and the performance data of the aircraft were determined The first production airplane is expected to enter the Air Force inventory in mid-1979 Some information is also given on flight tests of the A/C 2 (instrumented primarily for airloads) and A/C-3 (offensive avionics) aircraft, which have contributed to the B-1 flight test program
S N

A76-47679 # **Flight testing of the Tornado - The current situation /August 1976/** K Knauer (Messerschmitt-Bolkow-Blohm GmbH, Tornado Flight Test Center, Ottobrunn, West Germany) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex, Sept 27-29, 1976, Paper 76-887* 15 p

Besides airframe and engine all systems and major system components have been developed and optimized especially to Tornado requirements Before flight trials were started, each system was tested many hours on rigs Flight tests demonstrate a level of system reliability for prototypes well on the way to production standard The performance of the individual systems has already reached production standard Comparisons show excellent handling and flight performance Some problems with lateral stability and thrust reverser operation have been experienced in the early days of the flight test program, but could be solved by minor modifications
(Author)

A76-47680 # **Technical applications for an experimental supersonic cruise aircraft** E E Riccioni *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex, Sept 27 29, 1976, Paper 76 892* 7 p

In order to decide on the feasibility of an efficient supersonic cruise fighter (supercruiser), the technical requirements for integrating aircraft technologies are analyzed Current characteristics of supersonic airplanes, such as radius of action, energy maneuverability, and 'G' capabilities are examined Special attention is paid to the performance disparity between fighters designed for supersonic cruise and those for transonic maneuvering In particular, the problem of the combat engagement time (persistence), i e, the

disparity between attained maximal speeds (up to M 2 5 in F-101, F 104, F-106, and F-111 models) and the cruise (combat) speeds of these fighters is analyzed A cost evaluation is presented as well as recommendations regarding further research, and an optimistic conclusion is reached as to the possibility of realization for the supersonic cruise fighters and their potential S N

A76-47681 # **The demonstration of advanced metallic technologies in primary wing structure** J R Ellis (Vought Corp , Systems Div , Dallas, Tex) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex , Sept 27-29, 1976, Paper 76 908* 7 p

Several new design and fabrication technologies using advanced metallic configurations and processes have been demonstrated in a main wing box section typical of fighter/attack aircraft This multi-cell box demonstration article was an all aluminum design utilizing adhesively bonded laminated main skins, advanced formed sheet metal substructure in a rivetbonded assembly The article was also designed as an integral fuel tank with innovative fuel sealing and environmental protection systems Supporting element test data is presented and the results of full scale pressure and static load tests are discussed Program results provide the basis for projected payoffs of reduced cost and weight with increased unrepaired service life (Author)

A76-47682 # **An integrated capability for the preliminary design of aeroelasticity tailored wings** R W Lynch, W A Rogers, and W W Braymen (General Dynamics Corp , Fort Worth, Tex) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex , Sept 27 29, 1976, Paper 76-912* 12 p 24 refs USAF-sponsored research

An automated design procedure called the Wing Aeroelastic Synthesis Procedure has been developed to yield optimum wing laminates while satisfying a variety of design constraints The algorithm considers only the wing skin thickness distribution and orientations for composites and balance masses as design variables It is assumed that the external lines of the wing have been defined during configuration synthesis and that the substructure will be designed after the skins are defined The stiffness and mass matrices for the wing structural box, the leading edge, and the trailing edge are generated using a direct Rayleigh Ritz energy formulation The leading and trailing edge Ritz models are coupled to the structural box with moment springs The optimization scheme uses the Fiacco-McCormick nonlinear programming technique As an illustration, the procedure is applied to the design of an aeroelastically tailored wing (Author)

A76-47684 * # **A vectored-engine-over-wing propulsive-lift concept** R G Bradley (General Dynamics Corp , Aerospace Technology Dept , Fort Worth, Tex), R R Jeffries (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio), and F J Capone (NASA, Langley Research Center, Propulsion Integration Section, Hampton, Va) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex , Sept 27-29, 1976, Paper 76-917* 14 p 14 refs

An experimental investigation has been conducted to evaluate a unique engine over wing propulsive-life scheme for providing maneuver improvement in the subsonic transonic speed regime The concept combines the benefits of vectored thrust for added circulation and spanwise blowing for leading edge-vortex augmentation so as to provide full angle-of-attack aerodynamic improvements Results of a series of wind tunnel tests employing a powered research model illustrate the propulsive/aerodynamic features of the concept (Author)

A76 47685 **The high bypass ratio variable pitch turbofan for transport aircraft propulsion** W J Walsh F S LaMar, and R T Kawai (Douglas Aircraft Co , Long Beach, Calif) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex , Sept 27 29, 1976, Paper 76-919* 12 p 23 refs

The development of higher bypass ratio turbofan engines for transport aircraft to reduce fuel consumption is reviewed with emphasis on the improvement of airframe/engine integration Attention is paid to the development of a number of technologies, including variable pitch fans, advanced composites, remote accessory location, and digital engine controls, in the NASA QCSEE engine program It is noted that the greatest obstacle to utilization of any new propulsion system which includes turboprops and high pressure-ratio cycles will probably be the establishment of credibility for the maintenance costs B J

A76 47686 * # **Review of V/STOL lift/cruise fan technology** L S Rolls, H C Quigley (NASA, Ames Research Center, Moffett Field, Calif), and R G Perkins, Jr (U S Navy, Air Systems Command, Washington, D C) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex , Sept 27-29, 1976, Paper 76-931* 12 p 11 refs

This paper presents an overview of supporting technology programs conducted to reduce the risk in the joint NASA/Navy Lift/Cruise Fan Research and Technology Aircraft Program The aeronautical community has endeavored to combine the low-speed and lifting capabilities of the helicopter with the high-speed capabilities of the jet aircraft, recent developments have indicated a lift/cruise fan propulsion system may provide these desired characteristics NASA and the Navy have formulated a program that will provide a research and technology aircraft to furnish viability of the lift/cruise fan aircraft through flight experiences and obtain data on designs for future naval and civil V/STOL aircraft The supporting technology programs discussed include (1) design studies for operational aircraft, a research and technology aircraft, and associated propulsion systems, (2) wind tunnel tests of several configurations, (3) propulsion system thrust vectoring tests, and (4) simulation These supporting technology programs have indicated that a satisfactory research and technology aircraft program can be accomplished within the current level of technology (Author)

A76-47687 # **Aerodynamic design and analysis of winglets** K K Ishimitsu (Boeing Commercial Airplane Co , Seattle, Wash) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex , Sept 27-29, 1976, Paper 76-940* 9 p 5 refs

A procedure has been developed to design and analyze winglets The procedure uses a vortex lattice computer program to determine various winglet geometry parameters, such as camber and twist required to minimize induced drag The wing/winglet design is analyzed in a nonplanar, three dimensional, potential flow program to determine the change in lift curve, pitching moment, span load and surface pressures The span load is analyzed in a Trefftz plane analysis program to determine the induced drag and wing bending moment distribution The surface pressure distributions are analyzed with boundary layer methods to determine the winglet profile drag The surface pressure distributions are qualitatively analyzed for separation, interference and compressibility drag The change in wing parasite and compressibility drag, caused by the winglets, is estimated using the base configuration wind tunnel data This analytic procedure to design and analyze winglets was checked by comparing the results of this procedure with wind tunnel data of models tested with winglets (Author)

A76-47688 # **A comparison of two lift fan propulsion concepts** D P Gleiter (U S Naval Material Command, Air Vehicle Technology Dept , Warminster, Pa) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex , Sept 27-29, 1976, Paper 76-954* 10 p 6 refs

Conceptual designs of lift fan aircraft using tip turbine and shaft driven fans were compared to determine which concept best meets the requirements for a V/STOL antisubmarine warfare aircraft with an initial operational capability in 1985 The first concept consists of a propulsion system using two engines which are growth versions of the J97 turbojet, interconnected through valves and hot gas ducts with three turbo tip fans, while the second concept consists of a propulsion system using two compound turbofan/shaft engines and two geared, variable pitch lift/cruise fans The comparison is carried out in terms of propulsion system performance, aircraft

mission performance, propulsion system cost, aircraft reliability and maintainability, and propulsion system vulnerability B J

A76-47689 # Aerodynamic design of a Mach 2 2 supersonic cruise aircraft R L Radkey, H R Welge, and R L Roensch (Douglas Aircraft Co , Long Beach, Calif) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Dallas, Tex , Sept 27 29, 1976, Paper 76 955* 10 p 11 refs

The McDonnell Douglas Corporation has conducted numerous Mach 2 2 supersonic aircraft design and integration studies in support of the NASA Supersonic Cruise Aircraft Research (SCAR) program This paper traces the evolution of a baseline study configuration and an improved performance configuration through several aerodynamic design and trade study cycles The impact of real-world constraints on configuration design is discussed The results of a wind tunnel test of two configurations are presented, and comparisons of analytical and experimental results are shown This work has demonstrated high L/Ds at Mach 2 2 for a structurally feasible arrow wing configuration (Author)

A76-47847 Future trends in aero gas turbine design I - Conventional engines R M Denning S C Miller, and G H Wright (Rolls Royce /1971/, Ltd , Aero Div , Derby, England) *Aeronautical Journal,* vol 80, Aug 1976, p 343 349

Single stage turbofan engines of high bypass ratio are compared and classified as the preferred design for aircraft cruising at high subsonic Mach numbers Specific fuel consumption is singled out as the most important criterion, in view of current fuel price trends, and attention is given to weight, noise, and exhaust pollution The turbine engines are grouped in three thrust size categories (1) large engines powering large aircraft including wide body craft, and delivering 40,000 lb thrust and over 189 kN, (2) intermediate engines delivering 15,000 to 30,000 lb thrust, or 65 to 135 kN, (3) small engines, including helicopter propulsion engines, delivering about 10,000 lb thrust and below 45 kN Space parts and maintenance costs, specific thrust, endurance, overall pressure ratio, and turbine entry temperature are also considered as criteria for comparisons R D V

A76-47848 An appraisal of present and future large commercial hovercraft. R L Wheeler (British Hovercraft Corp , Ltd , East Cowes, England) *Aeronautical Journal,* vol 80, Aug 1976, p 354 364 7 refs

Some commercial hovercraft, particularly those in service on English Channel short sea routes, are compared as to performance, powerplant, weight and dimensions, operating costs, and all weather capability Problems in model testing (towing tank, channels, basins, open sea) are taken up Power and fuel data and drag components (aerodynamic drag plus hydrodynamic drag, the latter including wakemaking drag, water wetting, overwave increment) are discussed Modular lengthening of hovercraft by addition of modular bays, and attendant problems, are described Some future large hovercraft projects, including surface effect ships for open seas operation in military or paramilitary service, are mentioned R D V

A76-47849 * Aeroelastic stability and control of an oblique wing R T Jones (NASA, Ames Research Center, Moffett Field, Calif) and J W Nisbet (Boeing Commercial Airplane Co , Seattle, Wash) *Aeronautical Journal,* vol 80, Aug 1976, p 365 369

Dynamic model tests were staged to compare the aeroelastic stability of a free flying oblique-winged aircraft and the known divergent instability characterizing swept forward wing configurations, to test the effect of wing elasticity on aileron control and trim The aircraft fuselage was clamped in some tests and left free to roll in others Two rigid wing panels were hinged near the wing center with elastic restraining springs It is found that the aeroelastic divergence affecting swept forward wings does not occur with an oblique wing, whose aeroelastic instability sets in at a dynamic pressure exceeding that for static divergence of swept-forward wings, and appears in the form of undamped oscillations Oblique wing stability is sensitive to the moment of inertia of the fuselage in roll Roll control and lateral which divergence of a clamped forward wing shows up R D V

A76-47868 Use of a laser energy source for the production of jet thrust (Ispol'zovanie lazernogo istochnika energii dlia sozdaniia reaktivnoi tiagi) F V Bunkin and A M Prokhorov (Akademiia Nauk SSSR, Fizicheskii Institut, Moscow, USSR) *Uspekhi Fizicheskikh Nauk,* vol 119, July 1976, p 425 446 26 refs In Russian

Physical principles of laser jet engines are examined In such engines, energy would be provided by a laser source located on the outside of the aircraft to be accelerated Two thrust producing mechanisms are considered vaporization of a target under the action of the incident laser radiation and an 'explosion' resulting from laser breakdown of air, which induces a shock wave that exerts pressure on the aircraft It is shown that the first mechanism could be used in both the atmosphere and space, while the second mechanism could be employed only in the atmosphere The main properties of an air breathing laser jet engine are outlined and experimental data verifying some of them are presented F G M

A76-47878 # Separated flow induced by trailing-edge flaps on delta wings at M = 8 2 D M Rao (National Aeronautical Laboratory, Bangalore, India) *Aeronautical Society of India, Journal,* vol 27, Feb 1975, p 17 21 7 refs Research supported by the Ministry of Technology of England

Flow separation phenomena on the wind ward surface of delta wings, caused by full span trailing edge flap deflection were studied in a 8-in-diam tunnel at Mach 8 2 Surface flow visualization, together with static pressure and overall aerodynamic load measurements were made on two models with 70 and 76-degree leading edge sweep angles respectively, at various incidence and flap deflection angles Some effects associated with the Reynolds number were also studied The overall forces with deflected flaps were compared with simple theoretical predictions, the salient features of three dimensional separation patterns are interpreted in an attempt to obtain a physical description of the flow field (Author)

A76-47879 # Transonic aerofoils - Advances in theory and design R C Lock *Aeronautical Society of India, Journal,* vol 27, Feb 1975, p 22-48 31 refs

The main achievements in two-dimensional aerodynamics during the last decade are summarized, with particular reference to theoretical research work One of the paramount achievements is seen in Sells' (1968) 'exact' numerical method for calculating plane subcritical flow past a lifting airfoil, which is based on the existence of a conformal mapping of the region exterior to the airfoil in the physical plane onto the interior of the unit circle in the working plane The importance of Sells' method is further emphasized in that some of the techniques employed have been adapted to the corresponding supercritical transonic flow problem Some landmarks of the effort of mathematicians to overcome the major difficulties involved in the transonic problem are examined, and design methods for supercritical airfoils are described V P

A76-47918 **Manufacture of gas turbine engine power shaft by induction brazing** J A Miller and J J O'Connor (Avco Corp , Avco Lycoming Div , Stratford, Conn) *(American Welding Society, International Brazing Conference, 7th, St Louis, Mo , May 10 14, 1976) Welding Journal,* vol 55, Oct 1976 p 832-837

Induction brazing development in the manufacture of absolutely reliable gas turbine engine power shafts is outlined along with cost effective nondestructive inspection techniques for the brazed joints with a high degree of confidence Twelve notches are machined in the end of the joint outer section to facilitate filler metal and flux flow during the brazing operation Ultrasonic inspection is found to produce the required confidence needed for the brazed joint system at reasonable cost A one to one facsimile printout is produced which provides a valuable tool for trouble shooting the brazing process The automatic induction equipment has reduced the reject rate from 15% to about 3% The induction silver-brazed shaft inspected by the ultrasonic technique has provided the required dependability, as 9000 shafts have so far successfully accumulated over 14 million engine hours S D

STAR ENTRIES

N76-32124*# Systems Research Labs Inc Newport News Va
THE EFFECT OF HELICOPTER MAIN ROTOR BLADE PHASING AND SPACING ON PERFORMANCE, BLADE LOADS, AND ACOUSTICS Final Report
Santu T Gangwani Washington NASA Sep 1976 100 p refs
(Contract NAS1-13705)
(NASA-CR-2737 SRL-3169-0014) Avail NTIS HC $5 00 CSCL 01A

The performance blade loads and acoustic characteristics of a variable geometry rotor (VGR) system in forward flight and in a pullup maneuver were determined by the use of existing analytical programs The investigation considered the independent effects of vertical separation of two three-bladed rotor systems as well as the effects of azimuthal spacing between the blades of the two rotors The computations were done to determine the effects of these parameters on the performance blade loads and acoustic characteristics at two advance ratios in steady-state level flight and for two different g pullups at one advance ratio To evaluate the potential benefits of the VGR concept in forward flight and pullup maneuvers the results were compared as to performance oscillatory blade loadings vibratory forces transmitted to the fixed fuselage and the rotor noise characteristics of the various VGR configurations with those of the conventional six-bladed rotor system Author

N76-32129*# Tennessee Univ Knoxville
EVALUATION OF TWO SWEPT-INFINITE-WING POTENTIAL/VISCOUS-FLOW COMPUTER PROGRAMS
Rao V Arimilli Aug 1976 23 p refs Sponsored by NASA
(NASA-CR-145037) Avail NTIS HC $3 50 CSCL 01A

Two computer programs capable of predicting the potential and viscous interacting flow around wings of infinite aspect ratio was evaluated The programs are compared in terms of their capabilities the approximations and the methods of solution used and the input requirements Six airfoils each representative of a class of airfoils are used as test airfoils The results predicted by the programs are presented for each airfoil at sweep angles of 0 20 and 40 degrees over a range of angles of attack The results show that at zero sweep both programs predicted the aerodynamic coefficients well and generally in good agreement with measurements At 20 and 40 degrees of sweep as there are no experimental data available definitive conclusions cannot be drawn about the accuracy of the predictions although the results are presented and discussed The execution times are approximately the same for the two programs Author

N76-32131*# Nielsen Engineering and Research Inc Mountain View, Calif
A COMPUTER PROGRAM TO CALCULATE THE LONGITUDINAL AERODYNAMIC CHARACTERISTICS OF WING-FLAP CONFIGURATIONS WITH EXTERNALLY BLOWN FLAPS Final Report
Michael R Mendenhall Frederick K Goodwin and Selden B Spangler Washington NASA Sep 1976 91 p refs
(Contract NAS1-13158)
(NASA-CR-2706) Avail NTIS HC $5 00 CSCL 01A

A vortex lattice lifting-surface method is used to model the wing and multiple flaps Each lifting surface may be of arbitrary planform having camber and twist, and the multiple-slotted trailing-edge flap system may consist of up to ten flaps with different spans and deflection angles The engine wakes model consists of a series of closely spaced vortex rings with circular or elliptic cross sections The rings are normal to a wake centerline which is free to move vertically and laterally to accommodate the local flow field beneath the wing and flaps The two potential flow models are used in an iterative fashion to calculate the wing-flap loading distribution including the influence of the waves from up to two turbofan engines on the semispan The method is limited to the condition where the flow and geometry of the configurations are symmetric about the vertical plane containing the wing root chord The calculation procedure starts with arbitrarily positioned wake centerlines and the iterative calculation continues until the total configuration loading converges within a prescribed tolerance Program results include total configuration forces and moments individual lifting-surface load distributions including pressure distributions individual flap hinge moments and flow field calculation at arbitrary field points Author

N76-32132*# Boeing Commercial Airplane Co Seattle Wash
TRANSONIC PRESSURE MEASUREMENTS AND COMPARISON OF THEORY TO EXPERIMENT FOR AN ARROW-WING CONFIGURATION
Marjorie E Manro Kenneth J R Manning Thomas H Hallstaff and John T Rogers Aug 1976 491 p refs
(Contract NAS1-12875)
(NASA-CR-2610 D6-42670-1 FAA-RD-76-72) Avail NTIS HC $12 50 CSCL 01A

A wind tunnel test of an arrow-wing-body configuration consisting of flat and twisted wings as well as a variety of leading- and trailing-edge control surface deflections was conducted at Mach numbers from 0 4 to 1 1 to provide an experimental pressure data base for comparison with theoretical methods Theory-to-experiment comparisons of detailed pressure distributions were made using current state-of-the-art attached and separated flow methods The purpose of these comparisons was to delineate conditions under which these theories are valid for both flat and twisted wings and to explore the use of empirical methods to correct the theoretical methods where theory is deficient The results are summarized Author

N76-32133*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
THE EFFECTS OF BLOWING OVER VARIOUS TRAILING-EDGE FLAPS ON AN NACA 0006 AIRFOIL SECTION, COMPARISONS WITH VARIOUS TYPES OF FLAPS ON OTHER AIRFOIL SECTIONS, AND AN ANALYSIS OF FLOW AND POWER RELATIONSHIPS FOR BLOWING SYSTEMS
Jules B Dods Jr and Earl C Watson Aug 1976 145 p refs Supersedes NACA-RM-A56C01
(NASA-TN-D-8293 A-6423 NACA-RM-A56C01) Avail NTIS HC $6 00 CSCL 01A

The results are presented of a two-dimensional investigation conducted to determine the effect of blowing over various types of trailing-edge flaps on a wing having the NACA 0006 airfoil section and a drooped-nose flap The position and profile of the trailing-edge flap the nozzle height and the location of the flap with respect to the nozzle were found to be important variables Data from many investigations were used to make an evaluation of the effects of blowing on lift An analysis was made of flow and power relationships for blowing systems Author

N76-32134*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
PERFORMANCE OF AN ISOLATED TWO-DIMENSIONAL WEDGE NOZZLE WITH FIXED COWL AND VARIABLE WEDGE CENTERBODY AT MACH NUMBERS UP TO 2 01
Donald L Maiden Washington Sep 1976 126 p refs
(NASA-TN-D-8218 L-10611) Avail NTIS HC $6 00 CSCL 01A

A wind tunnel investigation has been conducted to determine the aeropropulsion performance (thrust minus drag) of an isolated two-dimensional wedge nozzle with a simulated variable-wedge mechanism and a fixed cowl The investigation was conducted statically and at Mach numbers from 0 60 to 1 20 in the Langley 16-foot transonic tunnel and at a Mach number of 2 01 in the Langley 4-foot supersonic pressure tunnel The ratio of exhaust jet total pressure to free-stream static pressure was varied up to 27 depending on free-stream Mach number The results indicate that the aeropropulsion performance of the two-dimensional fixed-cowl variable-wedge nozzle is slightly lower (0 7 to 1 4 percent of ideal thrust) than that achieved for a two-dimensional wedge nozzle with a translating shroud although part of the difference in performance is attributed to internal-performance differences The effects of cowl boattail angle internal expansion area ratio, and wedge half-angle on the performance of the two-dimensional wedge nozzle are discussed Author

N76-32135# California Univ Davis
MAGNUS FORCES ON SPINNING SUPERSONIC CONES PART 1 THE INVISCID FLOW Final Report
B R Sanders and H A Dwyer Mar 1976 47 p refs
(Contract DAAD05-73-C-0039 DA Proj 1T1-61102-A-33H)
(AD-A022670 BRL-CR-292) Avail NTIS CSCL 20/4

The numerical solution of steady three-dimensional inviscid supersonic flows is applied to the calculation of Magnus forces on spinning cones at angle of attack The Magnus force is made up of several contributions the contribution due to the asymmetrical boundary-layer displacement-thickness interaction with the inviscid flow field is considered here Three-dimensional laminar boundary-layer solutions for the spinning cone were obtained by methods described in Part I of this paper The displacement-thickness contribution to the Magnus force is calculated by solving the complete inviscid flow field over body shapes obtained by adding the three-dimensional displacement thickness to the cone radius The gas dynamic equations are solved by applying MacCormack s second-order shock-capturing finite-difference technique Special precautions had to be taken in both finite differencing and in applying the surface boundary conditions to maintain enough significant digits in the pressure calculation since the Magnus force is as small as one part in three hundred of the normal force for some cases considered The displacement-thickness contribution to the Magnus force along with three other contributions described in Part I of this paper are summarized here in Part II The considerable cancellation effect observed among the four contributions shows that all of the components must be included if accurate predictions of the Magnus force are to be obtained Author (GRA)

N76-32139# Committee on Government Operations (U S House)
TRANSPORTATION OF HAZARDOUS MATERIALS BY AIR
Washington GPO 1976 96 p refs Hearing before a subcomm of the Comm on Govt Operations 94th Congr 1st Sess 8 Oct 1975
(GPO-62-325) Avail Comm on Govt Operations

Legislation enacted to protect the Nation adequately against the risks to life and property which are inherent in the transportation of hazardous materials in commerce is discussed Emphasis is placed on transportation of hazardous materials by air J M S

N76-32140* National Aeronautics and Space Administration Marshall Space Flight Center Huntsville Ala
AIRCRAFT-MOUNTED CRASH-ACTIVATED TRANSMITTER DEVICE Patent
Robert Manoli (Rockwell Intern Corp Downey Calif) and Bertram R Ulrich inventors (to NASA) (Rockwell Intern Corp Downey Calif) Issued 31 Aug 1976 7 p Filed 3 Oct 1974 Supersedes N74-34647 (12 - 24 p 2922) Continuation-in-part of abandoned US Patent Appl SN-307714 filed 17 Nov 1972 which is a continuation-in-part of abandoned US Patent Appl SN-82279 filed 20 Oct 1970
(NASA-Case-MFS-16609 3 US-Patent-3 978 410
US-Patent-Appl-SN-511894 US-Patent-Class-325-114,
US-Patent-Class-325-115 US-Patent-Class-325-186
US-Patent-Class-343-705 US-Patent-Appl-SN-307714
US-Patent-Appl-SN-82279) Avail US Patent Office CSCL 17C

An aircraft crash location transmitter tuned to transmit on standard emergency frequencies is reported that is shock mounted in a sealed circular case atop the tail of an aircraft by means of a shear pin designed to fail under a G loading associated with a crash situation The antenna for the transmitter is a metallic spring blade coiled like a spiral spring around the outside of the circular case A battery within the case for powering the transmitter is kept trickle charged from the electrical system of the aircraft through a break away connector on the case When a crash occurs the resultant ejection of the case from the tail due to a failure of the shear pin releases the free end of the antenna which automatically uncoils The accompanying separation of the connector effects closing of the transmitter key and results in commencement of transmission
Official Gazette of the U S Patent Office

N76-32142# Air Force Flight Dynamics Lab Wright-Patterson AFB Ohio
ANALYSIS OF SHOCK-ABSORBING CONCEPTS FOR BIRD-PROOF WINDSHIELDS OF ADVANCED AIR FORCE VEHICLES Final Report, Apr 1972 - Nov 1974
Werner R Jansen Feb 1976 284 p refs
(AF Proj 1368)
(AD-A023621 AFFDL-TR-74-155) Avail NTIS CSCL 01/2

Shock-absorbing windshields and mounting frames are required in advanced AF aircraft to permit mission continuance after a hit by a bird in low level high speed flight Analytical structural models of bird strike-proof high visibility window systems are optimized using existing glazing materials designs for realistic environmental conditions and the influencing factors of proposed shock absorbing mechanisms Theoretical results generated are compared with published experimental data Parametric studies of structural response due to impact loading and damping of dynamic stresses due to energy absorption were performed to provide preliminary design data for windscreen protection against bird strike Author (GRA)

N76-32143# Dayton Univ Research Inst Ohio Research Inst
BIRD IMPACT FORCES IN AIRCRAFT WINDSHIELD DESIGN Final Report, Jan - Jun 1975
Richard L Peterson and John P Barber Wright-Patterson AFB Ohio AFFDL Mar 1976 65 p refs
(Contract F33615-73-C-5027 AF Proj 2202 AF Proj 5027)
(AD-A023628 AFFDL-TR-75-150) Avail NTIS CSCL 01/2

In order to design transparent aircraft windshield and canopy panels which can withstand the impact of birds and at the same time meet other equally important operational requirements it is necessary to define the forces generated during the birdstrike event The total force as a function of time was measured by impacting birds onto a large diameter Hopkinson bar The local pressures and pressure distribution during the bird impact were measured by flush mounting piezo-electric pressure transducers in a heavy rigid flat plate and impacting the plate/transducer assembly The forces and pressures are a function of the relative impact velocity and angle the weight and average density of the bird and the stiffness of the impacted structure In order to define the temporal and spatial distribution of the bird impact forces a parametric bird/plate impact test program was initiated These tests cover a velocity range from 30 m/s to 350 m/s impact angles from 15 to 90 deg in trajectory and bird weights from 0 05 kg to 3 6 kg The results at the 90 deg test angle indicate that (1) Birds behave essentially as a fluid during impact (2) Birds do not bounce at impact -- the impulse is equal to the initial impact momentum (3) The high-frequency component of pressure superimposed on the base pressure-time pulse is caused by breakup of the bird flesh and inhomogeneities in the bird and (4) The duration of loading is approximately equal to the squash up time GRA

N76-32144# National Transportation Safety Board Washington D C Bureau of Aviation Safety
ANNUAL REVIEW OF AIRCRAFT ACCIDENT DATA US GENERAL AVIATION CALENDAR YEAR 1974

31 Jan 1976 198 p
(PB-252606/9 NTSB-ARG-76-1) Avail NTIS HC $7 50 CSCL 01B

The Annual Review of Aircraft Accident Data is a statistical compilation published by the National Transportation Safety Board The publication contains statistical information compiled from reports of 4425 general aviation accidents that occurred during the calendar year 1974 Included in the total number of accidents are 59 collisions between aircraft By coding each aircraft involved in the collisions an additional 59 records are produced bringing the total accidents records to 4484 This figure reflects the true number of pilots and aircraft involved in the accidents

Author (GRA)

N76-32146*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
THE DESIGN, DEVELOPMENT, AND FLIGHT TEST RESULTS OF THE BOEING 737 AIRCRAFT ANTENNAS FOR THE ICAO DEMONSTRATION OF THE TRSB MICROWAVE LANDING SYSTEM
Thomas G Campbell William E White and Melvin C Gilreath 17 Aug 1976 96 p refs
(NASA-TM-X-73943) Avail NTIS HC $5 00 CSCL 17G

The Research Support Flight System a modified Boeing 737 was used to evaluate the performance of several aircraft antennas and locations for the Time Reference Scanning Beam (TRSB) Microwave Landing System (MLS) These tests were conducted at the National Aviation Facilities Experimental Center (NAFEC) Atlantic City New Jersey on December 18 1975 The flight tests measured the signal strength and all pertinent MLS data during a straight-in approach a racetrack approach and ICAO approach profiles using the independent antenna-receiver combinations simultaneously on the aircraft Signal drop-outs were experienced during the various approaches but only a small percentage could be attributed to antenna pattern effects

Author

N76-32178*# McDonnell Aircraft Co St Louis Mo
WIND TUNNEL AND GROUND STATIC INVESTIGATION OF A LARGE SCALE MODEL OF A LIFT/CRUISE FAN V/STOL AIRCRAFT
2 Aug 1976 413 p refs
(Contract NAS2-8655)
(NASA-CR-137916 MDC-A4318) Avail NTIS HC $11 00 CSCL 01C

An investigation was conducted in a 40 foot by 80 foot wind tunnel to determine the aerodynamic/propulsion characteristics of a large scale powered model of a lift/cruise fan V/STOL aircraft The model was equipped with three 36 inch diameter turbotip X376B fans powered by three T58 gas generators The lift fan was located forward of the cockpit area and the two lift/cruise fans were located on top of the wing adjacent to the fuselage The three fans with associated thrust vectoring systems were used to provide vertical and short takeoff and landing capability For conventional cruise mode operation only the lift/cruise fans were utilized The data that were obtained include lift drag longitudinal and lateral-directional stability characteristics and control effectiveness Data were obtained up to speeds of 120 knots at one model height of 20 feet for the conventional aerodynamic lift configuration and at several thrust vector angles for the powered lift configuration

Author

N76-32180*# Martin Marietta Corp Denver Colo
X-24C RESEARCH VEHICLE
Oct 1974 82 p refs Sponsored in part by NASA and AF
(NASA-CR-148832 M-74-9) Avail NTIS HC $5 00 CSCL 01C

A group of experiments that might be accomplished on the X-24C research vehicle are discussed indicating in each case the technology development needed to ready the experiments for flight and also indicating interface problems between the vehicle and the experiment Experiments that could be cheaply done using test platforms other than the X-24C have been eliminated Experiments that are clearly applicable only to the X-24C research vehicle are of course included Experiments that might be accomplished on either the X-24C or some other platform requiring further investigation concerning proper applicability are included for consideration

Author

N76-32181*# Boeing Commercial Airplane Co Seattle Wash
THE 737 GRAPHITE COMPOSITE FLIGHT SPOILER FLIGHT SERVICE EVALUATION Annual Report, Jul 1973 - Mar 1975
Robert L Stoecklin May 1975 39 p refs
(Contract NAS1-11668)
(NASA-CR-132663 AR-1) Avail NTIS HC $4 00 CSCL 01C

The flight service experience of 108 graphite-epoxy spoilers on 737 transport aircraft and related ground-based environmental exposure of graphite-epoxy material specimens were evaluated Four spoilers were installed on each of 27 aircraft for a 5-year study As of February 28 1975 a total of 294 280 spoiler flight-hours and 460 696 spoiler landings were accumulated Based on visual ultrasonic and destructive testing no moisture migration into the honeycomb core and no core corrosion has occurred Tests of removed spoilers and of ground-based exposure specimens after the first year of service indicate no significant changes in composite strength

Author

N76-32182*# Boeing Co Wichita Kans
EVALUATION OF LOW WING-LOADING FUEL CONSERVATIVE, SHORT-HAUL TRANSPORTS
L H Pasley and T A Waldeck 1976 305 p refs
(Contract NAS1-13714)
(NASA-CR-145041) Avail NTIS HC $9 75 CSCL 01C

Fuel conservation that could be attained with two technology advancements Q fan propulsion system and active control technology (ACT) was studied Aircraft incorporating each technology were sized for a Federal Aviation Regulation (FAR) field length of 914 meters (3 000 feet) 148 passengers and a 926 kilometer (500 nautical mile) mission The cruise Mach number was 70 at 10100 meter (33 000 foot) altitude The improvement resulting from application of the Q fan propulsion system was computed relative to an optimized fuel conservative transport design The performance improvements resulting from application of ACT technology were relative to the optimized Q fan propulsion system configuration

Author

N76-32183# Advisory Group for Aerospace Research and Development Paris (France)
ADVANCES IN ENGINE BURST CONTAINMENT AND FINITE ELEMENT APPLICATIONS TO BATTLE-DAMAGED STRUCTURE
Sep 1976 22 p refs Presented at 42d Struct and Mater Panel Meeting, Ottawa Apr 1976
(AGARD-R-648) Avail NTIS HC $3 50

Two papers dealing with protection systems for aircraft against damage arising from the impact of a variety of projectiles such as military weapons and debris from engine disintegration were presented

N76-32184 Boeing Co Seattle Wash
ADVANCES IN ENGINE BURST CONTAINMENT
R J Bristow C D Davidson and J H Gerstle *In* AGARD Advan in Eng Burst Containment and Finite Elem Appl to Battle-Damaged Struct Sep 1976 p 1-6

A partial review of recent research performed into the application of fragment impact studies leading to an understanding of engine burst fragment impacts and the initial development of an engine burst containment system using duPont Kevlar material were described All test work to date has involved translational accelerators The program has not yet resulted in a satisfactory containment system In addition to a summary of program accomplishments several areas where unexpected results occurred and where information was obtained that may influence future fragment containment efforts were discussed One of these areas involves spinning fragments None of the predicted adverse effects on Kevlar fabric was found Another area concerns thermal effects It was found that the efficiency of the barrier in stopping fragments was influenced by the temperature of the Kevlar Author

N76-32185 Naval Surface Weapons Center White Oak Md
FINITE ELEMENT APPLICATIONS TO BATTLE DAMAGED STRUCTURE
Pao C Huang *In* AGARD Advan in Eng Burst Containment and Finite Elem Appl to Battle-Damaged Struct Sep 1976 p 7-16 refs

A Patching Technique for the development of a finite element model truly representing a battle-damaged aircraft was introduced The applications of the preprocessors Ping and Bing to the automatic generation of input data for NASTRAN analyses are also briefly shown Finally the importance of modeling technique is addressed Author

N76-32192*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
DURABILITY OF ZIRCONIA THERMAL-BARRIER CERAMIC COATINGS ON AIR-COOLED TURBINE BLADES IN CYCLIC JET ENGINE OPERATION
Curt H Liebert, Richard E Jacobs Stephan Stecura and C Robert Morse Washington Sep 1976 17 p refs
(NASA-TM-X-3410 E-8700) Avail NTIS HC $3 50 CSCL 21E

Thermal barrier ceramic coatings of stabilized zirconia over a bond coat of Ni Cr Al Y were tested for durability on air cooled turbine rotor blades in a research turbojet engine Zirconia stabilized with either yttria magnesia or calcia was investigated On the basis of durability and processing cost the yttria stabilized zirconia was considered the best of the three coatings investigated Author

N76-32193# Ohio State Univ Research Foundation Columbus
GAS TURBINE TRANSPIRATION COOLING RESEARCH PART 1 AN EXPERIMENTAL STUDY OF TURBINE AIRFOIL WAKES AS INFLUENCED BY UPSTREAM NOZZLE VANES Final Report, 1 Jan 1973 - 30 Sep 1975
Wesley R Cox and L S Han Wright-Patterson AFB Ohio AFAPL Nov 1975 172 p refs
(Contract F33615-73-C-2033 AF Proj 3066)
(AD-A023445 OSURF-3611-IF-Pt-1 AFAPL-TR-76-2-Pt-1) Avail NTIS CSCL 21/5

An experimental study was made of the effects of stationary upstream wakes on the static pressure distribution and wake profiles of a downstream cascade of turbine blade models The most significant cyclic static pressure changes on the downstream airfoils were found to take place along the suction surface and near the stagnation region of an instrumented airfoil The wake minimum velocity was found to be displaced toward the suction side of the airfoil by the addition of an upstream cascade although no significant change was found to occur when the relative position of the cascades was changed The results suggest that an upstream cascade may effectively be modeled as an increase in free-stream turbulence for predicting its effects on the downstream wakes GRA

N76-32195# Aeronautical Systems Div Wright-Patterson AFB Ohio
A MULTI-VARIABLE CONTROL FOR THE F100 ENGINE OPERATING AT SEA LEVEL STATIC Technical Report Jan - Jun 1975
Marc S Weinberg Nov 1975 47 p refs
(AD-A022699 ASD-TR-75-28) Avail NTIS CSCL 21/5

This report describes a multi-variable control for the F100 engine operating at sea level static It represents one phase of an in house effort to develop practical applications of modern control theory to gas turbine engines GRA

N76-32196# Naval Air Development Center Warminster Pa Air Vehicle Technology Dept
LIFT FAN PROPULSION CONCEPTS STUDY Interim Report, Mar 1975 - Feb 1976
Donald P Gleiter 25 Mar 1976 49 p refs
(WF41411000)
(AD-A023087 NADC-76079-30) Avail NTIS CSCL 21/5

Contractor s conceptual designs of multimission lift fan VSTOL aircraft based on two different fan designs one with a tip-turbine drive and one with a mechanical drive were compared to determine the more suitable propulsion system for a Navy ASW aircraft with an initial operational capability in 1985 The comparison was based on consideration of propulsion system performance propulsion-induced effects propulsion system effects on flying qualities and control system design aircraft mission performance propulsion system cost aircraft reliability and maintainability and propulsion system vulnerability The mechanically-driven fans were found to be more suitable primarily because of differences in mission performance and cost However it was determined that aircraft could be designed to meet Navy mission requirements using either fan design An aircraft design based on the mechanically-driven fan concept was optimized to an ASW mission for comparison with the contractor s multimission aircraft It was found that the contractor s takeoff gross weight estimates accurately represented an aircraft optimized for the ASW mission Author (GRA)

N76-32198# Air Force Aero Propulsion Lab Wright-Patterson AFB Ohio
DUMP DIFFUSER INLET PROGRAM Final Report, Sep 1972 - Apr 1973
M Brian Bergsten Feb 1976 127 p refs
(AF Proj 3012)
(AD-A023404 AFAPL-TR-75-33) Avail NTIS CSCL 21/5

In an investigation of variable geometry inlets and nozzles for application to integral rocket ramjet engines one of the inlet concepts included a variable ramp which produced a discontinuity in the diffuser region unless a trailing flap was used The purpose of the program described herein was to evaluate the effect of this discontinuity and provide information for determining whether or not the added complexity and weight of a trailing flap would be required to obtain acceptable inlet performance The approach undertaken was an experimental program in the Mach 3 wind tunnel with an inlet model incorporating a variable dump diffuser The model was designed with interchangeable components to provide numerous configurations GRA

N76-32203*# McDonnell Aircraft Co St Louis Mo
EXPANSION OF FLIGHT SIMULATOR CAPABILITY FOR STUDY AND SOLUTION OF AIRCRAFT DIRECTIONAL CONTROL PROBLEMS ON RUNWAYS, PHASE 1 Final Report
15 Mar 1975 109 p refs
(Contract NAS1-13378)
(NASA-CR-145084 MDC-A3304) Avail NTIS HC $5 50 CSCL 14B

The MCAIR five-degree-of-freedom motion-base simulator (MBS) was used in combination with a six-degree-of-freedom aircraft mathematical model to demonstrate the simulation adequacy on uncrowned runways under various conditions Known aircraft parameters were used where possible to increase program credibility Tire-runway friction models were coordinated with personnel of NASA Langley Research Center The F-4 experienced pilots representing NASA FAA and USAF participated in the 130 approach-touchdown-rollout demonstration and verified the simulation adequacy Author

N76-32251*# Princeton Univ N J Dept of Aerospace and Mechanical Sciences

IMPACT OF COMPOSITE PLATES ANALYSIS OF STRESSES AND FORCES Final Report, May 1974 - Aug 1975

F C Moon B S Kim and S R Fang-Landau Jan 1976 111 p refs

(Grant NGR-31-001-267)

(NASA-CR-134999 AMS-1298) Avail NTIS HC $5 50 CSCL 11D

The foreign object damage resistance of composite fan blades was studied Edge impact stresses in an anisotropic plate were first calculated incorporating a constrained layer damping model It is shown that a very thin damping layer can dramatically decrease the maximum normal impact stresses A multilayer model of a composite plate is then presented which allows computation of the interlaminar normal and shear stresses Results are presented for the stresses due to a line impact load normal to the plane of a composite plate It is shown that significant interlaminar tensile stresses can develop during impact A computer code was developed for this problem using the fast Fourier transform A marker and cell computer code were also used to investigate the hydrodynamic impact of a fluid slug against a wall or turbine blade Application of fluid modeling of bird impact is reviewed Author

N76-32333# Analytical Sciences Corp , Reading Mass

ENERGY MANAGEMENT TECHNIQUES FOR FUEL CONSERVATION IN MILITARY TRANSPORT AIRCRAFT Final Report, 6 Jan 1975 - 6 Feb 1976

Robert F Stengel and Fred J Marcus Wright-Patterson AFB Ohio AFFDL Feb 1976 222 p refs

(Contract F33615-75-C-3039, AF Proj 1987)

(AD-A023527 TASC-TR-545-1 AFFDL-TR-75-156) Avail NTIS CSCL 21/4

This report presents the results of an investigation of energy management techniques for fuel conservation in a large transport aircraft the USAF C-141A Using the methods of optimal control theory and numerical simulation, fuel-optimal flight paths are computed and compared with conventional vertical profiles for typical mission scenarios Algorithms for on-board guidance to minimize fuel use are synthesized and evaluated and functional requirements for system implementation are developed Concepts for flight testing this throttle/energy management technique are presented GRA

N76-32576# Technische Hogeschool Delft (Netherlands) Dept of Aeronautical Engineering

PREDICTION OF FATIGUE CRACK PROPAGATION IN AIRCRAFT MATERIALS UNDER VARIABLE-AMPLITUDE LOADING

J Schijve Mar 1975 27 p refs Presented at ASTM Symp on Fatigue Crack Growth Under Spectrum Loads Montreal 23-24 Jun 1975

(VTH-193) Avail NTIS HC $4 00

Loads in service are first discussed after which various types of variable-amplitude loading as applied in test programs are surveyed The various phenomenological aspects of fatigue damage associated with fatigue cracks are indicated Interaction effects between cycles of different magnitudes are defined Methods for measuring interaction effects examples of interaction effects and possible explanations are reviewed This includes both tests with simple types of variable-amplitude loading (overloads and step loading) and more complex load-time histories (program loading random load and flight-simulation loading) New evidence on crack closure is presented Various types of prediction methods are discussed Author

N76-32583# Aeronautical Research Inst of Sweden Stockholm

INFLUENCE OF DETECTED CRACK LENGTH AT INSPECTIONS ON PROBABILITY OF FATIGUE FAILURE OF WING PANEL

Sigge Eggwertz 1975 35 p refs

(FFA-HU-1745-Pt-2 ICAF-834) Avail NTIS HC $4 00

A statistical model for evaluating the probability of fatigue failure of a wing panel subjected to regular inspections was established where stochastic variation of the maximum load fatigue life to crack initiation residual static strength and crack length at detection, is taken into account In a numerical analysis five different distribution functions for the crack length at detection were introduced These distributions range in effectiveness from conditions met in laboratory inspection to scheduled service inspection Two different assumptions concerning the reduction of the residual static strength were studied The results are given in two tables and three diagrams, which show a considerable influence of the inspection effectiveness especially for long service lives and inspection intervals exceeding 1 000 flights The reduction in probability of failure due to crack stoppers is also large for longer service lives except where the inspection effectivity is very high Author

N76-32599# Aeronautical Systems Div Wright-Patterson AFB Ohio

THERMAL BUCKLING OF UNIFORM RECTANGULAR PLATES Final Technical Report, Sep 1974 - Jun 1975

Robert E Kielb Feb 1976 89 p refs

(AD-A023472 ASD-TR-75-37) Avail NTIS CSCL 20/11

The extensive utilization of light-weight alloys in many structures such as aircraft ships and nuclear powerplants necessitates a thorough analysis of the load-deformation relationships of the structural components Of these relationships the problem of instability is among the more difficult and interesting ones to analyze For high temperature environments the instability due to thermal expansion becomes more important and compelling from a safety and performance standpoint Elastic instability phenomena of two basic structural elements rods (columns) and plates have been extensively studied in the past fifty years and are well documented insofar as the current status is concerned The analysis of column instability and post-instability is generally considered complete except for the inelastic behavior of the material For plate structures the analysis has not reached the same level of completeness Exact solutions have not been available for certain loading and boundary conditions The purpose of this report is to present the exact solution for the thermal buckling of uniform rectangular plates The solutions are presented for all possible combinations of simply supported and clamped edge conditions This filled a void existing in plate buckling analysis Author (GRA)

N76-32601# Air Force Flight Dynamics Lab Wright-Patterson AFB Ohio

LOW AND HIGH FREQUENCY AIRCRAFT GUNFIRE VIBRATION PREDICTION AND LABORATORY SIMULATION Final Report, 1 Oct 1972 - 11 Dec 1974

Robert W Sevy and Elbert E Ruddell Dec 1975 219 p refs (AF Proj 329A)

(AD-A023619 AFFDL-TR-74 123) Avail NTIS CSCL 20/11

This study describes in-house efforts with two primary objectives (1) Generation of a gunfire-induced vibration prediction model that defines the equipment vibration spectrum in terms of four low frequency sinusoidals superimposed on a high frequency random vibration field and (2) Synthesis of an economic laboratory test method by which the spectral characteristics of the prediction model are simulated In the process a flexible prediction function is introduced to the technology as a p omising vehicle through which more accurate and realistic vibration fields might be predicted and portrayed in the future A gunblast power model is invoked from previous work that relates vibration magnitude and spectral character of the aircraft structural response to the gun power parameters and the distance separating the equipment from the gun muzzles The test method development necessitated modification of existing commercial vibration equipment resulting in general improvement of the vibration system as a whole The prediction technique and test method developed in this program is being integrated into MIL-STD-810C and will appear as Method 519 2 GRA

N76-32971*# Bolt Beranek and Newman Inc Cambridge Mass
DATA ANALYSIS AND NOISE PREDICTION FOR THE QF-1B EXPERIMENTAL FAN STAGE
D B Bliss K L Chandiramani and A G Piersol Aug 1976 118 p refs
(Contract NAS3-19426)
(NASA-CR-135066 BBN-3338) Avail NTIS HC $5 50 CSCL 20A

The results of a fan noise data analysis and prediction effort using experimental data obtained from tests on the QF-1B research fan are described Surface pressure measurements were made with flush mounted sensors installed on selected rotor blades and stator vanes and noise measurements were made by microphones located at the far field Power spectral density analysis time history studies and calculation of coherence functions were made The emphasis of these studies was on the characteristics of tones in the spectra The amplitude behavior of spectral tones was found to have a large often predominant random component suggesting that turbulent processes play an important role in the generation of tonal as well as broadband noise Inputs from the data analysis were used in a prediction method which assumes that acoustic dipoles produced by unsteady blade and van forces are the important source of fan noise Author

N76-32972*# Boeing Commercial Airplane Co Seattle Wash
STATIC AND WIND TUNNEL NEAR-FIELD/FAR-FIELD JET NOISE MEASUREMENTS FROM MODEL SCALE SINGLE-FLOW BASELINE AND SUPPRESSOR NOZZLES VOLUME 1 NOISE SOURCE LOCATIONS AND EXTRAPOLATION OF STATIC FREE-FIELD JET NOISE DATA
C L Jaeck Sep 1976 184 p refs
(Contract NAS2-8213)
(NASA-CR-137913 D6-44121-1-Vol-1) Avail NTIS HC $7 50 CSCL 20A

A test was conducted in the Boeing Large Anechoic Chamber to determine static jet noise source locations of six baseline and suppressor nozzle models and establish a technique for extrapolating near field data into the far field The test covered nozzle pressure ratios from 1 44 to 2 25 and jet velocities from 412 to 594 m/s at a total temperature of 844 K Author

N76-32973*# National Aeronautics and Space Administration Flight Research Center Edwards Calif
MEASURED NOISE REDUCTIONS RESULTING FROM MODIFIED APPROACH PROCEDURES FOR BUSINESS JET AIRCRAFT
Frank W Burcham Jr Terrill W Putnam Paul L Lasagna and O Owen Parish Nov 1975 31 p refs
(NASA-TM-X-56037) Avail NTIS HC $4 00 CSCL 20A

Five business jet airplanes were flown to determine the noise reductions that result from the use of modified approach procedures The airplanes tested were a Gulfstream 2 JetStar Hawker Siddeley 125-400 Sabreliner-60 and LearJet-24 Noise measurements were made 3 5 and 7 nautical miles from the touchdown point In addition to a standard 3 deg glide slope approach a 4 deg glide slope approach a 3 deg glide slope approach in a low-drag configuration and a two-segment approach were flown It was found that the 4 deg approach was about 4 EPNdB quieter than the standard 3 deg approach Noise reductions for the low-drag 3 deg approach varied widely among the airplanes tested with an average of 8 5 EPNdB on a fleet-weighted basis The two-segment approach resulted in noise reductions of 7 to 8 EPNdB at 3 and 5 nautical miles from touchdown but only 3 EPNdB at 7 nautical miles from touchdown when the airplanes were still in level flight prior to glide slope intercept Pilot ratings showed progressively increasing workload for the 4 deg low-drag 3 deg and two-segment approaches Author

N76-32974*# United Technologies Research Center East Hartford Conn
ACOUSTIC RADIATION AND SURFACE PRESSURE CHARACTERISTICS OF AN AIRFOIL DUE TO INCIDENT TURBULENCE Final Report
Robert W Paterson Washington NASA Sep 1976 106 p refs
(Contract NAS1-13823)
(NASA-CR-2733) Avail NTIS HC $5 50 CSCL 20A

A theoretical and experimental investigation of the noise and unsteady surface pressure characteristics of an isolated airfoil in a uniform mean velocity homogeneous nearly-isotropic turbulence field was conducted Wind tunnel experiments were performed with a 23 cm chord two dimensional NACA 0012 airfoil over a free stream Mach number range of 0 1 to 0 5 Far-field noise spectra and directivity were measured in an anechoic chamber that surrounded the tunnel open jet test section Spanwise and chordwise distribution of unsteady airfoil surface pressure spectra and surface pressure cross-spectra were obtained Incident turbulence intensities length scales spectra and spanwise cross-spectra required in the calculation of far-field noise and surface pressure characteristics were also measured Author

N76-33131# Committee on Science and Technology (U S House)
THE FUTURE OF AVIATION, VOLUME 1
Washington GPO 1976 110 p refs Rept for Comm on Sci and Technol 94th Congr , 2d Sess Oct 1976
(GPO-72-600) Avail SOD HC $1 40

A number of findings and recommendations relative to the future of the aviation industry in the United States are presented These are primarily focussed on the following points oriented on the need to (1) maintain the U S preeminence in aeronautics (2) set-up a national civil R and D policy (3) restructure and reorient government sponsored R and D and demonstration programs and activities with those related to other modes of transportation (4) accelerate application of new technology (5) expand federally-sponsored civil R and D and demonstration efforts to compensate for reduced military fall-out (6) improve ability of U S air carriers to purchase new equipment, (7) have the Department of Transportation act as a focus for civil aviation R and D (8) setting-up a strong centralized policy-level authority (9) assist the U S aircraft industry in developing new generation aircraft (10) reduce the recent emphasis on joint ventures with foreign manufacturers through some form of government assistance (11) increase operating efficiency of aircraft Y J A

N76-33132# Committee on Science and Technology (U S House)
THE FUTURE OF AVIATION, VOLUME 2
Washington GPO 1976 105 p refs Compilation of papers for Comm on Sci and Technol 94th Congr 2d Sess , Oct 1976
(GPO-77-667) Avail SOD HC $1 35

A number of papers intended to support The future of aviation Volume 1 are presented These deal with the organization for aviation and a description of the R & D facilities of FAA and NASA Y J A

N76-33133*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
EXPERIMENTAL EFFECTS OF FUSELAGE CAMBER ON LONGITUDINAL AERODYNAMIC CHARACTERISTICS OF A SERIES OF WING-FUSELAGE CONFIGURATIONS AT A MACH NUMBER OF 1 41
Samuel M Dollyhigh Odell A Morris and Mary S Adams Washington Oct 1976 27 p refs
(NASA-TM-X-3411 L-10847) Avail NTIS HC $4 00 CSCL 01A

An experimental investigation was conducted to evaluate a method for the integration of a fighter-type fuselage with a theoretical wing to preserve desirable wing aerodynamic characteristics for efficient maneuvering The investigation was conducted by using semispan wing fuselage models mounted on a splitter plate The models were tested through an angle of attack range at a Mach number of 1 41 The wing had a leading edge sweep angle of 50 deg and an aspect ratio of 2 76 the wing camber surface was designed for minimum drag due to lift and was to be self trimming at a lift coefficient of 0 2 and at a Mach number of 1 40 A series of five fuselages of various camber was tested on the wing Author

N76-33134*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
PASSENGER RIDE COMFORT TECHNOLOGY FOR TRANSPORT AIRCRAFT SITUATIONS
William Conner and Ira D Jacobson Oct 1976 24 p refs
(NASA-TM-X-73953) Avail NTIS HC $3 50 CSCL 05E

Research in ride comfort and of the resultant technology is overviewed Several useful relations derived from the technology are input environments to the vehicle aircraft operations and aircraft configurations Input environments which influence the ride motion environment consist of naturally occuring phenomena such as gusts or turbulence and man generated phenomena such as trailing vortex wakes or runway roughness Aircraft operations influence ride environments in the form of motions caused by maneuvers of pressure changes caused by rapid descents or of too high temperature Aircraft configurations influence the ride environment by size and shape of external surfaces which generate aerodynamic perturbing forces by onboard equipment such as power plant noise and vibrations and by passive equipment which directly interfaces the passengers such as marginal size seats with limited elbowroom and legroom S M

N76-33136*# Scientific Translation Service Santa Barbara Calif
A CRITIQUE OF TRANSONIC AEROFOIL TESTING TECHNIQUES
M Bazin R Bernard-Guelle and J Ponteziere Washington NASA 26 Oct 1976 49 p refs Transl into ENGLISH from Aeronaut Astronaut (Paris) no 31 1971 p 69-76 and no 32 1971 p 41-52 Presented at the 7th Appl Aerodynamic Colloq of the AFITAE Lyon France 4-5 Nov 1970
(Contract NASw-2791)
(NASA-TT-F-17251) Avail NTIS HC $4 00 CSCL 01A

Research on new transonic airfoil sections in two dimensional wind tunnel flow is being reported The Modane set-up is harnessed to industrial uses It is suited for tests on large scale models over an extensive Reynolds number range Experiments on helicopter blade members of equal chord with the rotor blades tested in the S1MA tunnel provided a basis for comparison of two dimensional flow and rotor The R1 tunnel was the scene of systematic investigations into wall interactions as the key to a full knowledge of the aerodynamic coefficients The first results suggest some correctives to testing conditions in this wind tunnel Author

N76-33143*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
THEORETICAL AND EXPERIMENTAL STUDY OF TWISTED AND CAMBERED DELTA WINGS DESIGNED FOR A MACH NUMBER OF 3 5
Russell B Sorrells III and Emma Jean Landrum Washington Aug 1976 238 p
(NASA-TN-D-8247 L-10823) Avail NTIS HC $8 00 CSCL 01A

Data are provided for the evaluation of the aerodynamic performance of a series of twisted and cambered delta wings designed for a Mach number of 3 5 Systematic force and pressure data are also presented for comparison with theory Force tests were made at Mach numbers of 2 3 3 0 3 5 4 0 and 4 6 Design lift coefficients of 0 0 and 0 1 were employed on the 55 deg and 68 deg sweep wings and design lift coefficients of 0 0 0 05 and 0 1 were employed on the 76 deg sweep wings Pressure tests were conducted on the 55 deg and 76 deg sweep flat wings and on the 0 1 design lift coefficient 76 deg sweep wing The results indicate that for the sweep angles tested an increase in the zero lift pitching moment coefficient is the primary benefit of twist and camber at a Mach number of 3 5 Comparison of the experimental results with results obtained from several lift theories indicates that the Carlson Middleton linear theory method gave the best overall agreement The pressure data indicate however that there is a cancellation of error at high angle of attack where the lower surface pressures are significantly underpredicted over the inboard region of the wing and where the upper and lower surface pressures are overpredicted over the outboard region of the wing Author

N76-33149# Royal Aircraft Establishment, Farnborough (England) Structures Dept
MEASUREMENTS IN LOW-SPEED FLOW OF UNSTEADY PRESSURE DISTRIBUTIONS ON A RECTANGULAR WING WITH AN OSCILLATING CONTROL SURFACE
D A Drane London Aeron Res Council 1976 45 p refs Supersedes RAE-TR-70182 RAE-TR-71113 ARC-33080 ARC-33515
(ARC-R/M-3763 RAE-TR-70182 RAE-TR-71113 ARC-33080 ARC-33515) Avail NTIS HC$4 00 HMSO £3 50 PHI

An experiment made jointly by an Anglo-French team to determine unsteady pressure distributions and forces on a low speed ratio wing with an oscillating control surface is described Two series of tests were made in the RAE 5-ft-low-speed wind tunnel at frequency parameters between 0 73 and 8 45 The pressure measuring installations were of two types one consisted of a number of individual transducers the other employed a series of tubes connected to a single transducer via a pressure switch The results were compared with calculations based on methods developed at RAE and ONERA The tests showed that the measuring systems provided results which were in themselves consistent there were however disparities between upper and lower surface oscillatory pressure distributions which made comparisons between theory and experiment difficult
Author (ESA)

N76 33150# British Aircraft Corp London (England)
EVALUATION OF PRESSURE DISTRIBUTIONS ON THIN WINGS WITH DISTORTED CONTROL SURFACES OSCILLATING HARMONICALLY IN LINEARISED, COMPRESSIBLE, SUBSONIC FLOW PART 1 DETAILS OF THE PRESSURE DISTRIBUTIONS, AND A SET OF NUMERICAL RESULTS INCLUDING COMPARISONS WITH EXPERIMENT
W R Marchbank Aeron Res Council 1976 77 p refs Supersedes ARC-35831
(ARC R/M-3783 ARC-35831) Avail NTIS HC $5 00 HMSO £4 50 PHI

Details of a method which allows the calculation of converged pressure distributions are presented The local loading solutions, which were developed from the original work of Landhal were used to extract the discontinuous part of the boundary conditions associated with oscillating control surfaces The resulting regularized problem was then solved using a lifting surface collocation procedure giving together with the local solutions the required pressure distribution Results using the current theory for a rectangular wing and two swept tapered wings are compared with experiment and other theoretical methods, including the long established equivalent modes' technique Author (ESA)

N76-33154# Martin Marietta Aerospace Orlando Fla
AERODYNAMIC METHODOLOGY BODIES WITH TAILS AT ARBITRARY ROLL ANGLES (TRANSONIC AND SUPERSONIC) Final Report
Gennaro F Aiello Apr 1976 282 p refs
(Contract DAAH01-74-C-0621)
(AD-A023425, OR-14145) Avail NTIS CSCL 20/4

Development and use of empirical methods to predict aerodynamic characteristics of missile body-tail configurations are described Methods cover the Mach number range of 0 6 to 3 0 Prediction methods cover the individual body and tail bend characteristics over the angle of attack range from 0 to 180 degrees For body-tail configurations at arbitrary roll angles the applicable angle of attack range is 0 to 45 degrees All mutual interference effects are accounted for allowing accurate prediction of forces and center of pressure Author (GRA)

N76-33158# Rockwell International Science Center Thousand Oaks Calif
WAVE INTERACTIONS IN TRANSONIC AND HYPERSONIC FLOW Final Scientific Report, 1 Dec 1970 - 30 Nov 1975
Norman D Malmuth Jan 1976 12 p refs
(Contract F44620-71-C-0021)
(AD-A023189 SC506 8FR AFOSR-76-0040TR SR-1) Avail NTIS CSCL 20/4

Studies in the transonic and hypersonic regime of nonlinear flows are summarized In the approximation of weak three-dimensionality area rules have been developed which predict aerodynamic efficiencies of flat top conical wingbody combinations consisting of conically subsonic conical bodies mounted on the windward side of hypersonic delta wings Investigations of the pressure fields and shock waves over these combinations are discussed from the stand-point of cross-flow stagnation singularities The generalization of these results to non-conical supersonic conical bodies is also indicated For the former an extended area rule has been derived indicating that the increment in lift due to body addition depends on an area progressing at successive reflection of a two-dimensional disturbance emanating from the body with the shock Upper bounds for L/D benefits and optimum fuselage shaping are indicated In the case of conically supersonic conical bodies the subcritical area rule is demonstrated to remain valid Pressure fields for this class of configurations reveal a wave train structure The reflection coefficients intensity and number of reflections are quantified in terms of the supercriticality of the secondary leading edge For the aspect of the research dealing with transonic flow asymptotic results for the far field derived for supercritical jet flaps subject to solid tunnel wall interference are also discussed Author (GRA)

N76-33161# Air Force Inst of Tech Wright-Patterson AFB Ohio School of Engineering
A WIND TUNNEL STUDY OF THE EFFECTS OF TRAILING EDGE MODIFICATIONS ON THE LIFT-DRAG RATIO OF A CIRCULATION CONTROLLED AIRFOIL M S Thesis
Vayl S Oxford Dec 1975 68 p refs
(AD-A023356 GAE/AE/75D-16) Avail NTIS CSCL 01/1

Wind tunnel tests were conducted to determine the effects of trailing edge modifications on the lift-to-drag ratio of a circulation controlled airfoil The model was a 20 percent thick five percent cambered elliptical airfoil The airfoil was modified in aft contour blowing slot position and blowing angle A 1 5 inch splitter plate was mounted at the 99 percent chord for all tests The tests were run at a Reynolds number based on model chord of 741 000 while the angle of attack and blowing rate were varied during each test sequence GRA

N76-33162# Naval Postgraduate School Monterey Calif
THE OSCILLATING JET FLAP
Max F Plater 5 Mar 1976 43 p refs Presented at Short Course on High Lift Technol Tennessee Univ Space Inst Tullahoma 1975
(AD-A022768 NPS-57P176031) Avail NTIS CSCL 01/3

This document is the written version of a lecture presented in the 1975 Short Course on High Lift Technology at the University of Tennessee Space Institute GRA

N76-33163# Air Force Inst of Tech Wright-Patterson AFB Ohio
AN ANALYTIC AND EXPERIMENTAL STUDY OF THE EFFECTS OF SPLITTER PLATE POSITION ON THE TRAILING EDGE MODIFICATIONS OF A CAMBERED CIRCULATION CONTROLLED ELLIPTICAL AIRFOIL M S Thesis
Richard K DeJonckheere Dec 1975 86 p refs
(AD-A023354 GAE/AE/75D-12) Avail NTIS CSCL 01/1

Wind tunnel tests were conducted to determine the effects of splitter plate position on trailing edge modifications of a circulation controlled airfoil Analytic studies were conducted to determine the feasibility of using a potential flow computer program to predict the results of the wind tunnel tests The airfoil model was elliptical in shape 20 percent thick and had five percent camber It employed a blowing slot for circulation control and a splitter plate for reduction in mixing losses Modifications included slot positions on the upper surface of 96 and 97 percent chord slot angles of 5 and -33 degrees, circular and elliptic aft contours and splitter plate positions on the lower surface of 99 and 95 3 percent chord Tests were conducted at a Reynolds number of 740 thousand and blowing momentum coefficients of zero and 0 03 GRA

N76-33165*# Scientific Translation Service Santa Barbara Calif
TECHNOLOGIES FOR THE AIR TRANSPORT OF TOMORROW
P Poisson-Quinton Washington NASA Sep 1976 63 p refs Transl into ENGLISH of French Rept ONERA TP-1975 62 1975
(Contract NASw-2791)
(NASA-TT-F-17177) Avail NTIS HC $4 50 CSCL 01C

A review of technologies essential to the future cost effective development and implementation of large transport aircraft is presented Emphasis is placed upon the importance of improved methods of design optimization and qualification testing including ground and flight simulation techniques Progress in optimization of lift-drag ratios through reduction of transonic drag skin friction drag induced drag wave drag and casing/motor interference drag is discussed The task of developing turbofan engines to meet requirements for economical operation while minimizing noise by use of acoustic insulation and appropriate flight procedures is described The application of new construction techniques and the use of composites to reduce construction and maintenance costs are considered together with advancements in systems integration and avionics Author

N76-33167# National Transportation Safety Board Washington D C Bureau of Aviation Safety
BRIEFS OF ACCIDENTS INVOLVING TURBINE POWERED AIRCRAFT US GENERAL AVIATION 1974
15 Dec 1975 67 p
(PB-250514/7 NTSB-AMM-75-14) Avail NTIS HC $4 50 CSCL 01B

General aviation turbine powered aircraft accidents occurring in 1974 are reported Included are 100 accident briefs 26 of which involved fatal accidents A brief format of the facts conditions circumstances, and probable cause(s) for each accident are presented Additional statistical information was tabulated by type of accident phase of operation injury index aircraft damage pilot certificate injuries and cause/factor(s) Author (GRA)

N76-33168# National Transportation Safety Board Washington D C Bureau of Aviation Safety
BRIEFS OF ACCIDENTS INVOLVING AERIAL APPLICATION OPERATIONS US GENERAL AVIATION 1974
15 Dec 1975 325 p
(PB-250520/4 NTSB-AMM-75-22) Avail NTIS HC $9 75 CSCL 01B

The publication contains reports of U S general aviation accidents occurring in 1974 The brief format presents the facts conditions circumstances and probable cause(s)/factor(s) for each accident Additional statistical information is tabulated by type of accident phase of operation injury index, aircraft damage, pilot certificate injuries and causal/factor(s) GRA

N76-33169# National Transportation Safety Board, Washington D C Bureau of Aviation Safety
BRIEFS OF ACCIDENTS INVOLVING MISSING AND MISSING LATER RECOVERED AIRCRAFT US GENERAL AVIATION 1974
15 Dec 1975 106 p
(PB-250516/2 NTSB-AMM-75-18) Avail NTIS HC $5 50 CSCL 01B

For abstract, see N76-33168

N76-33170# National Transportation Safety Board, Washington D C Bureau of Aviation Safety
BRIEFS OF ACCIDENTS INVOLVING AMATEUR/HOME BUILT AIRCRAFT US GENERAL AVIATION 1974
15 Dec 1975 84 p
(PB-250517/0, NTSB-AMM-75-20) Avail NTIS HC $5 00 CSCL 01B
For abstract see N76-33168

N76-33171# National Transportation Safety Board Washington D C Bureau of Aviation Safety
BRIEFS OF ACCIDENTS INVOLVING AIR TAXI OPERATIONS US GENERAL AVIATION 1974
15 Dec 1975 122 p refs
(PB-250518/8 NTSB-AMM-75-21) Avail NTIS HC $5 50 CSCL 01B
For abstract see N76-33168

N76-33172# Air Force Weapons Lab Kirtland AFB N Mex
EVALUATION OF THE BIRD-AIRCRAFT STRIKE HAZARDS AT SEYMOUR JOHNSON AFB, NORTH CAROLINA Final Report
John P Nemergut Rutherford C Wooten Jr , and Robert O Collum Mar 1976 40 p refs
(AD-A023222 AFWL-TR-75-161) Avail NTIS CSCL 01/2
A serious bird-aircraft strike hazard potential exists at Seymour-Johnson Air Force Base North Carolina The three problem areas involve flight routes to and at the Dare County Gunnery Range the base airdrome, and birds roosting in fixed facilities adjacent to the runways Five National Wildlife Refuges in the area surrounding the gunnery range provide suitable habitat for waterfowl shorebirds and seabirds Measures to reduce the hazard potential include (1) determination and avoidance of airspace of known waterfowl concentrations shorebird and seabird activity (2) reducing the attractiveness of environmental features in the airbase environment (3) population reduction within the fixed facilities and (4) dispersal of starlings from the airfield using starling distress calls GRA

N76-33173# Air Force Weapons Lab Kirtland AFB, N Mex
RADAR INVESTIGATIONS OF THE BAT HAZARD TO HIGH PERFORMANCE AIRCRAFT AT RANDOLPH AFB, TEXAS Final Report
L C Ireland, V A Harris S S Ireland T C Williams, and J M Williams Mar 1976 69 p refs
(AD-A024500 AFWL-TR-75-146) Avail NTIS CSCL 01/2
During the months of April through October Mexican free-tailed bats (Tadarida brasiliensis mexicana) are a major cause of T-38 engine failures at Randolph AFB Texas The airborne behavior of T b mexicana emerging from and returning to the Bracken cave near Randolph AFB was observed with both search and height-finding radars Radar echoes from dense groups of bats covered areas as large as 500 sq km and rose to altitudes of over 3,000 m Evening bat flights appeared to have three distinct phases of development exit from the roost and ascent transition to level flight and dispersal In the dispersal phase the bats usually traveled directly toward Randolph AFB Bat flights may be grouped into three types on the basis of their vertical distribution One type characterized by flight at low altitude was usually observed on nights when T-38s were damaged A bat avoidance program based on real time radar observations, was initiated at Randolph AFB during the summer of 1971 and continued thru 1974 Since the start of the program, the frequency of strikes has decreased It appears possible to predict nights when bat strikes are most likely to occur 24 hours in advance Strobe lights were found to be an ineffective bat deterrent GRA

N76-33186*# Lockheed-Georgia Co , Marietta
TECHNICAL AND ECONOMIC ASSESSMENT OF SPAN-DISTRIBUTED LOADING CARGO AIRCRAFT CONCEPTS Final Report, 26 Mar - 16 Aug 1976
William M Johnston John C Muehlbauer Roy R Eudaily Ben T Farmer John F Monrath, and Sterling G Thompson Aug 1976 127 p refs
(Contract NAS1-14383)
(NASA-CR-145034 LG76ER0013) Avail NTIS HC $6 00 CSCL 01C
A 700,000 kg (1 540 000-lb) aircraft with a cruise Mach number of 0 75 was found to be optimum for the specified mission parameters of a 272 155-kg (600 000-lb) payload a 5560-km (3000-n mi) range, and an annual productivity of 113 billion revenue-ton km (67 billion revenue-ton n mi) The optimum 1990 technology level spanloader aircraft exhibited the minimum 15-year life-cycle costs direct operating costs, and fuel consumption of all candidate versions Parametric variations of wing sweep angle, thickness ratio rows of cargo, and cargo density were investigated The optimum aircraft had two parallel rows of 2 44 x 2 44-m (8 x 8-ft) containerized cargo with a density of 160 kg/cu m (10 lb/ft 3) carried throughout the entire 101-m (331-ft) span of the constant chord, 22-percent thick, supercritical wing Additional containers or outsized equipment were carried in the 24 4-m (80-ft) long fuselage compartment preceding the wing Six 284 000-N (64 000-lb) thrust engines were mounted beneath the 0 7-rad (40-deg) swept wing Flight control was provided by a 36 6-m (120-ft) span canard surface mounted atop the forward fuselage by rudders on the wingtip verticals and by outboard wing flaperons Author

N76-33187# National Aviation Facilities Experimental Center Atlantic City, N J
ABBREVIATED FULL-SCALE FLIGHT TEST INVESTIGATION OF THE LOCKHEED L1011 TRAILING VORTEX SYSTEM USING TOWER FLY-BY TECHNIQUE Final Report, Jun 1972
Leo J Garodz May 1976 220 p refs
(AD-A028095/8, FAA NA-75-14 FAA-AFS-1-76-2) Avail NTIS HC $8 00 CSCL 01/3
A brief flight test program was conducted to investigate the time-history characteristics of the vortex system of a Lockheed L1011 airplane in terminal area-type operations using a 140-foot high instrumented tower Vortex rotational flow velocities were measured by hot-film anemometers vortex flow visualization--as outlined by tower-mounted smoke grenades--was documented and meteorological data were recorded The test results showed that (1) the L1011 vortex system was more persistent and intense than that of other heavy jet transport (300 000 lb) aircraft (2) vortex dissipation was due primarily to vortex breakdown (bursting) (3) vortex core diameters were on the average about 5 4, and 2 feet in diameter for the landing approach and takeoff configurations, respectively (4) peak recorded tangential velocities were 126 135, and 224 feet per second for these same respective configurations (5) vortex lateral movement in-ground effect was approximately (pi/6 6)b above ground level and (6) average vortex descent velocities approached 6 feet per second out of ground effect Author

N76-33188# Committee on Appropriations (U S Senate)
F-18 NAVY AIR COMBAT FIGHTER
Washington GPO 1975 111 p Hearings on H R 9861 before a subcomm of the Comm on Appropriations 94th Congr 1st Sess , 21 Oct 1975
(GPO-60-913) Avail Comm on Appropriations
The controversy surrounding the selection of the F-18 is discussed along with a cost estimate for the F-18 the lack of commonality with the Air Force F-16, and the capability of the F-18 vis-a-vis the F-14 J M S

N76-33189*# National Aeronautics and Space Administration Langley Research Center Langley Station, Va
A SEAT CUSHION TO PROVIDE REALISTIC ACCELERATION CUES FOR AIRCRAFT SIMULATORS
Billy R Ashworth Sep 1976 22 p refs
(NASA-TM-X-73954) Avail NTIS HC $3 50 CSCL 14B
A seat cushion to provide acceleration cues for aircraft simulator pilots was built, performance tested and evaluated The four cell seat using a thin air cushion with highly responsive pressure control, attempts to reproduce the same events which occur in an aircraft seat under acceleration loading The pressure controller provides seat cushion responses which are considered adequate for current high performance aircraft

simulations The initial tests of the seat cushions have resulted in excellent pilot opinion of the cushion s ability to provide realistic and useful cues to the simulator pilot Author

N76-33190*# National Aeronautics and Space Administration *Ames Research Center, Moffett Field, Calif*
STUDY OF A VERY LOW COST AIR COMBAT MANEUVERING TRAINER AIRCRAFT
Gary C Hill and Jeffrey V Bowles Aug 1976 29 p refs
(NASA-TM-X-73162 A-6724) Avail NTIS HC $4 00 CSCL 01C

A very low cost aircraft for performing Air Combat Maneuvering (ACM) training was studied using the BD-5J sport plane as a point of departure The installation of a larger engine and increased fuel capacity were required to meet the performance and mission objectives Reduced wing area increased the simulation of the ACM engagement and a comparison with current tactical aircraft is presented Other factors affecting the training transfer are considered analytically, but a flight evaluation is recommended to determine the concept utility Author

N76-33191# Army Aeromedical Research Lab Fort Rucker Ala
VISIBLE AND NEAR INFRARED SPECTRAL TRANSMISSION CHARACTERISTICS OF WINDSCREENS IN ARMY AIRCRAFT Final Report
Wun C Chiou Feb 1976 20 p refs
(AD-A022769 USAARL-76-14) Avail NTIS CSCL 01/3

The increasing application of electro-optical devices such as night vision goggles as aids in night flight demands a prerequisite evaluation of the optical quality and the visual detection thresholds of those devices when they operate through the aircraft windscreen This report presents an analysis of the spectral transmission characteristics from 360 to 1080 nm spectral range of sixteen Army aircraft windscreen samples The samples were from six fixed wing and seven rotary wing aircraft windscreens GRA

N76-33192# Air Force Inst of Tech Wright-Patterson AFB Ohio School of Engineering
WIND TUNNEL TEST OF A TWIN-ENGINED CANARD CONFIGURATED MINI-REMOTELY PILOTED VEHICLE M S Thesis
Charles D Catoe Sep 1975 98 p refs
(AD-A023359 GAE/AE/75S-10) Avail NTIS CSCL 01/3

Many military applications are being found for small remotely piloted vehicles (Mini-RPVs) Professor Harold C Larsen of the Air Force Institute of Technology (AFIT) has designed one such RPV Under his direction a team of AFIT graduate students have studied and developed his preliminary design From this design an aircraft has been built and flown Flights of the original aircraft pointed out the need for larger engines and increased elevator power The aircraft was redesigned by decreasing wing camber increasing elevator size and replacing the original 1 2 BHP engines with 2 BHP engines A 1/3 scale wind tunnel model was modified to incorporate these design changes Tests were made in the AFIT five-foot wind tunnel to determine static stability and control characteristics of the modified aircraft This study included testing of the yaw, pitch and roll axis characteristics Limitations of the three component balance in the wind tunnel necessitated testing in each of the individual axes separately GRA

N76-33194# Air Force Flight Dynamics Lab Wright-Patterson AFB Ohio
EXPERIMENTAL AND THEORETICAL CONTROL SURFACE CHARACTERISTICS ON LOW ASPECT RATIO DELTA WING VEHICLES AT SUBSONIC MACH NUMBERS Final Report, May 1973 - Feb 1975
Peter R Gord Dec 1975 147 p refs
(AF Proj 1366)
(AD-A023408 AFFDL-TR-75-90) Avail NTIS CSCL 01/3

An experimental study was conducted to determine the characteristics of control surfaces on low aspect ratio delta wings at subsonic Mach numbers Included were parametric studies on control surface span chord and position, all of which were shown to have a significant effect on control surface performance Comparisons were made with several low speed theories and it was demonstrated that the vortex lattice theoretical approach provided an effective means of calculating control surface characteristics on both the study models and on several realistic configurations including the X-24B and two early advanced air defense interceptor concepts GRA

N76-33197# Southwest Research Inst San Antonio, Tex
ENERGY-ABSORBING MATERIALS FOR IMPROVING HELICOPTER CRASHWORTHINESS Final Report
C E Kimball and R C DeHart Mar 1976 25 p ref
(Contract N00014-70-C-0265, SwRI Proj 03-2801)
(AD-A023006) Avail NTIS CSCL 01/3

The purpose of the program was to identify materials which were not only suitable for structural components but were capable of absorbing energy at acceptable deceleration levels in a crash environment After review of available materials for their energy absorption capability five candidate materials were selected and a test program initiated to demonstrate their attenuation properties Those selected were three types of honeycomb, a rigid foam and a flexible foam GRA

N76-33199# General Dynamics/Fort Worth Tex
INTEGRATION OF HYBRID STRUCTURE INTO LOW-COST AIRCRAFT DESIGN RATIONALE AND METHODOLOGY Final Report, 1 Dec 1974 - 30 Jun 1975
T E Brents and J H Bridges Wright-Patterson AFB Ohio AFFDL Dec 1975 350 p refs
(Contract F33615-75-C-3029 AF Proj 1207)
(AD-A023416 AFFDL-TR-75-124) Avail NTIS CSCL 01/3

This report contains the rationale and methodology for using a blend of advanced metallics and advanced composites in the design of low-cost low-weight aircraft A systems engineering approach is developed via an example using a previously designed fighter aircraft as a baseline The criteria for improvement is low life-cycle-costs for derivatives of the baseline aircraft that meet the specific performance measures The rationale and methodology displayed pertains to the use of structural materials and associated manufacturing processes for airframe construction The emphasis is on cost related decisions made during the conceptual design phase This report contains a description of the salient properties of materials typical material applications and a description of the manufacturing processes associated with the materials The rationale and methodologies described can be used for conceptual design of all types of aircraft The specific results obtained are indicative of the value of advanced metallics and advanced composites From a cost viewpoint it is concluded that research and development of both advanced metallics and advanced composites should be continued Author (GRA)

N76-33200# Textron Inc Buffalo N Y Bell Aerospace Div
TESTS OF THE BELL AEROSPACE LA-4 ACLS FITTED WITH SUCTION BRAKING AND PREDICTIONS FOR OTHER AIRCRAFT Final Report, Jan - May 1975
T D Earl C L Stauffer and C E Satterlee Nov 1975 54 p refs
(Contract F33615-75 C-3038)
(AD-A023850 AFFDL-TR-75-135) Avail NTIS CSCL 01/2

A test program was conducted by Textron s Bell Aerospace Company using their air cushion landing system (ACLS) equipped Lake LA-4 aircraft to investigate the potential of a suction braking ACLS subsystem The new braking subsystem was tried on dry and wet runway and rough grass Deceleration up to 0 5g was recorded with the suction flow available The potential of a developed system applied to a cushion planform designed to utilize suction braking exceeds this range and the report predicts effective potential application to the C-130 Jindivik and XC-8A GRA

N76-33201# Boeing Vertol Co Philadelphia Pa
ADVANCED HELICOPTER STRUCTURAL DESIGN INVESTIGATION VOLUME 2 DESIGN APPLICATION STUDY FOR FREE PLANET TRANSMISSIONS Final Report, Jun 1974 - May 1975

John C Mack and William Rumberger Mar 1976 81 p refs (Contract DAAJ02-74-C-0066 DA Proj 1F2-62208-AH-90) (AD-A024478 D210-10965-2 USAAMDRL-TR-75-56B-Vol-2) Avail NTIS CSCL 01/3

The free planet gear drive was applied to the requirements of the Medium-Range Utility Transport Helicopter Design studies showed potential advantages for the free planet drive as compared to conventional planetary systems used hitherto Recommendations were made that existing free planet hardware be further tested to better define load-carrying capability and system reliability Author (GRA)

N76-33202# General Dynamics/Convair San Diego, Calif
DEVELOPMENT OF PREDICTION TECHNIQUES FOR AERODYNAMIC LOADS ACTING ON EXTERNAL STORES Final Report
Maurice B Sullivan Nov 1975 333 p refs
(Contract F33615-73-C-3011 AF Proj 1367)
(AD-A021435 AFFDL-TR-73-126) Avail NTIS CSCL 01/1

A preliminary design technique for the prediction of aerodynamic loads acting on external stores has been established through an empirical correlation of wind tunnel results obtained on a scale model of the F-111 Approximately 30 000 engineering data points were surveyed for various combinations of external stores These data originally stored on magnetic tape were transferred to CDC 6600 disk packs This was done to reduce the amount of computer run time required to collect the desired samples of data For this study, correlations were performed of each aerodynamic component of load or moment acting on a particular store grouping as a function of various geometry parameters The work was accomplished primarily through the utilization of numerical programs in which, through a series of trial and error calculations an equation composed of various key geometry parameters was generated The equations obtained for the numerical programs predict normal force side force pitching moment yawing moment and rolling moment for various external store arrangements GRA

N76-33206*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
EFFECTS OF LONG-CHORD ACOUSTICALLY TREATED STATOR VANES ON FAN NOISE 2 EFFECT OF ACOUSTICAL TREATMENT
James H Dittmar, James N Scott Bruce R Leonard and Edward G Stakolich Washington Oct 1976 99 p refs
(NASA-TN-D-8250 E-8736) Avail NTIS HC $5 00 CSCL 21E

A set of long chord stator vanes was designed to replace the vanes in an existing fan stage The long chord stator vanes consisted of a turning section and axial extension pieces all of which incorporated acoustic damping material The long chord stator vanes were tested in two lengths, with the long version giving more noise reduction than the short primarily because of the additional lining material The noise reduction achieved with the acoustically treated long chord stator vanes was compared with the reduction achieved by an acoustically treated exhaust splitter The long chord stator was at least as good as the splitter as a method for incorporating acoustic lining material In addition comparing an acoustic three ring inlet and an acoustic wall-only inlet discloses that the wall-only inlet could be used in an engine where the noise reduction requirements are not too stringent Author

N76-33207*# Scientific Translation Service Santa Barbara, Calif
CHOICE OF COMPRESSOR PRESSURE RATIO OF SMALL GAS TURBINES PLACED IN A BYPASS ENGINE DUCT
B D Fishbeyn Washington NASA Oct 1976 13 p refs Transl into ENGLISH from Izvestiya vysshikh uchebnykh zavedeniy, aviatsionnaya tekhnika (USSR) no 1 Jan 1966 p 78-85
(Contract NASw-2791)
(NASA-TT-F-17280) Avail NTIS HC $3 50 CSCL 21E

The bypass engine scheme with small gas turbine was studied It is found that a two duct engine with small gas turbine in the outer duct increases the thrust of ordinary bypass engines up to Mach numbers of 2 8 Author

N76-33208*# General Applied Science Labs Inc Westbury N Y
EFFECT OF INLET TEMPERATURE AND PRESSURE ON EMISSIONS FROM A PREMIXING GAS TURBINE PRIMARY ZONE COMBUSTOR Final Report
Gerald Roffe Washington NASA Sep 1976 48 p refs
(Contract NAS3-18563)
(NASA-CR-2740 GASL-TR-227) Avail NTIS HC $4 00 CSCL 21E

Experiments were conducted to determine the performance of a premixing prevaporizing gas turbine primary zone combustor design over a range of combustor inlet temperatures from 700 to 1000 K and a range of inlet pressures from 40 to 240 N/sq cm The 1 meter long combustor could be operated at pressures up to and including 120 N/sq cm without autoignition in the premixing duct or flashback from the stabilized combustion zone Autoignition occurred in the mixer tube at the 240 N/sq cm pressure level with an entrance temperature of 830 K and a mixer residence time of 4 msec Measured NOx level combustion inefficiency, and hydrocarbon emission index correlated well with adiabatic flame temperature The NOx levels varied from approximately 0 2 to 2 0 g NO2/kg fuel at combustion inefficiencies from 4 to 0 04 percent depending upon adiabatic flame temperature and pressure Measured NOx levels were sensitive to pressure Tests were made at equivalence ratios ranging from 0 35 to 0 65 The overall total pressure drop for the configuration varied slightly with reference velocity and equivalence ratio but never exceeded 3 percent Author

N76-33209# AiResearch Mfg Co , Phoenix Ariz
DETERMINATION OF EFFECTS OF AMBIENT CONDITIONS ON AIRCRAFT ENGINE EMISSIONS ENGINE TESTING VOLUME 1 GTCP 85 APU, TPE 331 TURBOPROP Final Report, 20 Dec 1974 - 20 Dec 1975
Gerrick A Slogar Mar 1976 182 p 2 Vol
(Contract EPA-68-03-2156)
(PB-252825/5 Rept-75-311636-1
EPA-460/3-76-009-a-Vol-1) Avail NTIS HC $7 50 CSCL 13B

Full scale engine tests were conducted on a GTCP85-98CK auxiliary power unit and a TPE331-251M turboprop engine Exhaust emission of HC CO CO2 NOx and smoke was measured at controlled (temperature humidity, and pressure) engine inlet conditions The data provide a data base for the determination of the effects of ambient conditions on gas turbine engines GRA

N76-33210# AiResearch Mfg Co Phoenix Ariz
DETERMINATION OF EFFECTS OF AMBIENT CONDITIONS ON AIRCRAFT ENGINE EMISSIONS ENGINE TESTING VOLUME 2 GTCP 85 APU, TPE 331 TURBOPROP Final Report, 20 Dec 1974 - 20 Dec 1975
Gerrick A Slogar and R C Holder Mar 1976 301 p refs 2 Vol
(Contract EPA-68-03-2156)
(PB-252826/3 Rept-75-311636-2
EPA-460/3-76-009-b-Vol-2) Avail NTIS HC $9 75 CSCL 13B

For abstract see N76-33210

N76-33211# Westinghouse Electric Corp Lima Ohio
AC POWER CONTROLLERS FOR B-1 FLIGHT TESTS PART 1 DESIGN, DEVELOPMENT, FABRICATION AND TESTING OF HYBRID POWER CONTROLLERS Final Report, Jan 1974 - Sep 1975
W W Billings Sep 1975 148 p refs
(Contract F33615-73-C-2082 AF Proj 3145)
(AD-A022616 AFAPL-TR-75-68-Pt-1) Avail NTIS CSCL 01/3

Fifty-nine solid state power controllers have been developed fabricated and tested These hybrid devices are rated at 1 5 A/230 V/400 Hz provide the control-protect-indicate functions are hermetically sealed and are packaged in a flight worthy configuration Significant tests performed are EMI temperature-altitude random vibration and load-life Details on the design assembly, testing and reliability analysis are included in this report In a separate volume is the Radiation Hardening Report Classified Part II Author (GRA)

N76-33212*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
FLIGHT DATA IDENTIFICATION OF SIX DEGREE-OF-FREEDOM STABILITY AND CONTROL DERIVATIVES OF A LARGE CRANE TYPE HELICOPTER
Robert L Tomaine (USAAMRDL Hampton Va) Sep 1976 55 p refs
(NASA-TM-X-73958) Avail NTIS HC $4 50 CSCL 01C

Flight test data from a large crane type helicopter were collected and processed for the purpose of identifying vehicle rigid body stability and control derivatives The process consisted of using digital and Kalman filtering techniques for state estimation and Extended Kalman filtering for parameter identification utilizing a least squares algorithm for initial derivative and variance estimates Data were processed for indicated airspeeds from 0 m/sec to 152 m/sec Pulse doublet and step control inputs were investigated Digital filter frequency did not have a major effect on the identification process, while the initial derivative estimates and the estimated variances had an appreciable effect on many derivative estimates The major derivatives identified agreed fairly well with analytical predictions and engineering experience Doublet control inputs provided better results than pulse or step inputs Author

N76-33213*# Kanner (Leo) Associates Redwood City Calif
REALIZATION OF FAILURE DETECTION IN DIGITAL FLIGHT CONTROL SYSTEMS
K D Holle Washington NASA Oct 1976 14 p Transl into ENGLISH of 'Realisierung der Ausfallerkennuns in Digitalen Flugregler Deut Forsch - und Versuchsanstalt fuer Luft- und Ramfahrt E V Ueberlingen 1974 p 1-12
(Contract NASw-2790)
(NASA-TT-F-17277) Avail NTIS HC $3 50 CSCL 01C

An outline is given of the methods used for failure detection in the Honeywell 316, which is used for flight control in the HFV 320 Hansa-Jet The circuitry which monitors the redundant subsystems is illustrated, and the way it reacts to malfunctions is described Methods are shown for monitoring such devices as adders DACs and ADCs and for monitoring memory Author

N76-33214# Army Materiel Systems Analysis Agency Aberdeen Proving Ground, Md
EFFECT OF GUN PULSE ON HELICOPTER ATTITUDES
R R Oehrli Feb 1976 39 p ref
(DA Proj 1R7-65706-M-541)
(AD-A023461 AMSAA-TR-154) Avail NTIS CSCL 01/2

Computer programs have been devised to calculate both steady state pitch attitude and dynamic pitch response to a pulse gun-initiated moment of a typical helicopter It is shown that for large fixed gun pulses the resulting motions may be difficult to control A critical condition is the ability to hold position and attitude at hover GRA

N76-33215# Air Force Inst of Tech Wright-Patterson AFB Ohio School of Engineering
THE INFLUENCE OF ROLL, PITCH, AND YAW RATE PERTURBATIONS ON THE ALPHA-BETA STABILITY ENVELOPE OF THE F-4D AIRCRAFT M S Thesis
Douglas R Withers Jr Jan 1976 108 p refs
(AD-A023216) Avail NTIS CSCL 01/1

A study was made of the influence of pitch roll and yaw rate perturbations on an alpha-beta stability envelope of the F-4D aircraft The nonlinear equations of motion were integrated numerically and the motion analyzed for stability The stability criteria were adapted from MIL-F-8785B(ASG) Military Specification - Flying Qualities of piloted Airplanes Equilibrium conditions were perturbed and the stability analyses revealed two characteristic motions The stable motion was a yaw divergence with a minor roll oscillation Whereas the unstable motion was a divergence in roll The aircraft appears to enter a steep rolling dive GRA

N76-33218# National Aviation Facilities Experimental Center Atlantic City N J
EFFECTIVENESS OF A PILOT GROUND TRAINER AS A PART TASK INSTRUMENT FLIGHT RULES FLIGHT-CHECKING DEVICE STAGE 2 Final Report, Sep 1974 - Sep 1975
Robert J Ontiveros Jun 1976 66 p refs
(FAA Proj 184-530-000)
(AD-A026754/2 FAA-NA-75-60 FAA-RD-76-72) Avail NTIS HC $4 50 CSCL 05/9

The second stage of a two stage experiment was conducted to determine if a pilot ground trainer (PGT) could be used to flight check instrument pilot applicants on instrument approaches in lieu of performing these tasks in an aircraft on their initial instrument flight check Based on the comparative PGT and aircraft performance scores of a control and experimental group the results of Stage II indicate that an appropriately equipped PGT may be used to flight check instrument pilot applicants on the automatic direction finder very high frequency omni-directional radio range and instrument landing system approaches Equipment and capabilities required for the ground trainer to be effective as a part task flight checking device for accomplishing these tasks are listed Significant differences between PGT and aircraft performance scores are discussed Factors contributing to the performance differences are identified Author

N76-33221*# Kanner (Leo) Associates Redwood City Calif
TWO-DIMENSIONAL AIRFOIL TEST FACILITY IN THE MODANE-AVRIEUX S3 BLOWDOWN WIND TUNNEL
M Bazin Washington NASA Oct 1976 25 p refs Transl into ENGLISH of ONERA Report NT-203 Office Natl d Etudes et de Recherches Aerospatiales Paris Oct 1972 p 1-15
(Contract NASw-2790)
(NASA-TT-F-17253) Avail NTIS HC $3 50 CSCL 14B

A device for two dimensional airfoil profile testing in the transonic test section of the S3 blowdown wind tunnel was designed and built Airfoils up to 0 3 m chord length were studied by pressure measurements up to 0 95 Mach with stagnation pressure from 1 2 to 4 0 bar The Reynolds number can be varied up to 15,000 000 at Mach 0 95 The main features of the device are outlined and its various components described, including a 0 78 x 0 56 m test section with horizontal perforated walls rotating supports for angle of attack variations from -35 to +215 deg mobile rake for wake pressure survey and models with wall pressure taps The method and means for data acquisition are given along with the aerodynamic characteristics of the test device The visualization methods are described and improvements are suggested Author

N76-33328# Air Force Materials Lab Wright-Patterson AFB Ohio
MEASUREMENTS OF STRESS CORROSION CRACKS IN ALUMINUM ALLOY DCB SPECIMENS USING AN ULTRASONIC PULSE-ECHO TECHNIQUE Final Technical Report, Jan - Jul 1975
Peter J Blau and Walter M Griffith Jan 1976 42 p refs
(AF Proj 7351)
(AD-A023185 AFML-TR-75-200) Avail NTIS CSCL 01/3

This program evaluated a non-destructive ultrasonic method for monitoring crack growth rate Alumimum alloy test specimens were used to calibrate the equipment and to assess the measurement accuracy and reproducibility Together the optical and ultrasonic techniques could lead to a more accurate assessment of stress corrosion crack growth in aerospace alloys through obtaining a truer picture of interior crack front shapes GRA

N76-33228# Stanford Research Inst, Menlo Park Calif
ENVIRONMENTALLY COMPATIBLE AIRCRAFT CRASH AND RESCUE TRAINING FACILITIES Final Report, 1976
R S Alger, S B Martin, and A E Lipska 24 Oct 1975 59 p refs
(Contract N60921-75-C-0184)
(AD-A024503 NSWC/WOL/TR-75-205) Avail NTIS CSCL 01/2

With the increasing sophistication of aircraft has come a corresponding increase in payload of weapons fuel and cargo which is reflected in a potential increase in accidents and fires This report is concerned with development of training facilities and techniques to enhance the capability of firemen in coping with their fires while still maintaining a reasonable level of environmental impact Training objectives are reviewed and evaluation criteria are discussed Location and operation of training facilities are analyzed from a cost - effectiveness viewpoint Three levels of training are described It is concluded that the essential facilities can be realized within the environmental constraints but additional cost-benefit analysis is recommended
Author (GRA)

N76-33332# Advisory Group for Aerospace Research and Development Paris (France)
THE THEORY, SIGNIFICANCE AND PREVENTION OF CORROSION IN AIRCRAFT
Sep 1976 158 p refs Presented as a lecture series Wright-Patterson AFB Ohio 6-7 Oct 1976 Delft Netherlands 11-12 Oct 1976 Lisbon 14-15 Oct 1976
(AGARD-LS-84) Avail NTIS HC $6 75

The significance implications and economics of the various types of corrosion in aircraft were discussed as well as the threats and preventive measures for the product life cycle design, material selection construction maintenance and repair inspection and test The stress is placed on the need for greater application of known preventive methods, greater visibility of the problem expanded engineering education and better practical transfer of knowledge and technology

N76-33333 Promisel (N E) Silver Spring Md
INTRODUCTION A SURVEY OF THE PROBLEM
N E Promisel *In* AGARD The Theory, Significance and Prevent of Corrosion in Aircraft Sep 1976 5 p

The overall situation and perspective of the corrosion problems in aircraft was reviewed A striking paradox is that despite extensive research and knowledge in the field of corrosion and practical measures to combat it aircraft corrosion damage is still being experienced that annually is costing many millions of dollars as well as indirect penalties such as aborted missions decreased aircraft usage factor and even occassionally safety hazards to aircraft and personnel It appears that there does not exist an adequate transfer of technology between scientists, engineers designers and users The cost of corrosion should be determined by looking at a complete life cycle of a total system Aircraft are subject to practically every type of corrosion pitting intergranular fatigue stress-corrosion cracking crevice bacterial embrittlement fretting galvanic etc Easy access for in situ inspection should be a prime factor in aircraft design
YJA

N76-33335 Ohio State Univ, Columbus Dept of Metallurgical Engineering
ECONOMICS OF CORROSION
R W Staehle *In* AGARD The Theory Significance and Prevent of Corrosion in Aircraft Sep 1976 3 p (For availability see N76-33332 24-26)

The uncertainties related to the problems of defining the real costs of corrosion to military aircraft due to the complete lack of manipulable information were described Various informed but informal estimates suggest that the costs directly associated with corrosion including repair and inspection are at least 25% of the maintenance costs which are of the order of $1 5-2 0 billion per year Some general considerations which should serve as a reasonable basis for improving the understanding of not only corrosion economics but the general problem of maintenance economics are outlined
Author

N76-33336 Naval Aircraft Materials Lab Fleetlands (England)
CORROSION IN AIRFRAMES, POWER PLANTS AND ASSOCIATED AIRCRAFT EQUIPMENT
E J Hammersley *In* AGARD The Theory Significance and Prevent of Corrosion in Aircraft Sep 1976 16 p refs

A review of corrosion problems in airframes power plants, and aircraft equipment primarily found on naval and other aircraft operating in marine environments was presented The following factors affecting the problem were first discussed exposure (special nature of marine environment), initial standards (choice of materials protection and inspection techniques, maintenance) feedback of information (between engineers designers and users), economics (original cost and operating cost) awareness of the problem (training of users) Specific corrosion problems encountered in the following aircraft components were then described airframe structures (aluminum magnesium ferrous titanium alloys paint protective systems geometric considerations and the use of temporary or supplementary preservatives) engines and aircraft equipment Some comments on corrosion monitoring were also given
YJA

N76-33337 Messerschmitt-Boelkow-Blohm G m b H Munich (West Germany) Aircraft Div
CORROSION PREVENTION TECHNIQUES, MAINTENANCE AND REPAIR
Karl O Sippel *In* AGARD The Theory Significance and Prevent of Corrosion in Aircraft Sep 1976 15 p refs

Possibilities which exist to increase the corrosion resistance of aircraft structures mainly involving aluminum alloys were described Material selection and its treatment application of suitable surface protections and appropriate procedures during assembly were considered Other materials such as titanium and steel are also taken into consideration Special attention is drawn to those problems which arise during assembly and result from incompatibility of protective coatings with structural materials or fasteners Furthermore a short description of a procedure used to determine inspection intervals by taking corrosive influence into account was given As corrosion-preventive coatings on surfaces and fasteners are easily damaged simple and inexpensive repair methods obtain great significance in practice Therefore methods in common practice in today s aircraft maintenance to repair corrosion-preventive coatings are described
Author

N76-33339 Ohio State Univ Columbus Dept of Metallurgical Engineering
DESIGNING FOR CORROSION PREVENTION
R W Staehle *In* AGARD The Theory Significance and Prevent of Corrosion in Aircraft Sep 1976 26 p refs

Approaches that may be used in aircraft design to prevent or minimize in general corrosion were discussed These include (1) simple preventive ideas such as avoiding chlorides high surface stresses hydrogen in metals etc (2) point of view that aircraft must be designed on the basis of cyclic loading or fatigue (3) the life cycle costs (capital and maintenance) must be kept as low as possible without compromising safety reliability or availability (4) compromise must be made between the use of high strength light weight heterogeneous material systems and the chemical or mechanical instability of all engineering materials with resulting problems of accelerated corrosion due to intimate juxtaposition Applications were made to the B-1 program and to various alloys
YJA

N76-33340 Advisory Group for Aerospace Research and Development Paris (France)
PREVENTION AND COMBAT OF CORROSION IN AIRCRAFT STRUCTURES, BIBLIOGRAPHY
In its The Theory Significance and Prevent of Corrosion in Aircraft Sep 1976 34 p refs

A bibliography with abstracts dealing with aircraft corrosion was presented The following areas were covered high temperature corrosion, erosion and cavitation manufacturing processes non-destructive testing and inspection failure analysis fracture

fatigue and stress corrosion cracking, wear general and galvanic corrosion exfoliation localized corrosion coatings surface finish and plating, power generation fuels and combustion materials selection, testing and evaluation Author

N76-33388# Singer Co Sunnyvale Calif Simulation Products Div
SIMPLIFIED RADAR AZIMUTH BEAMSPREAD STUDY Final Report, 10 May - 19 Dec 1975
David Windsor 19 Dec 1975 58 p
(Contract F33657-73-C-0692 AF Proj 1183)
(AD-A022618 UC-7256) Avail NTIS CSCL 17/9

This report describes a study for a simplified beamspread simulation for use in digital radar landmass simulators Four new beamspread algorithms are presented which require less memory and computing hardware than those found in currently available systems Computer-generated photographs are included to give a direct visual comparison of the effects of the new algorithms with the effects of the beamspread algorithm in the F-4F DRLMS Author (GRA)

N76-33398# Armament Development and Test Center Eglin AFB, Fla
RAT SCAT EVALUATION OF COMMERCIALLY AVAILABLE RADAR ABSORBING MATERIALS, VOLUME 1 Final Report
William OHara Mar 1976 229 p refs
(AD-A024469 ADTC-TR-76-23-Vol-1) Avail NTIS CSCL 17/4

This report summarizes performance evaluation tests on a variety of commercially available thin flexible sheet type radar absorber materials including both resonant and non-resonant types A corner reflector test technique was used which allowed test and evaluation of the absorber at both normal incidence and grazing angles out to ninety (90) degrees Fourteen types of RAM were tested at frequencies near 11, 13 17 and 35 GHz The higher frequency data and off-normal incidence data in this report are often unavailable in RAM manufacturers literature RAM types tested include FGM-40 ANW-73 ANP-74XP AN-73 AN-72 AN-75 ANP-73 NRL-2764B SF-14 GRAM-52 and NR-95 This report provides reproductions of the data runs taken and 5 degree median plots of each run The measurement configurations and parameters for each cut are identified on each pattern with an overall summary chart included in the main body of the report GRA

N76-33526*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
INSPECTION OF COMPOSITES USING A COMPUTER-BASED REAL-TIME RADIOGRAPHIC FACILITY
Ernest Roberts Jr and Alex Vary 1976 12 p refs Presented at the 2d Conf on Automated Inspection and Product Control Chicago 19-21 Oct 1976
(NASA-TM-X-73504) Avail NTIS HC $3 50 CSCL 14D

A radiographic inspection facility was developed at the NASA Lewis Research Center The facility uses a digital computer to provide enhanced images in near real time Some capabilities of the facility are demonstrated in the inspection of a fan frame ring for an experimental aircraft gas turbine The ring was fabricated from a carbon-fiber reinforced epoxy composite material Inspection procedures were evaluated and comparisons were made with an ultrasonic C-scan and conventional film X-ray Author

N76-33957# Naval Air Engineering Center Lakehurst N J Ground Support Equipment Dept
EXPERIMENTAL EVALUATION OF NAS MIRAMAR HUSH HOUSE (PROJECT P-114), VOLUME 1 Final Report
W P Sule and E T Pulcher Feb 1976 148 p refs
(AD-A024403 NAEC-GSED-96-Vol-1) Avail NTIS CSCL 20/1

This report summarizes the results of an extensive experimental test and evaluation of the new NAS Miramar Hush House The tests consisted of both aero-thermodynamic and acoustic data acquisition Four different aircraft (A-4 F-8 F-4 F-14) were run in the facility, and acoustic data were obtained on two of the aircraft (F-4, F-14) The results of the full size testing were compared with 1/15th scale model test results to estimate the reliability of scale model tests for this application Author (GRA)

N76-33958# Naval Air Engineering Center Lakehurst, N J Ground Support Equipment Dept
EXPERIMENTAL EVALUATION OF NAS MIRAMAR HUSH HOUSE (PROJECT P-114), VOLUME 2
W P Sule and E T Pulcher Feb 1976 389 p
(AD-A024404 NAEC-GSED-96-Vol-2) Avail NTIS CSCL 20/1

Tables are presented showing third octave sound pressure levels at 250 ft for F-4 and F-14 aircraft tested in various positions A R H

N76-33959# Syracuse Univ N Y Dept of Mechanical and Aerospace Engineering
ATTENUATION OF HIGH-INTENSITY SOUND IN A DROPLET-LADEN GAS Interim Report, Jan 1974 - Dec 1975
Frederic A Lyman Feb 1976 29 p refs
(Grants NSF ENG-73-04257-A01 NSF GK-41217)
(PB-252985/7 MAE-5192-T1) Avail NTIS HC $4 00 CSCL 20A

The effect of acoustic streaming on the attenuation of a high intensity plane sound wave propagating in a gas containing a small concentration of micron sized droplets was studied analytically Calculations are carried out to predict the increase in attenuation resulting from the enhanced droplet heat and mass transfer caused by acoustic streaming It is concluded that other phenomena must be responsible for the anomalously high attenuation observed in the experiments and one such phenomenon and the research presently underway to evaluate it are outlined GRA

N76-34039*+ National Aeronautics and Space Administration Langley Research Center Langley Station Va
SUPERSONIC CRUISE AIRCRAFT RESEARCH (SCAR) PROGRAM BIBLIOGRAPHY, JULY 1972 - JUNE 1976
Sherwood Hoffman Sep 1976 40 p refs
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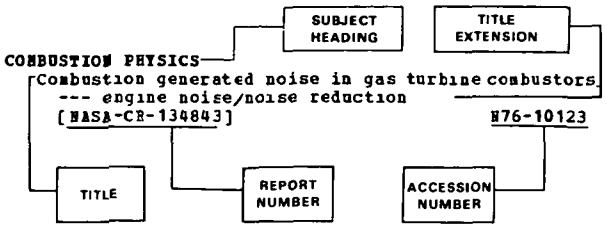

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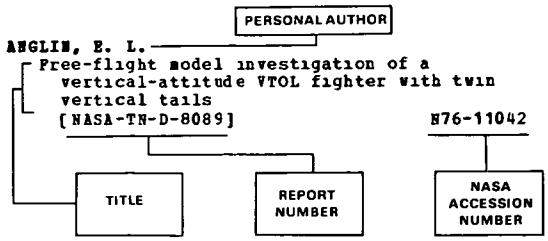

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7 Author(s)	8 Performing Organization Report No
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