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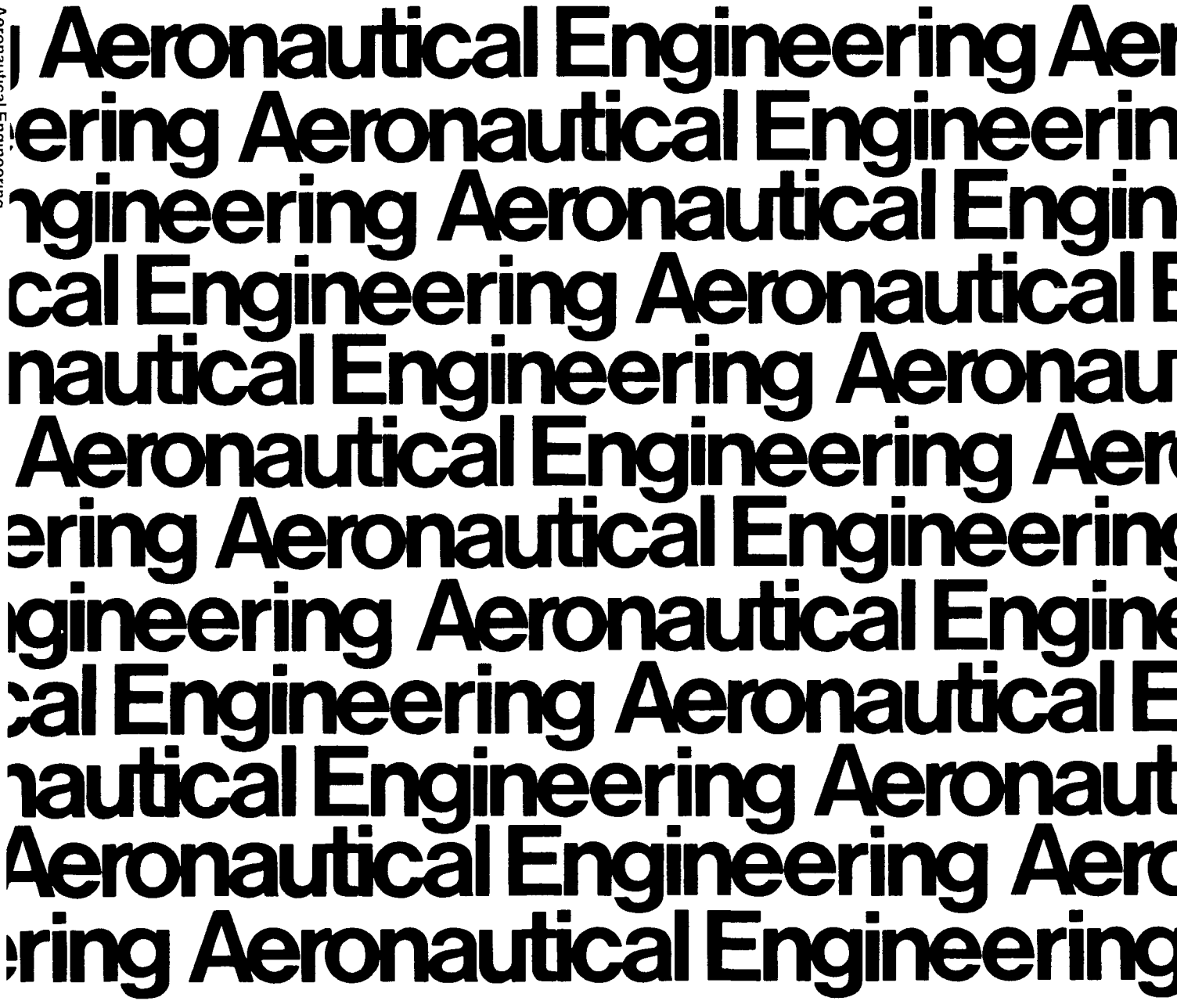
Aeronautical Engineering
A Continuing Bibliography with Indexes

NASA SP-7037 (99)
August 1978

National Aeronautics and Space Administration

Aeronautical Engineering
A Continuing Bibliography with Indexes



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NASA SP-7037 (99)

AERONAUTICAL ENGINEERING

A Continuing Bibliography

Supplement 99

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in July 1978 in

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

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This supplement to *Aeronautical Engineering -- A Continuing Bibliography* (NASA SP-7037) lists 292 reports, journal articles, and other documents originally announced in July 1978 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*

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

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

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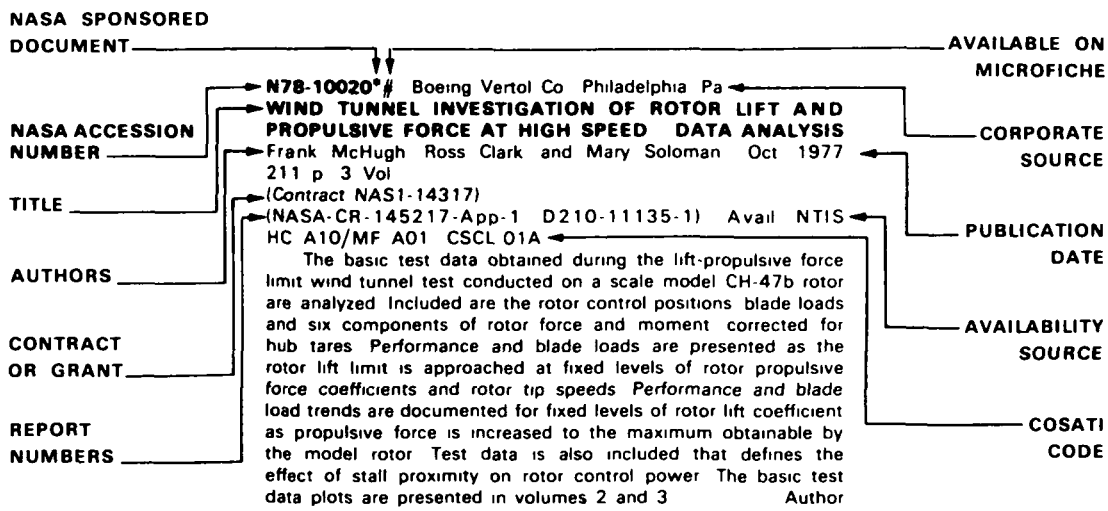

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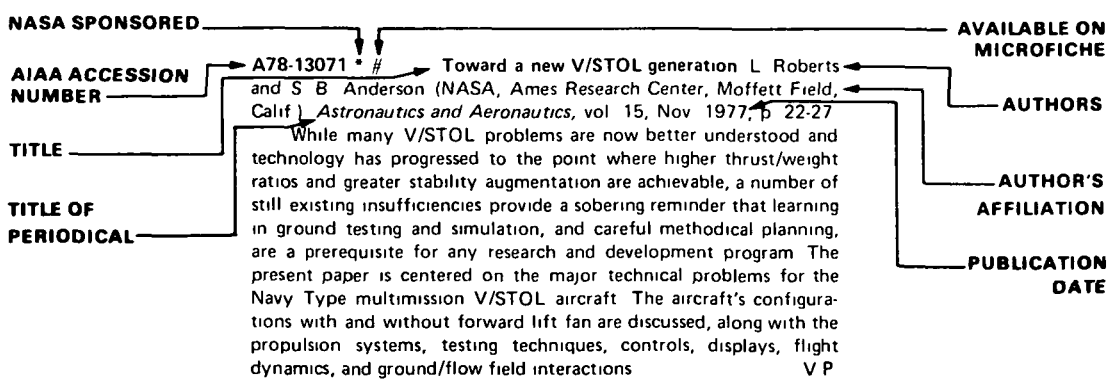

AERONAUTICAL ENGINEERING

A Special Bibliography (Suppl. 99)

AUGUST 1978

IAA ENTRIES

A78-32534 # **Some contributions to aerodynamic theory for vertical-axis wind turbines** H Ashley (Stanford University, Stanford, Calif.) *Journal of Energy*, vol 2, Mar Apr 1978, p 113 119 27 refs Grant No AF-AFOSR 74-2712

A review and modest extensions are described of quasi-steady aerodynamic theory for performance prediction on Darrieus type turbines Results are given for both parallel-axis and curved-blade configurations Blade stall and variable inflow are neglected it is hypothesized that unsteady effects support the former approximation down to lower values of tip speed ratio than hitherto believed Both profile and induced drag are included, and their influences on power and downwind force are expressed in terms of elliptic integrals Comparisons are presented with power data from the Sandia 2 m turbine Three values of profile drag coefficient are employed, and it is argued that numbers in the range of 0 015 0 017 are most appropriate to the example chosen Finally, a linearized analysis of unsteady flow effects on performance is summarized Calculations suggest that they may be quite large, considering the low operating reduced frequencies of these machines (Author)

A78-32607 # **Nonlinear model of the wind effect in problems involving flight vehicle dynamics (Nelineinaia model' vetrovogo vozdeistviia v zadachakh dinamiki letatel'nykh apparatov)** V A Velichkin and Iu I Savvin *Kosmicheskie Issledovaniia na Ukraine*, no 10, 1977, p 26 31 7 refs In Russian

A model of the action of the wind on a flight vehicle is derived in the form of Chernetskii's (1968) expansion Both the long-period wind velocity component and small-scale turbulence are taken into consideration The model's spectral density, normalized correlation function, and correlation intervals are determined In combination with spectral methods of analyzing random processes, the model simplifies the study of problems in the statistical dynamics of flight vehicles V P

A78-32622 **Study of gas flows with shearing interferometers** L B Nevskii *(Optiko-Mekhanicheskaia Promyshlennost'*, vol 44, July 1977, p 6-9) *Soviet Journal of Optical Technology*, vol 44, July 1977, p 389-391 Translation

This paper presents the results of a visualization of gas flows in wind tunnels by means of a mirror shearing interferometer The method of calculating the density in an axially symmetrical flow is described when the flow boundaries do not fall within the instrument field of view A procedure is given for calculating the density in axially symmetrical gas flows through the use of shearing interference patterns Quantitative experimental results are compared with the data obtained theoretically (Author)

A78-32645 # **A new propeller for agricultural aircraft (Nowe smiglo do samolotow rolniczych)** Z Brodzki *Technika Lotnicza i Astronautyczna*, vol 33, Mar 1978, p 8 11 5 refs In Polish

The three blade propeller R289 developed by the British Dowty Rotol Company for the Provost and Pembroke aircraft is illustrated and its details are discussed Part of the R&D work was carried out in Poland, since the propeller is adaptable to Polish PZL 3S engine intended for crop dusters Tests, in which the R289 proved superior to the standard two-blade propeller, are described V P

A78-32646 # **Future of the electronic equipment for light multipurpose airplanes, crop dusters, combat-trainers, and helicopters I (Przyszlosc osprzetu elektronicznego do samolotow lekkich wielozadaniowych, rolniczych, szkolno-bojowych oraz smiglowcow I)** R Staniszewski *Technika Lotnicza i Astronautyczna*, vol 33, Mar 1978, p 12-14 In Polish

The present paper is essentially a brief review of the organization of air space and air traffic control and of representative onboard navigation and communications systems Future trends in the development of air traffic control are examined V P

A78-32647 # **Tribological tests involved in designing aircraft brakes (Badania trybologiczne towarzyszace projektowaniu hamulcow lotniczych)** A Derkaczew (Instytut Lotnictwa, Warsaw, Poland) *Technika Lotnicza i Astronautyczna*, vol 33, Mar 1978, p 15-18 7 refs In Polish

The present paper deals with friction tests commonly used in the design and manufacture of aircraft brakes These include steady state bench tests of friction materials, testing of brake models on an inertial machine, analytical tests, and testing of prototype brakes during a landing run The principal features of these tests are discussed, along with the application of test data to the selection of brake materials and brake design and correction V P

A78-32648 # **Endurance testing of turbine-engine bearings in a test bed (Badania ukladu lozyskowania lotniczego silnika turbinowego podczas dlugotrwalej proby w hamowni)** J Lewitowicz and M Ostapkowicz *Technika Lotnicza i Astronautyczna*, vol 33, Mar 1978, p 31 33 In Polish

In the tests described, X ray fluorescence analysis was used to study the chemical composition of oil probes taken from turbine engine rolling contact bearings made to operate at twice the engine overhaul period The data obtained are used to plot the iron concentration against time Some characteristic features of the curve are discussed V P

A78 32649 # **Investigation of the conditions of ingestion of debris into intakes of turbojet engines (Badanie warunkow zasysania zanieczyszczen mechanicznych do wlotow turbinowych silnikow odrzutowych)** S Szczecinski and R Szczepanik *Technika Lotnicza i Astronautyczna*, vol 33, Mar 1978, p 34, 35 7 refs In Polish

The study described was aimed at gaining insight into the nature of the vortex action in front of intakes and its role in the ingestion of debris A two dimensional model describing the distribution of the lines of flow and the velocity at intakes is developed, using a source-and-sink technique The ground effect is taken into considera tion It is shown that the vortex action responsible for injection arises in the boundary layer at the stagnation point and develops subsequently about the stagnation line which forms the axis of the vortex The necessary conditions for the vortex action are the existence of a stagnation point in the plane of the airfield in front of the intake, and the onset of a disturbance (usually in the form of a wind gust) near the stagnation point V P

A78-32651 **The role of avionics in modern aircraft** R P G Collinson (Marconi Elliot Avionics Systems, Ltd , Rochester, Kent, England) *Electronics and Power,* vol 24, Apr 1978, p 280 284

Avionics is a growth industry, and is expected to continue its growth to the tune of over $60 billion over the next 10 years Some of the major applications of avionics in civilian and military aircraft are outlined These include fly by-wire active controls, which avoid the bulk taken up by mechanical systems, provide automatic safety parameters for aircraft maneuvering, and supply increased informa tion to the pilot, drift error correction, which is better realized through solid state electronics than by mechanical gyros and accelerometers, and head up and raster displays, which correlate and collimate (in the case of fire control systems) instrument information with the pilot's view through the cockpit D M W

A78 32810 # **Ground and near ground maneuvers of air-crafts with minimal exhaust emission** E Pasztor and E Racz (Budapesti Muszaki Egyetem, Budapest, Hungary) *Periodica Polytechnica, Transportation Engineering,* vol 6, no 1, 1978, p 3 22 10 refs Research sponsored by the Ministry of Transports and Communication

The paper is concerned with engine operating conditions which affect emission levels from aircraft turbojet engines The possibility of reducing emission in ground and near ground flight operations is analyzed in general and for the specific case of the TU-134 Taxiing, take off, climb, landing, and load testing of engines are analyzed separately It is shown that each of these can be performed at the operation mode corresponding to minimum emission, although in some cases other disadvantages were introduced M L

A78-32814 # **International trends in airport construction (Internationale Tendenzen im Flughafenbau)** E Haas and D Schmelzer (Gesellschaft fur Internationalen Flugverkehr mbH, Berlin, East Germany) *Technisch-okonomische Information der zivilen Luftfahrt,* vol 13, no 6, 1977, p 313-323 In German

Air transport, in terms of passengers per year, is growing at a prodigious rate, and can now be considered an element of mass-transit in general Thus, airports planned for today must reckon with greatly increased traffic by the time they are completed This study emphasizes flexibility of design, especially in relation to facilities for handling aircraft ground traffic, and for improving the connections between airports and adjacent cities in order to avoid passenger congestion at the terminals The Aeroport Charles de Gaulle and the Leningrad airport are presented as illustrations D M W

A78 32850 **Interavia combat aircraft design analysis I - Dassault Breguet Mirage 2000** G Farrow *Interavia,* vol 33, Apr 1978, p 347 349

Design characteristics of the French Mirage 2000 are discussed in terms of aerodynamics, avionics, powerplant, and performance The tailless delta configuration is reviewed, noting low supersonic drag, low buffet at high incidence, large underwing area for the carriage of external stores, and full time fly by-wire lateral/ directional stability and control augmentation Body weight is trimmed by use of composite materials, wing/body blending, and a more efficient hydraulic system The aircraft is powered by a SNECMA M53 engine, which is a single spool engine of low bypass ratio (0 4) and high reheat boost (55%) Maximum speed is between Mach 2 3 and 2 7 (for later versions), rate of climb is 75 sec to 12,000 m, with an operational ceiling of 20,000 m Radius of action is 700 km with external tanks D M W

A78-32921 # **SHF/EHF satellite communication terminal** C K H Tsao (Raytheon Co , Sudbury, Mass) In Communications Satellite Systems Conference, 7th, San Diego, Calif , April 24 27, 1978, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1978, p 359-363 5 refs (AIAA 78 581)

Because of the multiplicity of communications requirements, it is expected that EHF and SHF satellites will be utilized to handle different types of communications A command post should, therefore, be equipped with a terminal which can operate either in EHF or SHF band A single dual frequency terminal has the advantages of significantly reduced size and weight over the use of separate SHF and EHF terminals A description is presented of the airborne dual frequency SATCOM terminal which has been developed to obtain these advantages The terminal consists of several major components, including radome and antenna, low noise amplifier, high power amplifier, and low level terminal The system interfaces with two MODEM The dual band SATCOM terminal system weighs about 4000 lbs and has a volume of 127 cubic feet The SHF/EHF terminal is currently being integrated into a C 135 test aircraft and will undergo extensive flight testing G R

A78-32971 **Aerodynamic noise of gliders** E V Vlasov and V F Samokhin *(Akusticheskii Zhurnal,* vol 23, July Aug 1977, p 550 556) *Soviet Physics - Acoustics,* vol 23, July Aug 1977, p 314 318 8 refs Translation

The noise caused by air flowing around KAI-12 or L-13 sport gliders was studied with attention to the intensity, spectral composition, and directional pattern The dependence of aerodynamic flow noise on the flight regime and the positions of the flaps and wing interceptors was investigated The basic causes of the noise were examined M L

A78-33003 # **Numerical methods for structural analysis (Metode numerice de analiza structurala)** M D Stere (Institutul de Mecanica a Fluidelor si Constructii Aerospatiale, Bucharest, Rumania) *Studii si Cercetari de Mecanica Aplicata,* vol 36, Sept Oct 1977, p 647 664 100 refs In Rumanian

Three principal numerical techniques for structural analysis, the finite difference method, the finite-element method and the dynamic relaxation method, are reviewed The comparative study emphasizes the computing times and the memory requirements for the methods and the facility with which formulae may be developed and the results interpreted Advantages of the finite difference method include its capability for providing good approximations with a small number of parameters and its usefulness as a universal procedure for static and structural stability analyses Calculation of initial and thermal stresses with the finite element method is considered, and applications of the technique to such aircraft as the Concorde and the F 15 are mentioned The dynamic relaxation method, a recently developed iterative technique, also receives attention J M B

A78 33005 # **Geometric properties of NACA profiles (Proprietati geometrice ale profilelor NACA)** G Zidaru (Bucuresti, Institutul Politehnic, Bucharest, Rumania) *Studii si Cercetari de Mecanica Aplicata,* vol 36, Sept Oct 1977, p 741 746 9 refs In Rumanian

The surface, the center of mass and the moment of inertia are determined analytically with respect to two axes of the NACA profile series with four digits and the NACA profile series 65 (the laminar series) The determinations facilitate the adoption of the profiles for the design of axial hydraulic or pneumatic turbo machinery blades J M B

A78-33085 **Aircraft noise** R E Russell (Boeing Commercial Airplane Co, Seattle, Wash) In Noise and fluids engineering, Proceedings of the Winter Annual Meeting, Atlanta, Ga, November 27-December 2, 1977 New York, American Society of Mechanical Engineers, 1977, p 29-37

An overview is provided of the elements of the aircraft noise reduction engineering process, taking into account the current status of each of the problem's major constituent parts Examples of work currently under way or planned at a U S aerospace company are used to clarify aspects of work performed and objectives for future investigations It appears that after the occurrence of breakthroughs concerning conventional subsonic aircraft noise reduction in the past, future progress will be slow but steady provided adequate national resources are employed in work related to the problem Attention is given to regulatory noise requirements, noise limits for new and old type aircraft, aircraft noise components, questions of noise reduction methodology, problems of source noise isolation, an anechoic test chamber, full scale engine test stands, a noise data reduction system, and the demonstration of static inlet inflow control G R

A78-33088 **Evaluation of airframe noise prediction methods** M R Fink (United Technologies Research Center, East Hartford, Conn) In Noise and fluids engineering Proceedings of the Winter Annual Meeting, Atlanta, Ga, November 27 December 2, 1977 New York, American Society of Mechanical Engineers, 1977, p 69 77 13 refs U S Department of Transportation Contract No FA76WA-3821

Predictions by Revell's drag element model, and Hardin's total aircraft noise method where applicable, are compared with measured flyover noise spectra for different configurations of a large commercial jet transport, a business jet, a small twin-propeller aircraft, and a sailplane These two methods had been recommended in the NASA Aircraft Noise Prediction (ANOPP) study Predictions by a noise component method recently developed under a contract with FAA also are shown This new method gives closest agreement with measured flyover spectra The total aircraft noise method, which applies only for aircraft in the clean configuration, was in poor agreement with measured spectra (Author)

A78-33089 **Prospects for supersonic jet noise suppression** D S Dosanjh, P K Bhutiani, K K Ahuja (Syracuse University, Syracuse, N Y), and M Gharib In Noise and fluids engineering, Proceedings of the Winter Annual Meeting, Atlanta, Ga, November 27 December 2, 1977 New York, American Society of Mechanical Engineers, 1977, p 79 88 30 refs

The aero-acoustic characteristics of an effective and practical supersonic jet-noise suppressor are noted and the prospects for the suppression of supersonic jet noise are briefly examined The substantial supersonic jet noise reductions achieved by employing coaxial (or coannular) high speed jet flow configurations where the outer (annular) jet flow is operated at a higher pressure ratio (i e, at a higher fully-expanded flow Mach number) and at a higher flow temperature (thus at a higher fully-expanded flow velocity) than those of the inner jet, are discussed The noise suppression potential of this 'inverted' mode of operation of coaxial (coannular) supersonic jets issuing from (1) coaxial nozzles with coplanar exits, (2) coaxial nozzles with staggered exits, (3) coannular with staggered exits and plug, and (4) three coaxial jets with coplanar exits, is briefly reviewed To underscore the importance of some of the attributes of an effective supersonic jet-noise suppressor, a few typical results of the observed noise-reductions and the corresponding flow features of the multinozzle coaxial cold/heated supersonic jets with coplanar exits are presented (Author)

A78-33090 * **Non-linear duct acoustics and its application to fan noise** P G Vaidya (Boeing Commercial Airplane Co, Seattle, Wash) In Noise and fluids engineering, Proceedings of the Winter Annual Meeting, Atlanta, Ga, November 27-December 2, 1977 New York, American Society of Mechanical Engineers, 1977, p 137 143 12 refs NASA supported research

Quite often the scalar Helmholtz equation is assumed to be the fundamental equation of duct acoustics and various relations are derived from it An investigation is, therefore, conducted regarding the underlying assumptions leading to the Helmholtz equation It is found that serious errors, even well below 186 dB, are possible if the assumption of linearity were to be made In duct acoustics these errors are highest near the cutoff points and in the case of ducts with transonic flow It is pointed out that serious errors could arise if a nonlinear problem is analyzed by linear methods At times, an entire phenomenon remains unpredictable by linear methods Attention is given to the characteristics of nonlinear systems, the phenomenon of multiple pure tones in the case of noise from the aircraft engine fans, the limitations of the conventional acoustics equation, duct shape and nonlinearity, and the numerical simulation of a fan with 8 blades G R

A78-33093 **Rotor-stator interaction noise with hindsight** N A Cumpsty (Cambridge University, Cambridge, England) In Noise and fluids engineering, Proceedings of the Winter Annual Meeting, Atlanta, Ga, November 27 December 2, 1977 New York, American Society of Mechanical Engineers, 1977, p 179-182

An examination is conducted concerning the tone noise produced by the interaction of rotors and stators in a fan or compressor Such interactions are important in the forward radiated noise of most compressors and fans at subsonic tip speeds and in the rearward noise at all tip speeds Basically the noise is produced by one of two processes Either the steady pressure fields of the blades of one row interact with the blades of another row moving relative to it, or else the wakes from the blades of one row interact with the blades of a downstream row In either case a tone at blade passing frequency or its harmonics is produced Problems concerning a reduction of the noise by means of suitable device design procedures are considered The designer of a fan or compressor has many constraints and the noise is only one It is, therefore, generally not possible to select design characteristics which would minimize tone noise and a compromise is necessary G R

A78-33103 **Aerodynamic design and verification of a two-stage turbine with a supersonic first stage** R L Binsley and J L Boynton (Rockwell International Corp, Rocketdyne Div, Canoga Park, Calif) In Turbomachinery developments in steam and gas turbines, Proceedings of the Winter Annual Meeting, Atlanta, Ga, November 27-December 2, 1977 New York, American Society of Mechanical Engineers, 1977, p 21-27 11 refs Contract No F33615 74-C-2013

Aircraft requirements necessitate a supersonic component in the turbine powerplant A two stage turbine with a supersonic first stage is described, which provides an overall power output of 4474 kW The turbine has a 312 4 mm pitch diameter, operating on hydrazine fuel at 4 826 MPa and temperatures of 1172 K, with an overall pressure ratio of 41 2 Attention is given to first stage design characteristics, noting that the rotor blades are exposed to the core of the nozzle (as opposed to a mixed flow) Test results were found to be in good agreement with predicted performance, although static pressure was somewhat less than optimum due to the bluntness of the rotor blade leading edges (sharp edges are not practical for high speed operation) D M W

A78-33111 * **Effect of airstream velocity on mean drop diameters of water sprays produced by pressure and air atomizing nozzles** R D Ingebo (NASA Lewis Research Center, Cleveland, Ohio) In Gas turbine combustion and fuels technology, Proceedings of the Winter Annual Meeting, Atlanta, Ga, November 27 December 2, 1977 New York, American Society of Mechanical Engineers, 1977, p 31 35 6 refs

A scanning radiometer was used to determine the effect of airstream velocity on the mean drop diameter of water sprays produced by pressure atomizing and air atomizing fuel nozzles used in previous combustion studies Increasing airstream velocity from 23 to 53 4 meters per second reduced the Sauter mean diameter by

approximately 50 percent with both types of fuel nozzles The use of a sonic cup attached to the tip of an air assist nozzle reduced the Sauter mean diameter by approximately 40 percent Test conditions included airstream velocities of 23 to 53 4 meters per second at 293 K and atmospheric pressure (Author)

A78-33113 Development of a catalytic combustor fuel/air carburetion system G A Roffe (General Applied Science Laboratories, Inc , Westbury, N Y) In Gas turbine combustion and fuels technology, Proceedings of the Winter Annual Meeting, Atlanta, Ga , November 27-December 2, 1977 New York, American Society of Mechanical Engineers, 1977, p 51-58 5 refs Contract No F33615-76-C-2070

Three fuel/air carburetion systems were screened to determine their ability to produce a uniform, gas phase mixture of Jet A fuel and air Pressure, air blast and air-assist atomization techniques were examined The air-assist fuel injection scheme was selected as most appropriate and was modified by the use of a variable angle swirl generator to produce acceptably flat fuel and velocity profiles at the system exit The device was tested over a range of air velocity, inlet pressure, inlet temperature and fuel/air ratios Profiles of velocity, fuel concentration and degree of vaporization were measured at the exit plane and at an intermediate station 75% of the distance between the injector and the exit Velocity profiles were found to have a standard deviation of only 10 5% from the ideal case, while the average deviation of the fuel concentration profile was 9 3% from ideal Measurements indicated that complete vaporization was achieved prior to the system outlet plane (Author)

A78-33114 Fuel hydrogen content as an indicator of radiative heat transfer in an aircraft gas turbine combustor T A Jackson (USAF, Aero Propulsion Laboratory, Wright Patterson AFB, Ohio) and W S Blazowski (Exxon Research and Engineering Co , Linden, N J) In Gas turbine combustion and fuels technology, Proceedings of the Winter Annual Meeting, Atlanta, Ga , November 27-December 2, 1977 New York, American Society of Mechanical Engineers, 1977, p 59 65 8 refs

Eleven fuels representing a wide range of hydrogen content were studied using a T56 single can combustor rig Test fuels included single and double ring aromatic types as well as paraffins blended with each other and with JP 4 Fuel mixtures with hydrogen contents ranging from 9 9 to 15 9 percent by weight were examined The combustor inlet conditions simulated the discharge from both low and high pressure ratio gas turbine compressors operating at the cruise condition Thermocouple data from the T56 liner are correlated with fuel hydrogen content using a new, non dimensional combustor liner temperature parameter Least squares mathematical treatment of the data resulted in an excellent second order correlation between the non dimensional temperature parameter and fuel hydrogen content and a simplified radiation analysis is presented which also explains the resulting empirical trends (Author)

A78-33121 Terminal airspace/airport congestion delays H B Hubbard (United Airlines, Inc , Chicago, Ill) *Interfaces,* vol 8, Feb 1978, p 1 14

Methods of reducing airport congestion delays are discussed, with particular attention given to an FAA sponsored program at Chicago's O'Hare Airport Selection of low-delay runway configurations for the existing wind and weather conditions is found to reduce inbound holding delays by about two to three minutes per arrival In addition, wake vortex detection systems have been tested as a means to reduce in-trail separations when the wake vortices do not present a problem More complete real time air traffic monitoring may also aid in reducing delays J M B

A78-33142 # Load sequences for laboratory simulation of flight-by-flight stress spectra G J Roth (Dayton, University, Dayton, Ohio) *American Society of Mechanical Engineers, Winter Annual Meeting, Atlanta, Ga , Nov 27-Dec 2, 1977, Paper 77-WA/DE-25* 11 p 6 refs Members, $1 50, nonmembers, $3 00 USAF sponsored research

Load sequences were developed to model preflight stress, ground and flight 1-g stress, stress cycles for air and ground operations, and flight and ground cyclic stresses, these load sequences were applied to coupon specimens representing B-58 and F-106 aircraft, and the fatigue lives were studied Load sequences that yielded fatigue lives equivalent to lives obtained using strain gage data for gust-sensitive or maneuver sensitive aircraft were identified In addition, the importance of properly representing the minimum stress in a flight was noted J M B

A78-33168 # An example of additive damping as a cost savings alternative to redesign M L Drake (Dayton, University, Dayton, Ohio) and J D Sharp (USAF, Materials Laboratory, Wright Patterson AFB, Ohio) *American Society of Mechanical Engineers, Winter Annual Meeting, Atlanta, Ga , Nov 27-Dec 2, 1977, Paper 77-WA/GT-2* 9 p 11 refs Members, $1 50, nonmembers, $3 00 Research supported by General Motors Corp , Contract No F33615 76-C 5137

An approach used to resolve an airframe/engine interface incompatibility problem which arose during the early development stages of the A7 D aircraft was found to be very unsatisfactory The fiberglass wrap which had been designed to eliminate high cycle fatigue failures in the extension did not provide the expected solution An alternate design developed in a redesign program was rejected because of cost The possibility of a less expensive solution was, therefore, investigated A damping treatment was designed which, in the operating environment of the engine, sufficiently reduced the dynamic response of the inlet extension and consequently eliminated the need for the fiberglass wrap that had caused the initial difficulties G R

A78-33179 # Heated three-dimensional turbulent jets P M Sforza and W Stasi (New York, Polytechnic Institute, Farmingdale, N Y) *American Society of Mechanical Engineers, Winter Annual Meeting, Atlanta, Ga , Nov 27-Dec 2, 1977, Paper 77-WA/HT-27* 11 p 16 refs Members, $1 50, nonmembers, $3 00 Contract No AF 49 (638) 1623, Grant No DAHC04 69-C 0077 AF Project 9781-01, ARPA Order 1442

An experimental investigation of heated three-dimensional turbulent free jets is presented Emphasis is placed upon the basic character of such flows and their relation to their unheated counterparts and to heated axisymmetric jets Temperature and velocity distributions indicate that these flow fields may be characterized by three distinct regions in terms of the axis decays a potential core region where axis values are close to the exit values, a characteristic decay region wherein the axis decays are dependent upon orifice geometry, and an axisymmetric decay region where the axis decay is axisymmetric in nature and thus independent of orifice geometry These regions are not exactly the same for temperature as for velocity, the former being shifted somewhat upstream of the latter Half width data indicate that heated three dimensional jets change shape as they proceed downstream, ultimately becoming axisymmetric in nature, regardless of initial orifice shape Profile characteristics and similarity are discussed as well as cross plane contours of pertinent flow variables Schlieren photographs provide visual information pertinent to the discussion of growth characteristics of these variable density flows (Author)

A78-33218 * # Gas path sealing in turbine engines L P Ludwig (NASA, Lewis Research Center, Cleveland, Ohio) *NATO, AGARD, Power, Energetics, and Propulsion Panel Meeting on Seal Technology in Gas Turbine Engines, London, England, Apr 6, 7, 1978, Paper* 45 p 54 refs

Survey of gas path seals is presented with particular attention given to sealing clearance effects on engine component efficiency The effects on compressor pressure ratio and stall margin are pointed out Various case-rotor relative displacements, which affect gas path seal clearances, are identified Forces produced by nonuniform sealing clearances and their effect on rotor stability are discussed qualitatively, and recent work on turbine-blade-tip sealing for high temperatures is described The need for active clearance control and

for engine structural analysis is discussed The functions of the internal-flow system and its seals are reviewed (Author)

A78-33219 * # **Self-acting shaft seals** L P Ludwig (NASA, Lewis Research Center, Cleveland, Ohio) *NATO, AGARD, Power, Energetics, and Propulsion Panel Meeting on Seal Technology in Gas Turbine Engines, London, England, Apr 6, 7, 1978, Paper* 35 p 17 refs

Self-acting seals are described in detail The mathematical models for obtaining a seal force balance and the equilibrium operating film thickness are outlined Particular attention is given to primary ring response (seal vibration) to rotating seat face runout This response analysis reveals three different vibration modes, with secondary seal friction being an important parameter Leakage flow inlet pressure drop and effects of axisymmetric and nonaxisymmetric sealing face deformations are discussed Experimental data on self-acting face seals operating under simulated gas turbine conditions are given, these data show the feasibility of operating the seal at conditions of 345 N/sq cm and 152 m/sec sliding speed Also a spiral groove seal design operated to 244 m/sec is described (Author)

A78-33360 **General aviation crash survivability** R G Snyder (Michigan, University, Ann Arbor, Mich) *Society of Automotive Engineers, Congress and Exposition, Detroit, Mich , Feb 27 Mar 3, 1978, Paper 780017* 27 p 98 refs

Statistics indicate that during the past decade (1967 1976) the number of general aviation aircraft involved in an accident is equivalent to at least 38% of the total U S production during that period The paper reviews and illustrates current general aviation aircraft accident experience relative to occupant impact injury and damage indexes, and provides new data relative to current-generation aircraft Results clearly indicate that when the cabin structure remains relatively intact, the occupant is adequately restrained in an energy-absorbing seat system, the interior structures are designed to distribute loads and absorb energy, and the impact forces imposed on the occupant are within human tolerances, the occupant can survive without serious injury even when the aircraft is destroyed (Author)

A78-33361 * **NASA technical advances in aircraft occupant safety** J H Enders (NASA, Aviation Safety Technology Branch, Washington, D C) *Society of Automotive Engineers, Congress and Exposition, Detroit Mich Feb 27 Mar 3, 1978, Paper 780020* 29 p 9 refs

A NASA program to improve aircraft safety is discussed in terms of three areas of concentration unexpected turbulence encounters, fire, and crash impact To provide warning of clear air turbulence (CAT) so that the pilot can take evasive action, a laser Doppler system is described, which functions by measuring backscatter frequency radiation occurring in aerosols ahead of the aircraft The system was found able to detect CAT, but at shorter than optimal ranges (10 km as opposed to 32 km) Fire safety has focused on both the early detection of fires through improved sensing methods, and on the development of fire retardant materials, i e , intumescent char forming protective coatings Crashworthiness is discussed in terms of the development of a survivable crash envelope and improved seat and restraint systems To evaluate an aircraft for crashworthiness, finite element computer programs are currently being developed which analyze both aircraft structural configurations and the intrinsic strength of aircraft materials D M W

A78-33442 * **Comparative vibration environments of transportation vehicles** D G Stephens (NASA, Langley Research Center, Hampton, Va) In Passenger vibration in transportation vehicles, Proceedings of the Design Engineering Technical Conference, Chicago, Ill , September 26-28, 1977 New York, American Society of Mechanical Engineers, 1977, p 59-72 17 refs

Measured vibration data are presented for a number of air and surface vehicles Consideration is given to the importance of direction effects, of vehicle operating modes such as takeoff, cruise, and landing, and of measurement location on the level and frequency of the measurements Various physical measurement units or descriptors are used to quantify and compare the data Results suggest the range of vibration associated with a particular mode of transportation and illustrate the comparative levels in terms of each of the descriptors Collectively, the results form a data base which may be useful in assessing the ride of existing or future systems relative to vehicles in current operation In addition, subjective response data obtained from vibration simulator studies are presented to illustrate human response characteristics as well as to indicate a laboratory approach for the development of ride-quality criteria (Author)

A78-33443 **Ride technology applications to large passenger aircraft** S H Brumaghm and J R McKenzie (Boeing Co , Wichita, Kan) In Passenger vibration in transportation vehicles, Proceedings of the Design Engineering Technical Conference, Chicago, Ill , September 26-28, 1977 New York, American Society of Mechanical Engineers, 1977, p 73-85 18 refs

The use of advanced control technology to lessen the cabin vibrations experienced by passengers of commercial aircraft is discussed, and definitions of passenger ride comfort are proposed As an example of ride improvement, a gust alleviation system adapted to a STOL aircraft is described, canard installations and active controls form the basis of the system In addition, the International Standards Organization guidelines on acceptable airliner vibration levels are critiqued through reference to subjective evaluations of vertical structural-mode vibrations typical of a large passenger aircraft J M B

A78-33444 **Vibration in helicopters** R Gabel (Boeing Vertol Co , Philadephia, Pa) In Passenger vibration in transportation vehicles, Proceedings of the Design Engineering Technical Conference, Chicago, Ill , September 26 28, 1977 New York, American Society of Mechanical Engineers, 1977, p 87-111 6 refs

Low-frequency vibration in helicopters has long been an annoyance to the passengers and crew of this otherwise highly utilitarian air vehicle The primary disturbing vibration is at the frequency of the number of rotor blades times rotor speed or b/rev Depending on the size of the helicopter, this generally is in the range from 10 to 30 Hz Recent years have seen more successful assaults toward the elimination of these vibrations through the use of anti-vibration devices including isolation, pendulum absorbers, fixed and variable tune absorbers and airframe response detuning (Author)

A78-33445 **Flight evaluation of helicopter rotor isolation system** R Jones (Kaman Aerospace Corp , Bloomfield, Conn) In Passenger vibration in transportation vehicles, Proceedings of the Design Engineering Technical Conference, Chicago, Ill , September 26 28, 1977 New York, American Society of Mechanical Engineers, 1977, p 113-127

Helicopters characteristically exhibit large amplitude vibration at low frequencies caused by the main-rotor-induced shears and moments To reduce these vibrations, the rotor is designed to minimize the induced shears and moments, and the fuselage is designed to be free of resonance at the frequencies of these rotor induced inputs Also, many helicopters employ vibration mitigation devices Reported here are analytical and experimental programs on the Dynamic Antiresonant Vibration Isolator (DAVI), an inertially coupled isolation device which permits a high degree of isolation of discrete low frequencies without sacrifice of elastic stiffness The principles of the DAVI are discussed and laboratory test results are presented to show the independence of DAVI isolation from the weight of the isolated item A summary of the analytical, shake test and full helicopter scale rotor isolation programs is given (Author)

A78-33568 **Influence of the jet temperature on the characteristics of a gas-jet sound generator** V M Kuptsov *(Akusticheskii Zhurnal,* vol 23, Sept -Oct 1977, p 821-823) *Soviet Physics - Acoustics,* vol 23, Sept -Oct 1977, p 471, 472 Translation

A78-33587 **Monitoring airline performance** R J Pearson (Liverpool, University, Liverpool, England) *Aeronautical Journal*, vol 82, Feb 1978, p 64-74 25 refs

An investigation is conducted concerning the effects which various airline objectives can have on efficiency performances Airline efficiency is measured by using the concept of monitored airline performances According to the employed approach, efficiency is measured with respect to the airline's stated objectives Typical airline objectives are discussed along with the expected repercussions on efficiency parameters General airline objectives considered are related to profit maximization, revenue maximization, growth maximization, and efficiency British Airways' corporate objectives include the safe and punctual operation of air services, the earning of a rate of profit which meets the criteria laid down by the government and which is compatible with the profit rates achieved by competitors, the employment of a skilled work force with a high level of output per employee, a suitable expansion of business, and the development of operational policies which meet socially acceptable standards in terms of the environment G R

A78-33588 **Static and dynamic stability** A W Babister (Glasgow, University, Glasgow, Scotland) *Aeronautical Journal*, vol 82, Feb 1978, p 85 87 5 refs

A statically stable aircraft is not necessarily dynamically stable Sachs (1975) has considered an approach in which two-parameter stability diagrams are employed to establish the conditions for which static stability is sufficient An investigation is conducted concerning the development of a simpler approximate solution which is based on a consideration of the factors of the characteristic equation The characteristic equation related to the longitudinal stability of an aircraft in horizontal level flight is examined, taking into account a point which corresponds to an aircraft possessing both static and dynamic stability The effect of a change in the value of the pitching moment derivatives is investigated, giving attention to three cases regarding the relation of the mathematical parameters G R

A78-33609 **Development of fatigue cracks in real structures - Applications to aircraft design** J Nemec, J Drexler (Vyzkuny a Zkusebni Letecky Ustav, Prague, Czechoslovakia), and M Klesnil (Ceskoslovenska Akademie Ved, Ustav Vlastnosti Kovu, Brno, Czechoslovakia) In Advances in research on the strength and fracture of materials, Proceedings of the Fourth International Conference on Fracture, Waterloo, Ontario, Canada, June 19-24, 1977 Volume 1 New York, Pergamon Press, 1978, p 157-172 22 refs

A generalized probabilistic model is developed to describe the state variations with time of a complex cracked structure Within the framework of the model, attention is given to the safe life of the primary (fatigue-sensitive) substructure, and to plastic and stepwise pop-in crack propagation modes Fatigue crack development is also treated empirically, taking the observations of microfractography into account D M W

A78-33633 **The effect of microstructure on fracture of a new high toughness titanium alloy** J C Chesnutt, C G Rhodes (Rockwell International Science Center, Thousand Oaks, Calif), R G Berryman (Rockwell International Corp, Los Angeles Aircraft Div, El Segundo, Calif), F H Froes (Colt Crucible Materials Research Center, Pittsburgh, Pa), and J C Williams (Carnegie-Mellon University, Pittsburgh, Pa) In Advances in research on the strength and fracture of materials, Proceedings of the Fourth International Conference on Fracture, Waterloo, Ontario, Canada, June 19-24, 1977 Volume 2A New York, Pergamon Press, 1978, p 195-201 Contracts No N00019-74-C-0273, No N00019 75-C-0208

The development of a titanium alloy exceeding the strength and toughness standards set by Ti-6Al-4V is discussed, the new alloy, Ti-4 5Al-5Mo-1 5Cr, is intended for use in current and near-future aircraft designs Thermomechanical processing and heat treatment have provided control of the alloy fracture properties through manipulation of the microstructure In particular, the production of beta or alpha-beta structures, the control of primary alpha aspect ratios, and the precipitation of alpha phase in the retained beta phase are means employed to regulate the toughness and strength properties of the alloy J M B

A78-33700 **Effect of initial flaw shapes on cracks emanating from fastener holes under combined stress** P M Toor (Lockheed Georgia Co, Marietta, Ga) In Advances in research on the strength and fracture of materials, Proceedings of the Fourth International Conference on Fracture Waterloo, Ontario, Canada, June 19 24, 1977 Volume 2B New York, Pergamon Press 1978 p 1223 1231 15 refs

Investigations conducted by Gran et al (1971) concerning the development of early life aircraft structural failures indicated that the majority of failures originated from fastener holes, corners, and surface flaws It appears, however, that neither experimental nor empirical work has been done for cracks starting from fastener holes under either bending or combined bending and tensile load conditions An investigation was, therefore, carried out involving the conduction of experiments for cracks emanating from fastener holes *under bending and combined bending and tensile load conditions* A use of the Bowie correction for a single edge crack with appropriate variable flaw data provided an excellent correlation A much shorter life for tension testing was obtained on the basis of Bowie's solution only For bending, and combined bending and tension the correlation was reasonable G R

A78-33769 **Prediction of fail safe strength of realistic stiffened skin aircraft structures** H Vlieger (Nationaal Lucht en Ruimtevaartlaboratorium, Amsterdam, Netherlands) In Advances in research on the strength and fracture of materials, Proceedings of the Fourth International Conference on Fracture, Waterloo, Ontario, Canada, June 19 24, 1977 Volume 3B New York, Pergamon Press, 1978, p 699-704 7 refs

The paper discusses the prediction of the fail safe strength of realistic stiffened aircraft structures The behavior of a stiffened panel as a function of crack length is described It is noted that both the residual strength properties and the sheet stiffener interaction are important in predicting the residual strength of cracked stiffened panels S C S

A78-33802 **Environmental aerodynamics** R S Scorer (Imperial College of Science and Technology, London, England) Chichester, Sussex, England, Ellis Norwood, Ltd, New York, Halsted Press, 1978 488 p 122 refs S49 50

Aspects of fundamental theory vorticity, and waves are considered, taking into account fundamental equations, the phenomena of fluid flow, secondary vorticity, the rotating earth, waves in a stratified fluid, and billow mechanics Turbulent phenomena, clouds, and dispersion are also discussed Attention is given to definitions of turbulence, Reynolds stresses, mixing length, the degeneration of eddies, Richardson's criterion for the nonpersistence of turbulence, turbulence generated by standing waves, the application of turbulence theory to the atmosphere, turbulence in rotating fluids, mixing length theory applied to a rotating fluid, the generation of vortices by eddies, elastic properties of vortex tubes in turbulence, partly turbulent flow, buoyant convection in the dry atmosphere, the dispersion of pollution, clouds and fallout, and the aerodynamic environment of life G R

A78-33805 **Aircraft powerplants /4th edition/** R D Bent and J L McKinley New York, McGraw Hill Book Co, 1978, 559 p S15 95

This book is an instruction and reference manual for aircraft engine technicians for all types of modern aircraft propulsion systems Detailed descriptions, including exploded views, schematic diagrams, cross-sectional drawings, photographs, and assembly drawings of units, systems, and components are provided for most of the major specific makes of aircraft powerplants currently in service In addition, detailed instructions and recommendations are given for

the testing, repairing, and maintenance of all the systems and components Individual chapters are devoted to, for reciprocating engines float-type and pressure injection carburetors, fuel injection systems, superchargers, lubricating systems, ignition systems, engine indicating and warning systems, engine control systems, engine installation, engine testing and troubleshooting, and propellers for light and large aircraft, and for jet aircraft control of gas-turbine engines, turboprop and turboshaft engines, and operation, inspection, and maintenance of gas-turbine engines P T H

A78-34012 An integrated system of control for hovercraft using differentially acting 'elevons' T J R Longley *Hovering Craft and Hydrofoil,* vol 17, Feb Mar 1978, p 35-39

The effort to prevent sideways skidding in light utility hovercraft is examined from the standpoint of active and passive controls The basic aerodynamic principles of elevons are discussed, with attention to design optimization which minimizes resistance to rearward thrust, while providing the desired bank angle on a sideways turn An integrated system, in which both lift and propulsion are driven by a single engine, is considered with reference to the power requirements imposed by the addition of elevons Such addition is found to offer substantial improvements in the handling characteristics of almost any size hovercraft, although it is noted that for larger vessels hydraulic activation of the elevons may be required D M W

A78-34014 # A rigid airship concept for future naval operations. W L Marcy (Martin Marietta Aerospace, Denver, Colo) *(American Institute of Aeronautics and Astronautics, Lighter than Air Systems Technology Conference, Melbourne, Fla , Aug 11, 12, 1977, Paper 77-1195) Journal of Aircraft,* vol 15, May 1978, p 298-303

A parametric and conceptual design study of advanced airships has been conducted for the U S Navy A point design airship meeting requirements for eight days endurance at a radius of 2950 km and an altitude of 3050 m weighs 188 metric tons and is 239 m long The airship employs a gas-tight outer envelope with interior ballonets and both stern and side propellers All airship control, maneuvering, and subsystem functions are automated, and all subsystems are accessible in flight for inspection and maintenance Using side propellers, the airship can land, moor, and launch without external aid (Author)

A78-34015 # Dynamic analysis of an in-flight refueling system J Eichler (Negev, University, Beersheba, Israel) *Journal of Aircraft,* vol 15, May 1978, p 311-318

As part of the design of an in-flight refueling system, a dynamic analysis was performed The system has twin refueling pods set far out on the wings Consequently, the effects of wing vibration and vortex become important, together with the usual disturbance of vertical wind gusts The paper presents the derivation and solution of the nonlinear partial differential equations The solution was obtained in closed form for sine-wave gust disturbances and numerically for both sine wave and pulse type vertical gusts and wing vibration The vortex problem was studied separately using a simplified model Two designs and several flight conditions were considered The paper describes the entire study and conclusions Flight tests of the system are now being conducted and early results corroborate the vortex conclusions obtained in the analysis (Author)

A78 34016 # Remarks on conical supersonic wings with subsonic leading edges B Wagner (Darmstadt, Technische Hoch schule, Darmstadt, West Germany) *Journal of Aircraft,* vol 15, May 1978, p 319, 320 6 refs

Flowfields of a family of conically twisted supersonic wings with subsonic leading edges are studied through analytic integration, as a limiting case, the behavior of a wing with fixed parabolic twist is examined Pressure distributions and angles of attack for vanishing leading edge singularity are presented for the family of conical wings and for the wing with parabolic twist Special attention is given to the influence of wing shape modifications on the pressure distributions J M B

A78-34087 Prediction of the unsteady airloads on oscillating lifting systems and bodies for aeroelastic analyses H W Forsching (Deutsche Forschungs- und Versuchsanstalt fur Luft- und Raumfahrt, Institut fur Aeroelastik, Gottingen, West Germany) *Progress in Aerospace Sciences,* vol 18, no 3, 1978, p 211-269 73 refs

The paper surveys the state of the art in predicting the motion-induced unsteady airloads on oscillating lifting systems and bodies, required as inputs for high-frequency aircraft dynamics, in particular for aeroelastic analyses Special emphasis is given to current advances and new developments and to those methods now considered standard routine procedures The physical and mathematical background of these prediction methods and the techniques for a numerical solution of the governing analytical equations are outlined The analysis is in terms of the generalized unsteady aerodynamic coefficients The elements of aerodynamic strip theory are set forth A numerical lifting surface collocation procedure known as the kernel function method is described Other methods reviewed are the double-lattice method and the velocity potential panel method A supersonic kernel function method and the supersonic piston-theory are examined Attention is also given to methods for nonlifting surfaces P T H

A78-34158 On lateral stability of aircraft under random parametric excitations due to vertical gusts (Zur Seitenstabilitat von Flugzeugen bei stochastischer Parametererregung durch Vertikalboen) D Schafranek (Deutsche Forschungs- und Versuchsanstalt fur Luft- und Raumfahrt, Institut fur Flugmechanik, Braunschweig, West Germany) *Zeitschrift fur Flugwissenschaften und Weltraumforschung,* vol 2, Mar -Apr 1978, p 73-80 20 refs In German

The vertical turbulence experienced by aircraft is described as a stochastic process, in which the coefficients of motion equations are randomly excited A computer simulation of the turbulence is developed, with attention to lateral aircraft instabilities, whereby linear stochastic differential equations are used to parameterize the random motion Results indicate that instabilities of constantly increasing amplitude do not occur, but are instead dependent upon the immediate strength of individual turbulent gusts D M W

A78-34160 Effect of inflow nonuniformity on low-speed wind-tunnel nozzles (Der Einfluss inhomogener Zustromung bei Dusen fur Unterschallwindkanale) A Wehrum, H Tjokrosetio, and K Gersten (Ruhr Universitat, Bochum, West Germany) *Zeitschrift fur Flugwissenschaften und Weltraumforschung,* vol 2, Mar -Apr 1978, p 89 93 7 refs In German

Two axisymmetric nozzles suitable for low-speed wind tunnels have been investigated experimentally Both nozzles had a contraction ratio of 5 19 One nozzle had a contour of minimum length optimized according to G Borger The other more conventional nozzle had a contour according to C Witoszynski The measurements were carried out for a uniform flow as well as for two different well-defined distortions at the nozzle entrance Parameters characterising the uniformity of the flow at the nozzle exit as well as the losses within the nozzle showed the superiority of the Borger nozzle whose length was eighteen percent shorter than the Witoszynski nozzle (Author)

A78-34161 Influence of dampers on ground resonance systems by the example of the DFVLR rotor test stand (Einfluss von Dampfern auf Bodenresonanzsysteme am Beispiel des DFVLR-Rotorversuchsstandes) R Schroder (Deutsche Forschungs- und Versuchsanstalt fur Luft- und Raumfahrt, Institut fur Flugmechanik, Braunschweig, West Germany) *Zeitschrift fur Flugwissenschaften und Weltraumforschung,* vol 2, Mar -Apr 1978, p 94-104 In German

A description of the DFVLR (German aerospace research and testing institute) rotor test stand is presented in terms of design and operating characteristics Attention is given to the avoidance of self-excited mechanical oscillations of rotor systems in large wind tunnels The operating parameters of dampers are discussed with

reference to their effect on rotor test stands, both with and without fuselage attachments The results of the damping on x- and y-oscillations are analyzed numerically D M W

A78-34305 # **Contribution to the synthesis and analysis of systems of active antiflutter control of flight vehicles (K sintezu i analizu sistem aktivnogo upravleniia i podavleniia flattera na letatel'nykh apparatakh)** S M Belotserkovskii, B O Kachanov, and V V Novitskii *Akademiia Nauk SSSR, Izvestiia, Mekhanika Tverdogo Tela,* Jan -Feb 1978, p 45-56 7 refs In Russian

The paper deals with the technique of using control surfaces to suppress flutter by changing the stability characteristics of the aircraft, damping the elastic vibrations of the components, and increasing the critical flutter speed To facilitate analysis of the phenomenon, a linear unsteady-state mathematical model is derived as a basis for developing control synthesis methods A description of the dynamics of aircraft motion is presented, making allowance for the dynamic deformation of aircraft structure and the unsteady nature of the flow, the control surface deviations, and control actuator operation V P

A78-34319 # **Oxidation products of fuels obtained by hydrogenation processes (Produkty okisleniia topliv, poluchennykh gidrogenizatsionnymi protsesami)** V M Slitikova, B A Englin, E D Radchenko, and A A Kir'ianova (Vsesoiuznyi Nauchno-Issledovatel'skii Institut po Pererabotke Nefti i Gaza i Polucheniiu Iskusstvennogo Zhidkogo Topliva, USSR) *Khimiia i Tekhnologiia Topliv i Masel,* no 4, 1978, p 14-19 12 refs In Russian

Jet fuels obtained by different hydrogenation processes were oxidized at temperatures of 100 and 120 C by heating them twelve times in six-hour cycles They were also stored in a thermostat at 60 C The fuels could be classified into three groups according to the nature of the interrelation between the hydrogen peroxide content and the acidity of the fuel during oxidation It was found that formation of acidic oxidation products, even at temperatures as low as 60 C, takes place after accumulation in the fuel of a significant number of hydrogen peroxides and primary products of their neutral decomposition, capable of considerably worsening their working properties P T H

A78-34322 # **Investigation of high-temperature properties of aircraft oils (Issledovanie vysokotemperaturnykh svoistv aviatsionnykh masel)** E M Nikonorov, T I Nazarova, T M Komissarova, Iu I Turskii, L P Karlina, and N M Orlova *Khimiia i Tekhnologiia Topliv i Masel,* no 4, 1978, p 38-40 In Russian

The high-temperature properties of two aviation oils - a commercial brand and a test brand - were studied in the bulk and in thin films Kinematic viscosity, acid number, percent residue insoluble in isooctane, corrosive effect on metal plates, and volatility of the oils were measured under various heating conditions The tendency to formation of lacquer deposits in the oils was evaluated P T H

A78-34324 # **Estimating the service life of rolling contact bearings when synthetic oils are used (Otsenka rabotosposobnosti podshipnikov kacheniia pri ispol'zovanii sinteticheskikh masel)** B S Gutenev, A V Vilenkin, V N Gorodetskii, and A N Bezsonov *Khimiia i Tekhnologiia Topliv i Masel,* no 4, 1978, p 49, 50 In Russian

The statistical aspects of a method of testing gas turbine engine oils are discussed The magnitudes of the confidence interval of the test results with 95% reliability in the whole range of the measured parameter are given The measured parameter was the mean time to crumbling of bearings The method is recommended as suitable for qualification quality control of newly developed synthetic aviation oils P T H

A78-34374 **The strategy of traffic regulation in Western Europe** *The Controller,* vol 17, Feb 1978, p 7, 8, 10 (4 ff)

Air traffic regulation in Western Europe is discussed, with attention given to optimum use of airport capacity and en-route capacity, flow regulation planning principles, and flow control procedures established by ICAO Separation standards for wide-body jets, multirunway operations, and reduced longitudinal and vertical separations en route are among the problems considered A system of preferential flight level allocations to reduce traffic conflicts at high-density route junctions or cross-over points is also mentioned The need to establish national and Western European Flow Coordination Cells for better air traffic management is emphasized J M B

A78-34375 **By accident or design** B Adderley (Software Sciences, Ltd , Farnborough, Hants , England) *The Controller,* vol 17, Feb 1978, p 19-22

Collision protection systems for air traffic are discussed, with attention given to collision avoidance procedures for both controlled and uncontrolled airspace Overlapping radar controls in uncontrolled airspace, as well as the overlap of procedural and radar-based ATC in controlled airspace are the principal problems considered Development of an air interpreted Proximity Warning Indicator may provide a useful supplement to ATC collision avoidance measures J M B

A78-34421 **Motion of the solid phase of an aerosol at large Reynolds numbers** B Z Teverovskii *(Inzhenerno-Fizicheskii Zhurnal,* vol 33, Sept 1977, p 405-411) *Journal of Engineering Physics,* vol 33, no 3, Mar 20, 1978, p 1017 1022 Translation

Single-term formulas are given for determining the coefficient of resistance of a medium to the motion of suspended particles These are used to obtain relations for determining the drag force of the medium at high Reynolds numbers The general solution of the equation of rectilinear motion for a particle of arbitrary shape and a particular solution of this equation for Reynolds numbers above 1000 are obtained A particular solution is also obtained for the case of the steady process of precipitation of particles under the action of gravity in a rising gas stream P T H

A78-34435 **Analysis of two-dimensional gas flow in turbomachinery cascades by means of integral equations** B I Kurmanov, G L Podvidz, and G Iu Stepanov *(Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* July-Aug 1977, p 90 97) *Fluid Dynamics,* vol 12, no 4, Mar 1978, p 560-566 9 refs Translation

The steady two-dimensional inviscid flow along a surface of revolution in a layer of variable thickness is analyzed on the basis of a solution of the integral equation with respect to the magnitude of the velocity vector In a cylindrical system of coordinates, the surface of revolution (i e , a spinning blade cascade) is described by the equation r = r(z), and is characterized by the angle of slope to the axis of rotation This approach is shown to provide an accuracy superior to other existing methods It is also characterized by rapid convergence of the iterations on the density V P

A78-34436 **Experimental investigation of the characteristics of unsteady-state breakaway zones arising in a supersonic flow at a needle with a screen** A N Antonov and V K Gretsov *(Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* July-Aug 1977, p 98-104) *Fluid Dynamics,* vol 12, no 4, Mar 1978, p 567-572 11 refs Translation

A78-34442 **Calculation of the aerodynamic characteristics of a wing moving with subsonic velocity under a slight effect of a shock wave** N A Gritsenko and M I Nisht *(Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* July-Aug 1977, p 149-154) *Fluid Dynamics,* vol 12, no 4, Mar 1978, p 607-611 Translation

A78-34444 **Form of free vortices of a wing of finite span** A A Gruzdev *(Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* July-Aug 1977, p 159-163) *Fluid Dynamics,* vol 12, no 4 Mar 1978 p 616-620 10 refs Translation

The progressive deformation of a pair of trailing vortices by their own induction is analyzed with allowance for the influence of the wing and the vortices attached to it It is assumed that small periodic far-field disturbances are absent and that the rate of downwash is specified A system of integrodifferential equations describing the motion of the vortices is solved by a successive approximation technique The configuration of vortex filaments in the flow is identified, and the behavior of points along the vortex filaments at successive intervals of time is illustrated and discussed V P

A78-34448 **Measurement of momentum transport to surfaces of different form in a hypersonic free-molecular stream** A I Omelik *(Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* July-Aug 1977, p 176-179) *Fluid Dynamics,* vol 12, no 4, Mar 1978, p 633-636 11 refs Translation

The normal and tangential momentum transfer coefficients in a hypersonic free-molecular flow were determined experimentally in a free molecular wind tunnel with nitrogen as working gas at a residual gas pressure of 0 00005 The model was a flat plate with five types of surfaces tested tungsten surface, silver surface, crimped copper foil with silver coating, glass surface, and glass cloth The normal momentum transfer coefficient did not depend on the material of the surface, but did depend on surface roughness Hence the flow interacts, not with the material, but with the chemisorbed molecules The tangential momentum transfer coefficient depended on the angle of attack P T H

A78-34488 **Data acquisition in the case of a jet-engine test stand (Messdaten-Erfassung an einem Strahltriebwerksprufstand)** H Ostenrath *Motortechnische Zeitschrift,* vol 39, Apr 1978, p 161-164 In German

The flight Mach number-flight altitude-characteristic field is considered for a determination of the operational behavior of a flying jet engine The most important characteristic parameters are the thrust and the thrust-specific fuel consumption The various engine and thermodynamic parameters and their relations are examined, taking into account the rate of air flow as a function of the flight Mach number and flight altitude A diagram of the lossless cycle is also considered and a description is provided of a simplified method for the calculation of the engine characteristics The data measured at the engine are transformed with the aid of transducers into electrical quantities which are transmitted to the recording system Various computer programs are available for the determination of the desired parameter values G R

A78-34489 **The investigation of blade vibrations in the case of impellers of highly loaded radial compressors by means of data telemetry (Zur Untersuchung von Schaufelschwingungen an Laufradern hochbelasteter Radialverdichter mittels Datentelemetrie)** U Haupt and M Rautenberg (Hannover, Technische Universitat, Hannover, West Germany) *Motortechnische Zeitschrift,* vol 39, Apr 1978, p 177-180, 183 10 refs In German Research supported by the Forschungsvereinigung Verbrennungskraftmaschinen

The development of highly loaded radial compressors led to the design of impellers with very small blade thicknesses In connection with problems of blade vibrations in the case of such impellers, an investigation was conducted concerning the blade vibrations for radial compressors Multichannel telemetry systems provide a suitable means for signal transmission at the high rotational speeds in the experimental investigations Causes of blade vibration are related to blade excitation in connection with the geometrical irregularities in the flow channel, blade excitation due to the unsteady pressure characteristics in the blade channel, blade excitation during the pumping of the compressor, and blade flutter The calculation of the vibration and strength characteristics of blades with the aid of the finite element method is also discussed Attention is given to the available approaches for the determination of blade vibration, aspects of calibration, and problems of data transfer G R

A78-34641 # **Aircraft engine design - Development through lessons learned** B L Koff (General Electric Co, Aircraft Engine Group, West Lynn, Mass) *Astronautics and Aeronautics,* vol 16, May 1978, p 40-47

Initial trade-off studies, rigorous design analysis, accelerated cyclic endurance testing and process controls are identified as the principal components in an aircraft engine design program leading to a low rate of mechanical failures in the product A trade off study involving adoption of a simple, statically determinate ring-drum design for a compressor rotor spool is considered attention to detail in design is illustrated by photoelastic stress analysis of pin root blades Practical methods of attaching thermocouples and strain gages to rotating engine parts also figure in the discussion In addition, processing of premium-quality alloys and nondestructive evaluation of the alloy billets receive attention J M B

A78-34642 # **FAA's certification position on advanced avionics** H E Waterman (FAA, Systems Branch, Washington, D C) *Astronautics and Aeronautics,* vol 16, May 1978, p 49-51

FAA research programs relevant to airworthiness certification of advanced avionics include simulation techniques to validate digital avionics, the effects of lightning and static discharges on avionics systems, fault tolerant avionics in active control technology aircraft, and software validation procedures for digital avionics Rule making by the FAA in the field of digital avionics is discussed, with particular attention given to industry cooperation in obtaining certification Such cooperation is encouraged by legal safeguards for industries divulging trade secrets to the government agency The terms 'catastrophic' and 'extremely improbable', as used in FAA certification guidelines, are defined J M B

A78-34643 # **Taking a new perspective on design** U Haupt *Astronautics and Aeronautics,* vol 16, May 1978, p 52-58 13 refs

A designer needs to be familiar with probabilistic thinking, decision-making theory and optimization, fields which have been deemphasized by research-oriented aeronautical engineering curricula of the past 15 or 20 years The resultant deficiencies in a designer's training may be remedied by the case-study approach to design education, and by the integration of experienced designers in aeronautical engineering instruction programs, perhaps through greater reliance on work study plans The importance of computer-aided design and operations research in engineering education is also considered J M B

A78-34644 # **The products liability movement has improved aviation safety** J V Brennan (United States Aviation Underwriters, Inc, New York, N Y) *Astronautics and Aeronautics,* vol 16, May 1978, p 59, 60

Products liability litigation is held to have a positive effect on aviation safety, and in particular to have been a contributor to the improved U S airline safety record during the 1970s The threat of litigation has promoted the flow of information in accident investigations, thus leading to design improvements Increased attention to human factors engineering, fail safe design and crash-worthiness has also been encouraged by products-liability litigation Finally, figures are cited to show that the cost of aviation products liability, ranging from about 1% of gross annual sales for air-transport manufacturers to 1 5 to 3 5% of gross annual sales for general aviation manufacturers, cannot be considered prohibitive J M B

A78-34658 * # **Influence of internally generated pure tones on the broadband noise radiated from a jet** S P Parthasarathy, R Cuffel, and P F Massier (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif) *AIAA Journal,* vol 16, May 1978 p 538-540 Contract No NAS7-100

An experimental study was conducted to determine subsonic-jet-noise amplification by plane waves of sound (pure tones) generated upstream of the nozzle over wide ranges of frequency and amplitude The data were used to evaluate the behavior of the pure tone and the broadband parts of the radiated sound in the far field It is shown that a significant increase of broadband noise occurs only when the amplitude of the tone in the far field exceeds the sound pressure of the broadband noise at the same location in the far field Therefore, the sensitivity of the jet to the pure-tone excitation is not large S D

A78-34659 # **Comment on 'Dynamic characteristics of rotor blades - Integrating matrix method'** W F White, Jr (U S Army, Research and Technology Laboratories, Hampton, Va) *AIAA Journal,* vol 16, May 1978, p 541, 542, Author's Reply, p 542, 543 11 refs

A78-34670 Analysis of semimonocoque beam sections by the displacement method P Mantegazza (Milano, Politecnico, Milan, Italy) *L'Aerotecnica - Missili e Spazio,* vol 56, Dec 1977, p 179-182 9 refs

Displacements and rotations of a semimonocoque beam structure of moderate taper and sweep are studied through use of a simply implemented program for digital computers Adoption of warping displacements and torsion deformations as the primary unknowns permits development of an efficient analytical program for the aircraft fuselage structure The displacement formulation employed in the analysis is a special version of the general warping function method used to solve torsion and shear problems for arbitrary sections J M B

A78-34672 Applications of variational techniques to nonlinear problems in panel mechanics L Puccinelli (Milano, Politecnico, Milan, Italy) *L'Aerotecnica - Missili e Spazio,* vol 56, Dec 1977, p 195-203 9 refs

A computer technique for finding coefficients used in a variational approach to nonlinear static and dynamic problems of aerospace structural panels is presented Automatic computation of the integral expressions representing the coefficients of Ritz-method solution equations provides a means for rapid qualitative analysis of the nonlinear problems Sample problems involving the nonlinear behavior of a segment of a spherical shell under axial loading and the search for the frequency and natural modes of a quandrangular plane panel are presented J M B

A78-34676 ASPJ - Partners at last C Rodgers *Military Electronics/Countermeasures,* vol 4, Apr 1978, p 18, 21, 23, 25

The design and deployment of Airborne Self-Protection Jammers (ASPJ) is discussed with reference to commonality among different aircraft types, and cooperation between government and industry The construction of the jammer pod of the F-16 is presented by way of illustration It is noted that commonality studies are now in progress in all branches of the U S armed forces, and in European air forces, i e , Belgium, Norway, Denmark, and Holland D M W

A78-34724 The airport city and the future intermodal transportation system H McKinley Conway Atlanta, Ga , Conway Publications, Inc , 1977 336 p $35

The connection between city development and the prevalent mode of transportation is considered for the various periods of transportation development, taking into account also the present time in which air transportation has become a very important factor A planner looking for a suitable industrial site might find an appropriate location in a cargo center which provides maximum economy in transferring goods and materials between truck, rail, air, and ship It is concluded that a new era in transportation is beginning The system of the future will offer new intermodal and transmodal features The emerging new concept of planning is examined in detail, giving special attention to the role of general aviation Attention is given to market factors for airport projects, design factors for airport projects, office and industrial parks, cargo and distribution facilities, travel facilities, resorts, attractions, planned airport communities, jetport cities and metro complexes, a geographical index of reported projects, and a checklist of factors for planning large-scale developments G R

A78-34822 # **Dornier LSK - Light combat aircraft with hover capability for anti-tank missions and shipboard deployment (Dornier LSK - Leichtes schwebefahiges Kampfflugzeug fur Panzerbekampfung und Schiffsdeck-Einsatz)** P Pletschacher *Flug Revue/Flugwelt International,* May 1978, p 68, 69 In German

To counter the growing Warsaw Pact build-up in Central Europe, a light, relatively inexpensive aircraft is now in the testing phase, which will have tank busting and close ground support as its primary mission objectives Design and operating characteristics of the Dornier LSK are presented, with attention to high maneuverability, especially hovering maneuvers An additional jet intake is built into the nose to augment steering and stability Weapons stores will consist mostly of the electronically guided variety, weight up to 1000 kg, and permit a combat radius of 200 km D M W

A78-34828 Interacting shear layers in turbomachines and diffusers P Bradshaw (Imperial College of Science and Technology, London, England) In Turbulence in internal flows Turbomachinery and other engineering applications, Proceedings of the SQUID Workshop, Warrenton, Va , June 14, 15, 1976 Washington, D C , Hemisphere Publishing Corp , 1977, p 35-55, Discussion, p 56-65 33 refs

Three types of interaction between a shear layer and another turbulence field are discussed They are (1) the effect of free-stream turbulence on a boundary layer or mixing layer, (2) the merging of two boundary layers to form an aerofoil or blade wake, (3) the interaction of two perpendicular boundary layers in a wing body or blade-hub junction A brief description is given of recent experimental work on these problems, including flow visualization and temperature-conditioned sampling (Author)

A78-34839 Some important physical phenomena in flows with separated turbulent boundary layers R L Simpson (Southern Methodist University, Dallas, Tex) In Turbulence in internal flows Turbomachinery and other engineering applications, Proceedings of the SQUID Workshop, Warrenton, Va , June 14, 15, 1976 Washington, D C , Hemisphere Publishing Corp , 1977, p 311-346 40 refs Army-supported research

An investigation is conducted concerning the case of a steady freestream, incompressible, two-dimensional mean flow over a streamlined or gently curved body or surface with a developed turbulent boundary layer upstream of the separation zone Thus, in essence, the separation of the boundary layer is due to an adverse pressure gradient Experimental chordwise distributions of the suction side velocity just outside the boundary layer for an airfoil at several angles of attack are presented in a graph It is concluded that in the separated flow zone the velocity and pressure just outside the shear layer approach the free-streamline condition of constant pressure and velocity In the case of trailing edge separation, there is apparent strong interaction between the wakes of the suction and pressure sides, since the thickness and velocity distribution in the considered region is controlled by both shear layers A description is given of the attached boundary layer characteristics, the separated shear flow, and the wake flow G R

A78-34843 Wake cutting experiments L S G Kovasznay (Johns Hopkins University, Baltimore, Md) In Turbulence in internal flows Turbomachinery and other engineering applications, Proceedings of the SQUID Workshop, Warrenton, Va , June 14, 15, 1976 Washington, D C , Hemisphere Publishing Corp , 1977, p 463-479, Discussion, p 480-483 11 refs Research supported by the United Technologies Corp

The interaction between a turbulent wake and a moving blade (airfoil) is in many ways central to the understanding of both the unsteady forces on the blade and the resulting acoustic emission In order to obtain the details of a single wake cutting 'event' a special experimental facility was constructed Two-dimensional turbulent wakes were produced, and one-by one they swept in front of a stationary (usually two-dimensional and symmetrical) airfoil The time interval between passages was chosen long enough so that each passage could be regarded as a statistically independent experiment The key feature of the experiment was that all flow variables (instantaneous pressure distribution on the airfoil, fluctuating velocity components in the interaction zone, acoustic far field, etc) were measured by using time-dependent ensemble averaging over a large number (500-2000) of wake passages The results gave instantaneous lift, drag, and equivalent dipole sound source, each as a function of time (Author)

A78-34845 Visual study of oscillating flow over a stationary airfoil A A Fejer (Illinois Institute of Technology, Chicago, Ill) In Turbulence in internal flows Turbomachinery and other engineering applications, Proceedings of the SQUID Workshop, Warrenton, Va , June 14, 15, 1976 Washington, D C , Hemisphere Publishing Corp , 1977, p 517-520

Using special visualization techniques involving hydrogen bubbles the fundamental features of fluctuating flows over a stationary airfoil have been determined including the onset and nature of dynamic stall It has been found that in periodically changing flows dynamic stall can assume a variety of forms depending on the frequency and amplitude of the unsteadiness Furthermore, it has become apparent that a strong interplay exists between viscous and inviscid phenomena with the role of the latter being predominant (Author)

A78-34873 A camera system for small format aerial photography J C Rea and M Ashley (Maine, University, Orono, Me) In Remote sensing of earth resources Volume 6 - Annual Remote Sensing of Earth Resources Conference, 6th, Tullahoma, Tenn , March 29-31, 1977, Technical Papers Tullahoma, Tenn , University of Tennessee, 1977, p 365-374 19 refs

A camera control system suited for operation of any electrically operated small-format camera used in aerial reconnaissance is described The control system includes intervalometers, connecting cables and a mount adaptable to light aircraft Sequential firing of a single camera, simultaneous firing of two or more cameras, and independent firing of two cameras are among the options made available by the control unit The control system is economical and does not interfere with the pilot's activities during flight J M B

A78-34901 * # Composite structures for commercial transport aircraft L F Vosteen (NASA, Langley Research Center, Composite Primary Structures Office, Hampton, Va) *American Institute of Mining, Metallurgical and Petroleum Engineers, International Conference on Composite Materials, 2nd, Toronto, Canada, Apr 16-20, 1978, Paper* 38 p

The use of composites represents one of six possible approaches which, according to a NASA program initiated in 1975, could be used collectively to reduce the fuel consumption of commercial transport aircraft by up to 50 percent A description is provided of a NASA-industry program which will lead to a more extensive use of advanced composites The approach being taken is to develop, for existing aircraft, components which have potential for significant weight savings The design of each of the considered components is described, taking into account a graphite/epoxy rudder, an inboard aileron, a graphite epoxy elevator, a vertical tail, a horizontal tail, and a vertical stabilizer The components are in various stages of development at this time Preliminary weight estimates show from 25 to 30 percent weight savings from the use of composites G R

A78-34906 * # Use of piloted simulation for studies of fighter departure/spin susceptibility W P Gilbert and L T Nguyen (NASA, Langley Research Center, Hampton, Va) *NATO, AGARD, Flight Mechanics Panel Specialists Meeting on Piloted Aircraft Environment Simulation Techniques, Brussels, Belgium, Apr 24-27, 1978, Paper* 14 p 5 refs

The NASA-Langley Research Center has incorporated into its stall/spin research program on military airplanes the use of piloted, fixed-base simulation to complement the existing matrix of unique research testing techniques The piloted simulations of fighter stall/departure flight dynamics are conducted on the Langley Differential Maneuvering Simulator (DMS) The paper reviews the objectives of the simulation research, presents the rationale underlying the simulation methods and procedures used in the evaluation of airplane characteristics, and discuss in detail the evaluation steps used to assess fighter stall/departure characteristics Simulation results are presented to illustrate the flight-dynamics phenomena dealt with The use of the piloted simulation methods and procedures described has been found very effective in identifying stability and control problem areas and in developing automatic control concepts to alleviate many of these problems A good level of correlation between simulated flight dynamics and flight-test results has been obtained over the many fighter configurations studied in the simulator (Author)

A78-34941 New structuralization and work of current interest in the research area of fluid mechanics (Neustrukturierung und aktuelle Arbeiten des Forschungsbereichs Stromungsmechanik) J Barche (Deutsche Forschungs- und Versuchsanstalt fur Luft und Raumfahrt, Institut fur Stromungsmechanik, Gottingen, West Germany) *DFVLR-Nachrichten,* Mar 1978, p 9-13 In German

According to a decision made on June 1, 1977, the seven sections of the German Institute for Research and Experiments in the Field of Aeronautics and Astronautics which are concerned with investigations in the area of fluid mechanics have been combined to five organizational units with new objectives, including the Institute for Theoretical Fluid Mechanics, the Institute for Experimental Fluid Mechanics, the Institute for Propulsion Technology, the Section for Technical Acoustics, and the Institute for Aerodynamic Design The work conducted at the various institutes is illustrated with the aid of a number of examples Theoretical contributions in research related to the development of supercritical wing profiles include the development of the Sobieczky design procedure and the study of three-dimensional turbulence models Experimental contributions include the use of an acoustic concave mirror with a microphone for a noninterference measurement of a local acoustic event Such a device makes it possible to scan the noise sources along an aircraft model Attention is also given to aspects of free jet interference, an orbital test stand for Spacelab, the laser 2-focus procedure for the interference-free measurement of flow velocities in rotating machine components, and the design of the wing for the Airbus A 300 B10X G R

A78-34942 Flight mechanics today and tomorrow - Balance and perspectives (Flugmechanik heute und morgen - Bilanz und Perspektiven) P Hamel (Deutsche Forschungs- und Versuchs anstalt fur Luft- und Raumfahrt, Institut fur Flugmekhanik, Braunschweig, West Germany) *DFVLR-Nachrichten,* Mar 1978, p 14-24 In German

Theoretical and experimental research and development studies for the solution of flight mechanics problems, mainly in the area of aviation, are being conducted in the Institute of Flight Mechanics of the German Institute for Research and Experiments in the Field of Aeronautics and Astronautics The studies are partly based on the use of unsteady model-experimental techniques, flight tests with manned and unmanned aircraft, flight tests with life-saving devices and salvage equipment, and the employment of mathematical methods and simulation processes Attention is given to dynamical simulation in the wind tunnel, the mobile rotor test installation, operational flight procedures for reducing aircraft noise, the testing of active control systems, control configured vehicle technology, and the determination of characteristic parameters in flight tests. G R

A78-34949 # **Natural, flexural-torsional vibration analysis of helicopter rotor blades by the finite element method** Z Dzygadlo and W Sobieraj *Journal of Technical Physics,* vol 18, no 4, 1977, p 443-454 10 refs

A technique is described for the numerical study of the frequencies and modes of coupled, natural flexural-torsional vibrations of helicopter rotor blades It is assumed that blade geometrical dimensions along with inertia and rigidity coefficients vary linearly along the elements, and that at element edges there occur finite jumps in the values of these parameters These assumptions make it possible to model blades of various distributions of mechanical parameters The technique is evaluated for hypothetical blades having either a linear variation of the parameters along the radius or constant parameters Using a zero eccentric, an uncoupled vibration is obtained and comparisons with experimental and theoretical results are made S C S

A78-34959 # **Future of electronic equipment for multi-purpose light aircraft, agricultural aircraft, combat trainers, and helicopters II (Przyszlosc osprzetu elektronicznego do samolotow lekkich wielozadaniowych, rolniczych, szkolno-bojowych oraz smiglowcow II)** R Staniszewski *Technika Lotnicza i Astronautyczna,* vol 33, Apr 1978, p 9-12 10 refs In Polish

The paper discusses the basic elements of an autonomous navigation system, characterizes current Doppler navigation systems, and mentions the directions of future development in Doppler systems, automatic flight control, and aircraft control during landing Doppler navigation systems are seen to develop along the lines of increased accuracy, new semiconductor microwave sources, and integration with other flight systems Autopilots will develop with high integration, redundancy, and adaptive control Improvements in landing conditions will be brought about by the use of VOR, VOR/DME, Doppler MLS and scanning-beam MLS, and radar altimeters The basic idea of RNAV is also described P T H

A78-34960 # **Mutual counteraction of two moving objects I (Vzaimnoe protivodeistvie dvukh dvizhushchikhsia ob'ektov I)** A P Maslov *Avtomatika i Telemekhanika,* Feb 1978, p 5-14 9 refs In Russian

The mutual counteraction of two objects (Q and P) moving in space in a finite encounter time is studied, where the object P is controlled by a remote navigation system on the ground In controlling P, use is made of information on the motion of Q, but Q has no current information on P and must determine his behavior on the basis of a priori information The optimal strategies of Q and P are determined P T H

A78-34968 # **A flutter analysis of a system of two airfoils with aerodynamic interference** J Grzedzinski (Polska Akademia Nauk Instytut Podstawowych Problemow Techniki, Warsaw, Poland) *Archiwum Mechaniki Stosowanej,* vol 30, no 1, 1978, p 47-64 9 refs

A theoretical study is made of the influence of an aerodynamic interaction of two thin profiles in the plane flow of an ideal gas on the critical flutter velocity Presented are results of calculations of aerodynamic coefficients and the flutter velocity for biplane profiles and profiles laying on the straight line one behind the other (Author)

A78-34971 **Aircraft Satellite Data Link** B Pifer (NOAA, National Weather Service, Silver Spring, Md), M Zimmer (NOAA, National Hurricane Center, Coral Gables, Fla), J DuGranrut, and J McFadden (NOAA, Research Facilities Center, Miami, Fla) *American Meteorological Society, Bulletin,* Mar 1978, p 288-290

Automated communications via the Geostationary Operational Environmental Satellite have been employed to circumvent the interference problems associated with high-frequency radio transmission of weather reconnaissance data from aircraft The Aircraft-Satellite Data Link, used for the first time in August, 1977 to monitor a developing hurricane, consists of a flat-plate antenna, a UHF transmitter and a computer/keyboard assembly The computer permits message lengths of up to 500 characters, with transmission at intervals as low as once per minute After transmission to the satellite, the messages are retransmitted to the satellite ground station and then relayed via landline to the National Hurricane Center J M B

A78-34975 # **Experimental investigation of a centripetal turbine with adjustable guide vanes (Eksperimental'noe issledovanie tsentrostremitel'noi turbiny s povorotnymi lopatkami napravliaiushchego apparata)** A N Sherstiuk, A B Davydov, and V A Magala (Moskovskii Institut Khimicheskogo Mashinostroeniia, Moscow, Vsesoiuznyi Nauchno-Issledovatel'skii Institut Gelievoi Tekhniki, USSR) *Energetika,* vol 21, Feb 1978, p 56-61 5 refs In Russian

Centripetal turbines with adjustable guide vanes are widely used in power generation and cryogenics Results are presented for a study of the effectiveness of such turbines for a variety of configurations of the adjustable guide vane It is shown that in order to ensure the slope of the regulation curve of a centripetal turbine with adjustable guide vanes within the range of relative power from 0 5 to 1 0, the operating range of the effective exit angle of the guide vane should be above 12 deg It is recommended to use aerodynamically refined configurations for the guide vanes S D

A78-35050 # **The ABEILLE electronic scanning antenna (Antenne à balayage électronique ABEILLE)** G Albarel (Thomson-CSF, Division Equipements Avioniques, Malakoff, Hauts-de-Seine, France) *Revue Technique Thomson - CSF,* vol 10, Mar 1978, p 125-146 In French

The paper describes the principle, design, and development of the ABEILLE electronic scanning antenna which is adapted for use with the fire control radar of combat aircraft The reflector array is discussed with attention to the radiating section and the module, topics include the measurement of the radiating section gain, a simulator study of gain measurement at a certain incidence, a dephaser, and the command circuit Characteristics of the measurement capabilities are reported, and the advantages and disadvantages of a passive reflector array are considered M L

A78-35129 # **Probabilistic estimate of the creep-rupture strength of aircraft gas-turbine rotor blades (Veroiatnostnaia otsenka dlitel'noi prochnosti rabochikh lopatok aviatsionnykh gazovykh turbin)** A N Vetrov (Kievskii Institut Inzhenerov Grazhdanskoi Aviatsii, Kiev, Ukrainian SSR) *Problemy Prochnosti,* Mar 1978, p 25-29 8 refs In Russian

The method proposed in the present paper for calculating the time to failure of gas-turbine rotor blades under random static loads is based on a probabilistic treatment of the hypothesis of linear fatigue damage accumulation The method is illustrated by calculating the service life of rotor blades for an actual gas turbine V P

A78-35231 # **An analytic study of the energy dissipation of turbomachinery bladed-disk assemblies due to inter-shroud segment rubbing** R L Bielawa (United Technologies Research Center, East Hartford, Conn) *(American Society of Mechanical Engineers, Design Engineering Technical Conference, Chicago, Ill , Sept 26-30, 1977, Paper 77-DET-73) ASME, Transactions, Journal of Mechanical Design,* vol 100, Apr 1978, p 222-228

A novel computational method is presented for analytically studying the energy dissipative characteristics of turbomachinery bladed-disk assemblies due to intershroud segment rubbing Coulomb friction, as the dissipative mechanism, is utilized in this method with broader generality than that in other similar studies heretofore The immediate objectives of this study were (1) to obtain an understanding of the general slippage characteristics of the shroud segment interfaces in the presence of both steady normal (to the shroud segment interfaces) lock-up stresses and stresses due to modal vibration, and (2) to incorporate these characteristics in a calculation of the minimum modal deflection required for incipient slipping as well as an estimation of the energy dissipation (damping) due to subsequent rubbing It is concluded that the energy dissipation due

to intershroud segment rubbing tends to an amplitude squared dependency and is thus similar to classic structural damping (Author)

A78-35273 **Norway Well served by air - Sidelights on air transport in Europe's Far North** *Airport Forum,* vol 8, Apr 1978, p 11, 12, 14, 16, 17 In English and German

A review of the airports in Norway is presented, with special attention given to the problems of congestion at the Oslo-Fornebu airport, which serves the nation's capital Night flying restrictions and stringent noise standards at the Oslo airport have been instituted due to the proximity of the site to residential areas In addition, the size of the Oslo-Fornebu runways limit it to handling Boeing-707 aircraft Thus the possibility of developing a new airport 30 km south of the capital is now under consideration Details of the typical Norwegian STOL airfield are also provided J M B

A78-35274 **Airport fires and their causes.** L Scheichl *Airport Forum,* vol 8, Apr 1978, p 27-30, 32, 34 (5 ff) In English and German

A general consideration of the susceptibility of buildings and sites to spreading fires is presented, and the fire hazards encountered in and around airports are studied Fires in fuel pipelines, rail tank cars, airfield fuel trucks and fuel transport vehicles, fuel tank farms, hangars and workshops are discussed; attention is also given to fire hazards in parked aircraft, as well as in aircraft during engine start-up and taxiing and during maintenance operations Engine fires, fires due to the interaction of welding arcs and fuels, and fires caused by electrostatic charging near exposed fuels are mentioned J M B

A78-35275 **Nairobi's future has begun** V Davies (Ministry of Power and Communications, Aerodromes Dept , Nairobi, Kenya) *Airport Forum,* vol 8, Apr 1978, p 59, 61, 63 68, 71 In English and German

The opening of a new passenger terminal at Nairobi International Airport, Kenya in 1978 marked an important step in the development plans for an airport rated by ICAO studies as the leading flight processing center for Africa The circular terminal was designed to handle approximately 3 million passengers per year, a 50-m high air traffic control tower was also included in the design Mobile airbridges, an approach lighting system and a freight-handling facility were also installed J M B

A78-35325 **The quest for new technologies in the helicopter field** M Grangier *Interavia,* vol 33, May 1978, p 399 402

Helicopter technologies are reviewed with attention to improvements in blade stall limits, compressibility coefficients, blade configurations, and structural materials, e g , composites Developments by the helicopter division of Aérospatiale and Sikorsky are presented, and it is pointed out that advances in the overall capability of helicopters depend primarily on advances in blade design The Sikorsky Advancing Blade Concept (ABC), which uses two rigid, counter rotating main rotors, and dispenses with the tail rotor, and the Aerospatiale X910 with tilting rotors for two modes of operation, are given as examples D M W

A78-35371 * **A simplified Mach number scaling law for helicopter rotor noise.** K S Aravamudan, A Lee, and W L Harris (MIT, Cambridge, Mass) *Journal of Sound and Vibration,* vol 57, Apr 22, 1978, p 555-570 17 refs Grants No DAAG29-C-027, No NsG 2095

Mach number scaling laws are derived for the rotational and the high-frequency broadband noise from helicopter rotors The rotational scaling law is obtained directly from the theory of Lowson and Ollerhead (1969) by exploiting the properties of the dominant terms in the expression for the complex Fourier coefficients of sound radiation from a point source The scaling law for the high-frequency broadband noise is obtained by assuming that the noise sources are acoustically compact and computing the instantaneous pressure due to an element on an airfoil where vortices are shed Experimental results on the correlation lengths for stationary airfoils are extended to rotating airfoils On the assumption that the correlation length varies as the boundary layer displacement thickness, it is found that the Mach number scaling law contains a factor of Mach number raised to the exponent 5 8 Both scaling laws were verified by model tests P T H

A78-35380 # **Application of resistance curves to residual strength prediction** M M Ratwani and D P Wilhem (Northrop Corp , Hawthorne, Calif) *ASME, Transactions, Journal of Engineering Materials and Technology,* vol 100, Apr 1978, p 138-143 22 refs USAF-sponsored research

A resistance-curve approach to predicting residual strength of thin skin structures under plane stress type fracture is discussed Use is made of material resistance obtained in terms of crack extension as a function of the square root of the J integral (the square root of J sub R) Prediction has been made of the residual strength of two types of structures, namely stiffened aircraft panels and thin-wall cylindrical pressure vessels Elastic plastic analysis based on a Dugdale-type strip plastic zone is used in the residual strength prediction The analytical results are compared with available experimental data (Author)

A78-35397 **Low energy impact behavior of composite panels** J C Aleszka (Effects Technology, Inc , Santa Barbara, Calif) *Journal of Testing and Evaluation,* vol 6, May 1978, p 202-210 Contract No F33615-76-C-3142

Current results of an experimental study to determine the resistance of eight ply AS/3501 5 graphite/epoxy, /+ or - 45 deg/0 deg/90 deg/sub s, to impact loadings incurred during ground handling and routine maintenance of aircraft are presented The impact loading was simulated by dropping a 249 g cylindrical weight with a hemispherical head through a guide tube onto the panels The configuration of the drop weight head was designed to simulate a blunt instrument, while the total weight approximated that of a typical hand tool This technique enabled up to 3 6 J (2 7 ft lb) to be imparted to the panels Specimen response was monitored by strain gages attached to the drop weight and interfaced with an instrumen tation system to provide load-time and energy time records These records were correlated with visible damage in the panels The load and absorbed energy corresponding to incipient and full penetration damage were independent of impact velocity in the range studied (Author)

A78-35445 * **NDT of DC-10 graphite-epoxy rudder** D J Hagemaier (Douglas Aircraft Co , Long Beach, Calif) *Materials Evaluation,* vol 36, May 1978, p 57 61 5 refs Contract No NAS1-12954

The results of visual and ultrasonic nondestructive tests (NDT) on a DC-10 rudder constructed of Thornel 300/5208 graphite-epoxy are presented A viscous couplant was used for both contact pulse-echo ultrasonics and the Fokker bondtester Attention is given to the stiffness of cohesive bond structures (the rudder is assembled primarily in a basic six-ply pattern), and to possible delamination A piezoelectric transducer is employed to sense changes in impedance and signal amplitude In all, four rudder units were evaluated The main problems found in the units were porosity and cracking It is noted that rudder unit four was able to be sufficiently cured to permit static tests on all rib, spar, and skin panel interfaces D M W

A78-35467 # **Current and scattering field of a long short-circuited receiving vibrator (Tok i pole rasseianiia dlinnogo korotkozamknutogo priemnogo vibratora)** A S Il'inskii, L I Ponomarev, I V Berezhnaia, and A P Antonov *Radioelektronika,* vol 21, Feb 1978, p 113-117 6 refs In Russian

A numerical solution to the integral equation for a long short circuited receiving vibrator is presented The amplitude-phase distribution of current on the vibrator is calculated and an analysis is presented of the radiation pattern and the two-position scattering cross section for vibrators of different length and thickness at different angles of plane-wave incidence B J

A78-35652 **Status report on aircraft noise certification** C R Foster (FAA, Washington, D C) In NOISE CON 77, Proceedings of the National Conference on Noise Control Engineering, Hampton, Va , October 17 19, 1977 New York, Noise Control Foundation, 1977, p 11-40

The many requirements which must be considered in the development of fair and effective noise certification rules for aircraft are discussed and a description is presented of the FAA's current activities which relate to the development of such rules In 1965 a cohesive program was formalized to alleviate the impact of aircraft noise on the nation's airports Since that time, industry and government have spent more than $200,000,000 to improve the noise characteristics of commercial and private aircraft Legislative requirements are considered along with the FAA regulatory program, the development of subsonic aircraft noise standards, the development of supersonic aircraft noise standards and helicopter noise standards, the formal regulatory procedure, and the impact of the aircraft noise program G R

A78-35655 **Results of Concorde monitoring** J E Densmore (FAA, Washington, D C) In NOISE-CON 77, Proceedings of the National Conference on Noise Control Engineering, Hampton, Va , October 17-19, 1977 New York, Noise Control Foundation, 1977, p 155-164

In the decision to allow Concorde operations into the U S on a trial basis, the FAA was directed to monitor the Concorde's environmental impact for a period of 12 months and gather data for use in making a final decision concerning permanent landing rights Measurements were obtained on Concorde operations into Dulles International Airport (IAD) from May 24, 1976, to May 24, 1977 Three community opinion surveys around IAD and a baseline survey at John F Kennedy International Airport (JFK) have been completed The measured noise levels at 36 measuring points averaged over the 12 months period were those predicted in the Environmental Impact Statement Results of the IAD area surveys indicate that fewer people now disapprove of the Concorde than at the time of initiation of operations Monitoring of emissions at IAD has shown that Concorde produces more emissions than other aircraft G R

A78-35656 **Interior acoustic environment of STOL vehicles and helicopters** J F Wilby and J I Smullin (Bolt Beranek and Newman, Inc , Canoga Park, Calif) In NOISE CON 77, Proceedings of the National Conference on Noise Control Engineering, Hampton, Va , October 17 19, 1977 New York, Noise Control Foundation, 1977, p 165 178 24 refs

A review is conducted concerning the existing information regarding the interior noise levels of short take-off and landing (STOL) aircraft and helicopters Noise levels measured or predicted for STOL aircraft and helicopters are compared with levels in other vehicles, and the main noise sources and propagation paths are identified Methods of reducing the interior noise levels are discussed, with emphasis being placed on modification to the propagation paths The noise sources are examined, taking into account propeller and rotor, turbine, gear box, engine exhaust, and leading and trailing edge noise It is pointed out that existing noise control methods are adequate for reducing high frequency broadband or discrete frequency sound New techniques are, however, required to control low frequency cabin noise G R

A78-35657 * **Aircraft flyover noise prediction** W E Zorumski (NASA, Langley Research Center, Hampton, Va) In NOISE CON 77, Proceedings of the National Conference on Noise Control Engineering, Hampton, Va , October 17-19, 1977 New York, Noise Control Foundation, 1977, p 205-222 13 refs

A review is conducted of the prediction techniques for CTOL aircraft noise sources which are presently implemented in the NASA Aircraft Noise Prediction Program (ANOPP) The sources considered include jet noise, fan noise, combination noise, and airframe noise Questions related to propagation prediction methods, source shielding, atmospheric attenuation, and ground attenuation are also described It is pointed out that ANOPP is designed to make predictions of varying degrees of complexity, or amounts of detail, depending on the needs of the user These different degrees of complexity are called levels of prediction The prediction methods being used imply a similarity law for aircraft noise Propulsion noise is proportional to mass flow for a selected engine cycle and, since thrust is also proportional to mass flow, aircraft with a fixed thrust-to-weight ratio will have their propulsion noise proportional to weight G R

A78-35658 * **State-of-the-art of turbofan engine noise control** W L Jones and J F Groeneweg (NASA, Lewis Research Center, Cleveland, Ohio) In NOISE-CON 77, Proceedings of the National Conference on Noise Control Engineering, Hampton, Va , October 17-19, 1977 New York, Noise Control Foundation, 1977, p 361-380 22 refs

A description is presented of some of the recent advances in the technology of turbofan engine noise reduction, taking into account turbomachinery noise sources, new fans for low noise, fan and core noise suppression, and a new program for improving static noise testing of fans and engines The problem of jet noise has been substantially reduced in connection with the lower jet velocities employed in the case of the high bypass turbofan engines The dominant noise sources are now related to the turbomachinery with the fan stage, the compressor, and the turbine Since the fan stage is the primary source of turbomachinery noise, it has been considered in a major part of the investigations designed to reduce turbofan engine noise G R

A78-35659 **Some advances in design techniques for low noise operation of propellers and fans** R E Hayden (Bolt Beranek and Newman, Inc , Cambridge, Mass) In NOISE-CON 77, Proceedings of the National Conference on Noise Control Engineering, Hampton, Va , October 17 19, 1977 New York, Noise Control Foundation, 1977, p 381-396 15 refs

The amount of noise produced by a propeller or fan can depend to a large degree on the aerodynamic environment However, even propellers and fans operating in proper aerodynamic environments often still produce more noise than is tolerable Several new approaches for reducing the sources of 'self-noise' are discussed The applicability of techniques for reducing noise to a given propeller or fan depends on such factors as tip Mach number range, the use of ducts or shrouds, and the configuration Noise mechanisms related to design parameters are examined, taking into account noise sources, gross parameters affecting noise generation, discrete frequency noise, and broadband noise Attention is also given to noise reduction methods related to swept trailing edges, the elimination of stall, airfoil modifications, the reduction of noise from stationary aerodynamic distortions, and shock related noise G R

A78-35660 **Noise component method for airframe noise** M R Fink (United Technologies Research Center, East Hartford, Conn) In NOISE-CON 77, Proceedings of the National Conference on Noise Control Engineering, Hampton, Va , October 17-19, 1977 New York, Noise Control Foundation, 1977, p 397-412 20 refs U S Department of Transportation Contract No FA76WA 3821

A description is presented of a noise component method which was recently developed for the Federal Aviation Administration Noise radiation from each individual portion of the airframe is calculated without regard for other noise sources Noise radiation from clean wing and tail surfaces is assumed to be caused by convection of turbulent boundary layers past the trailing edges of these surfaces An evaluation is conducted of several airframe noise prediction methods on the basis of comparisons between calculated and measured flyover noise spectra The considered methods include two procedures which had been examined by NASA as part of the

Aircraft Noise Prediction Program (ANOPP) It is found that the FAA noise component method correctly predicts amplitudes and spectrum shapes of measured flyover noise due to extended landing gear and trailing edge flaps The NASA-recommended drag element method correctly predicts the general level but not the spectrum shape of trailing edge flap noise at small deflections, and overesti mates the level at large flap deflections The NASA-recommended total aircraft noise method for clean aircraft gave poor predictions G R

A78-35661 Acoustical standards and their application to aircraft noise W J Galloway (Bolt Beranek and Newman, Inc , Canoga Park, Calif) In NOISE-CON 77, Proceedings of the National Conference on Noise Control Engineering, Hampton, Va , October 17-19, 1977 New York, Noise Control Foundation, 1977, p 415-424

In the U S a national standard is a document which has been approved by the American National Standards Institute (ANSI) as an American National Standard In aircraft acoustics the standards of primary concern are those that relate to terminology, measurement and analysis equipment specifications, definitions of reference quantities such as that for sound pressure, and procedures for computing psychoacoustical measures such as perceived noise level The primary ANSI committees of interest for aircraft noise are S1-Acoustics and S3-Bioacoustics, operating with the Acoustical Society of America Aircraft noise standards of international interest are developed by two different organizations The International Electrotechnical Commission (IEC) develops standards concerned with the performance requirements for measurement and analysis equipment Standards for physical acoustics measurement procedures and psychoacoustical evaluations of primary concern for aircraft noise are the province of the International Organization for Standardization (ISO) G R

A78-35662 * Observed variability of aircraft noise footprint measurements D J Maglieri, H R Henderson, and D A Hilton (NASA, Langley Research Center, Hampton, Va) In NOISE-CON 77, Proceedings of the National Conference on Noise Control Engineering, Hampton, Va , October 17 19, 1977 New York, Noise Control Foundation, 1977, p 443-458 14 refs

A description is presented of some measurements which illustrate the variability of the experimentally developed ground noise footprints for a series of landing approach operations of a turbojet aircraft and a turbine powered helicopter Measurements on the recently developed NASA Remotely Operated Multiple Array Acoustic Range are considered The information presented is related to a turbojet fighter aircraft and a turbine powered helicopter performing landing approach operations along a 3 deg approach path Each vehicle was acquired on radar tracking approximately 10 kilometers from the touchdown point and entered the test area at an altitude of about 470 m The measured variations in meteorological quantities for the two time periods during which these tests were conducted are presented in graphs Other graphs show the ground noise contour for the turbojet aircraft and the turbine helicopter G R

A78-35663 Airport noise monitoring A H Odell (Port Authority of New York and New Jersey, New York, N Y) In NOISE CON 77, Proceedings of the National Conference on Noise Control Engineering, Hampton, Va , October 17 19, 1977 New York, Noise Control Foundation, 1977, p 459-462

The first automatic aircraft noise monitoring system was installed in 1960 at Kennedy International Airport Technical problems in the development of effective automatic noise monitoring systems are considered, taking into account the selection of a weatherproof microphone, the transmission of a high quality signal from the monitoring site to a central station, and the accurate identification of individual aircraft At the moment, the best source of accurate identification is the human monitor, who can listen to aircraft-tower communications and observe each aircraft as it passes the monitoring station Current monitoring systems are used for a wide range of objectives from individual flyover noise levels through community noise exposure measures to supervision of aircraft flight tracks G R

A78-35668 # Planning and design of small airports in Canada D G Hubley (Saint Mary's University, Halifax, D G Hubley and Associates, St Catherine's, Ontario, Canada) *ASCE, Transportation Engineering Journal,* vol 104, May 1978, p 373-377

The design of Canadian airports having runways less than 1 6 km in length is discussed, with attention given to site selection, environmental considerations, and requirements for Visual Flight Rules zoning Site selection involves assessment of population distributions or the location of industrial projects, topographical, meteorological and geotechnical conditions, and the costs of land Air traffic limitations and government licensing requirements also figure in the planning procedures J M B

A78-35728 * Supercritical wing sections III F Bauer, P Garabedian, and D Korn (New York University, New York, N Y) Research supported by the Energy Research and Development Administration and NASA, Grants No NGR-33-016-167, No NGR 33-016-201, Contract No EY-76-C-02-3077 Berlin, Springer-Verlag (Lecture Notes in Economics and Mathematical Systems Volume 150), 1977 183 p $9 00

The book describes recent computational flow research on the design and analysis of supercritical wing sections The central object is a detailed description of a supercritical wing design code based on the concept of designing a shockless airfoil so that its pressure distribution very nearly takes on prescribed data The accompanying two dimensional analysis code with fast Poisson solver is also described FORTRAN listings are included along with a users manual for the design code Airfoils designed with the new code and data from analysis and experiment are provided A brief description of the method of complex characteristics is also given P T H

A78-35769 # On the noise generated by an imperfectly expanded supersonic jet M S Howe and J E Ffowcs Williams (Cambridge University, Cambridge, England) *Royal Society (London), Philosophical Transactions, Series A,* vol 289, no 1358, May 2, 1978, p 271-314 32 refs Research sponsored by Rolls-Royce, Ltd

An analytical model of the interaction between turbulent velocity fluctuations and the shock cell system of an imperfectly expanded jet is developed It is found that the scattered field consists of the direct scattered sound and internally scattered disturbances causing the decay of the shock cell system and creating a broadband spectrum of free space radiation The directivity of the direct scattered sound is uniform over a wide range of angles in the forward arc The peak radiation angle is approximately 70 degrees to the jet axis Forward aircraft flight raises the forward arc radiation levels The total sound power associated with shock cells has a 0 2 1 2% predicted efficiency, a value which agrees with experimental results S C S

A78-35786 Active control of airfoils in unsteady aero dynamics A V Balakrishnan (California, University, Los Angeles, Calif) *Applied Mathematics and Optimization,* vol 4, no 2, 1978, p 171-195 8 refs Grant No AF-AFOSR-73-2492

A mathematical formulation is developed for the aeroelastic problem concerning the behavior of an elastic body in an air stream with significant interaction and flow, with particular reference to the active control of flutter and gust loads in flexible flight vehicles A time-domain model is derived from the basic aerodynamic equations and appropriate boundary conditions The interaction of the aerodynamics with the structure motion, including the active-surface control dynamics (trailing-edge flap), is examined, and an input/output model essential for the needs of optimal-control theory is obtained It is shown that the theory of linear quadratic regulator provides the suitable design tool for both the flutter-suppression and gust-load alleviation problems No numerical calculations are presented S D

A78-35787 **Minimum drag surfaces** W W Hager (Carnegie-Mellon University, Pittsburgh, Pa) and J C W Rogers (Johns Hopkins University, Laurel, Md) *Applied Mathematics and Optimization,* vol 4, no 2, 1978, p 197-207 5 refs Navy-supported research

We consider existence, uniqueness, and computation of minimum drag shapes for projectiles subjected to both Newtonian pressure drag and skin friction drag Critical values of the drag coefficients are determined where the optimal shape changes from perfectly blunt to conical to partially blunt The existence proof, based on duality theory, provides an efficient algorithm for computing the optimal shape (Author)

A78-35893 **Supersonic transport in terms of energy savings (Le transport supersonique face aux économies d'énergie)** G Cormery (Société Nationale Industrielle Aérospatiale, Toulouse, France) *(Congres International Aéronautique, 13th, Paris, France, June 2, 3, 1977) L'Aéronautique et l'Astronautique,* no 69, 1978, p 3-14 In French

The utilization of petroleum-based fuel for civil aviation is considered within the framework of total energy consumption Attention is given to developments in the United States and France, both currently and over the near-term future (through the 1980s) Various improvements in engine and aerodynamic design are discussed, including use of composite materials, supercritical wings, high bypass engines, and improved engine geometries The Concorde aircraft is presented as a model upon which the design of a second, more fuel efficient supersonic transport can be based Also considered are schemes for noise reduction using reduced ejection velocities D M W

A78-35894 **Flight and wind tunnel measurements on the leading edge of a Nord-2501 wing (Mesures en vol et en soufflerie sur le bord d'attaque d'une aile de Nord 2501)** J Coulomb (Toulouse, Centre d'Essais Aeronautiques, Toulouse, France), M Ledoux, and J Lerat (ONERA, Châtillon-sous-Bagneux, Hauts de-Seine, France) *(Colloque d'Aérodynamique Appliquée, 14th, Toulouse, France, Nov 7-9, 1977) L'Aéronautique et l'Astronautique,* no 69, 1978, p 19-28 In French Research supported by the Direction Technique des Constructions Aeronautiques

Measuring devices built on to the leading edge of a Nord-2501 wing have provided data on pressure distributions for various levels of lift, with attention to Reynolds number Forty specific points on the leading edge were evaluated at constant temperature in terms of boundary layer dynamics Wind tunnel results were then compared to results obtained in flight It is found that the Michel criterion (R equals f(Rx)) provides a good analysis of turbulent effects under circumstances of boundary layer transition D M W

A78-35895 **Alignment of inertial navigation units on the Super-Etendard aircraft carrier (Alignement sur porte-avions des unités de navigation inertielle des Super-Etendard)** M de Cremiers (Societe d'Applications Generales d'Electricite et de Mecanique, Division Systemes Aeronautiques, Osny, Val-d'Oise, France) *L'Aéronautique et l'Astronautique,* no 69, 1978, p 29-31 In French

A78-35897 **Research in a pre-vaporization combustion chamber on natural gas in liquid and gaseous states (Recherches sur une chambre à pré-vaporisation alimentée en gaz naturel en phase gazeuze ou liquide)** G Matton (Valenciennes, Centre Universitaire, Valenciennes, Nord, France) and J -P Muller (Ecole Nationale Polytechnique, Algiers, Algeria) *L'Aéronautique et l'Astronautique,* no 69, 1978, p 57-77 44 refs In French

Phase diagrams derived from pre-vaporization combustion chamber observations are presented to support the contention that LNG or liquid methane could be employed as reliably as LH2 in aircraft fuel It is noted that LNG can be burned as effectively as natural gas in gaseous form, and can also be used to start gas jet turbines and increase overall power by bypassing the heat exchanger The cryogenic circuitry involved in aircraft applications is reviewed It is also pointed out that LNG can be used more safely than LH2 D M W

A78-35898 **Early warning aircraft (Les avions de détection lointaine)** G Bruner (Centre de Documentation de l'Armement, Paris, France) *L'Aeronautique et l'Astronautique,* no 69, 1978, p 79 91 In French

Three NATO aircraft, the Grumman E 2C Hawkeye developed for the U S Navy, the Boeing E-3A, and the Hawker Siddeley Nimrod AEW, are described in terms of their surveillance and detection and tracking avionics Attention is given to the design and operating parameters of the antenna systems (variations of the Doppler mode) of all three aircraft in general, and of the E 3A in particular Six functional groups of the E 3A are outlined surveil lance radar, identification scheme, central processor, display con soles, navigation equipment, and communications facilities It is noted that the E 3A is optimized for the man machine interface, i e , the nine Multi Purpose Consoles (MPC) and two Auxiliary Display Units (ADU) are outfitted with symbology which is easy for an operator to interpret The Beyond the Horizon (BTH) capability of the E-3A is also discussed D M W

A78-35905 # **Method for calculating the longitudinal, lateral, and cross aerodynamic derivatives of a flight vehicle at subsonic speeds (Metod rascheta prodol'nykh, bokovykh i perekrestnykh aerodinamicheskikh proizvodnykh letatel'nogo apparata na dozvukovykh skorostiakh)** F I Ganiev *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* Mar -Apr 1978, p 77-88 12 refs In Russian

The numerous contradictory requirements arising in the designing of modern aircraft necessitate the development of computer-aided methods for extensive parametric studies In the present paper an engineering method is proposed for calculating the pitch, roll, and yaw derivatives and the induced drag, with allowance for the thickness of the lifting surfaces, the nacelles, and similar elements, for a subsonic aircraft performing low-frequency harmonic vibrations Results obtained by the method are illustrated and discussed V P

A78-35910 # **Contribution to the theory of rotational swirling flows of an ideal gas in Laval nozzles (K teorii vikhrevykh zakruchennykh techenii ideal'nogo gaza v soplakh Lavalia)** Iu A Gostintsev and O A Uspenskii *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* Mar -Apr 1978, p 126-137 16 refs In Russian

An asymptotic solution to the direct problem of the swirling nozzle flow of an ideal gas is obtained in the form of a double series in powers of small parameters characterizing the wall curvature in the nozzle throat and the swirl intensity The solution is shown to generalize the results obtained by Hall (1962) for transonic nonswirling nozzle flows The behavior of the sonic line is studied as a function of the vorticity and the radius of curvature of the nozzle wall V P

A78-35916 # **Influence of slip on the aerodynamic behavior of a wing at hypersonic speeds (O vliianii skol'zheniia na aerodinamicheskie kharakteristiki kryla pri giperzvukovykh skorostiakh)** V N Golubkin *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* Mar -Apr 1978, p 192-195 13 refs In Russian

The behavior of a slender delta wing situated at a finite angle of attack in hypersonic attached flow is analyzed as function of the angle of sideslip Asymptotic formulas for a wing with hypersonic leading edges are derived on the basis of a modification of Hayes and Probstein's (1966) hypersonic flow theory The principal terms are obtained of an expansion (in a small parameter representing the density at the shock wave) for the rolling moment coefficient and its derivative with respect to the angle of sideslip V P

A78-35968 # **Solution of an integral equation describing the flow past a lifting surface (O reshenii integral'nogo uravneniia obtekaniia nesushchei poverkhnosti)** N N Poliakhov and O F Mel'nikova *Leningradskii Universitet, Vestnik, Matematika, Mekhanika, Astronomiia,* Jan 1978, p 123-128 In Russian

In the present paper, the problem of the inviscid incompressible flow past a wing of finite span is reduced to the solution of Poliakhov's (1973) singular integral equation for the vorticity density Approximate methods for solving the equation are evaluated, showing that an iterative method is superior to a successive approximation technique and to a method based on reducing the singular equation to a system of algebraic equations V P

A78 35974 **Applications of new visualization techniques to on-board equipment (Applications aux équipements de bord des nouvelles technologies de visualisation)** G Lefevre *France Transports - Aviation Civile,* Spring 1978, p 44-46 In French

Visualization techniques, such as cathode ray tubes, gas plasma emission system, electroluminescent diodes, liquid crystals, and systems employing electrolytic deposition of silver have applications to avionics The systems may involve overall or selective visualization and rely on either active (light-emitting) sources or passive technologies (diffusion, refraction or reflection) Attention is given to radial sweep CRT units, CRT systems, capable of visualizing alphanumeric characters or geometric images, and CRT devices employing color The resolution and power requirements of these and other visualization techniques are discussed J M B

A78-35975 **The reduction of the annoyance caused by subsonic jet aircraft noise (La reduction de la gêne causée par le bruit des aéronefs subsoniques a réaction)** J -P Troadec *France Transports - Aviation Civile,* Spring 1978, p 58 62 In French

Methods for measuring subsonic jet aircraft noise during the approach, landing and takeoff phases are discussed, and noise reduction techniques involving engine modifications or alterations in operating procedure are described The U S aircraft noise standards and the aircraft noise tolerances specified by ICAO are reviewed Engine noise sources, including compressors, fans, jets and internal sources, are considered, and engine noise reductions achieved by increasing the dilution rate are mentioned Operational procedures such as power cut back after takeoff and delayed flap approaches also receive attention J M B

A78-36111 # **Triangulation using high-flying targets on aircraft in the case of direction and range measurements (Trianguliatsiia na vysokie tseli s pomoshch'iu samoletov, esli izmeriaiutsia napravleniia i rasstoianiia)** J Kabelac (Observatoriia Astronomii i Geofiziki, Prague, Czechoslovakia) In International Symposium on Geodesy and Physics of the Earth, 3rd, Weimar, East Germany, October 25-31, 1976, Proceedings Part 3
Potsdam, Deutsche Akademie der Wissenschaften, Zentralinstitut fur Physik der Erde, 1977, p 945-951 In Russian

In August 1976 a study was made of the space triangulation of high-flying beacons Measurements were made of the direction and range between the station and the targets using laser devices Results are presented for the data reduction Future work will concentrate on increasing the accuracy of the results, the altitude of the beacons, and the range of ground measuring points S C S

A78-36114 # **Some experiments with satellite-navigation Doppler receivers Magnavox 'MX-902' and 'ITT-6001'** T Stupak, K Vorbrich (Polska Akademia Nauk, Astronomiczna Stacja Szerokosciowa, Borowiec, Poland), and J Wieckowski In International Symposium on Geodesy and Physics of the Earth, 3rd, Weimar, East Germany, October 25-31, 1976, Proceedings Part 3
Potsdam, Deutsche Akademie der Wissenschaften, Zentralinstitut fur Physik der Erde, 1977, p 967-988 9 refs

In this paper the functional descriptions of 'MX-902' and 'ITT 6001' receivers installed on board the Polish training merchant ship m/s 'Antoni Garnuszewski' are presented 'Fixes' results from two different receivers, obtained from the same group of satellite passes are shown An analysis of some satellite navigation positions obtained during the mooring and motion of the vessel are made Some remarks connected with applying NNSS for navigation at sea are discussed (Author)

STAR ENTRIES

N78-22020*# George Washington Univ Washington, D C School of Engineering and Applied Science
A MAINTENANCE MODEL FOR K-OUT-OF-N SUBSYSTEMS ABOARD A FLEET OF ADVANCED COMMERCIAL AIRCRAFT
Douglas R Miller Mar 1978 65 p refs
(Grant NsG-1338)
(NASA-CR-145272, TM-66502) Avail NTIS HC A04/MF A01 CSCL 05A

Proposed highly reliable fault-tolerant reconfigurable digital control systems for a future generation of commercial aircraft consist of several k-out-of-n subsystems Each of these flight-critical subsystems will consist of n identical components k of which must be functioning properly in order for the aircraft to be dispatched Failed components are recoverable they are repaired in a shop Spares are inventoried at a main base where they may be substituted for failed components on planes during layovers Penalties are assessed when failure of a k-out-of-n subsystem causes a dispatch cancellation or delay A maintenance model for a fleet of aircraft with such control systems is presented The goals are to demonstrate economic feasibility and to optimize Author

N78-22021# Air Force Inst of Tech Wright-Patterson AFB Ohio School of Engineering
IMPROVING READINESS A COST-EFFECTIVE APPROACH M S Thesis
David Dean Dawson Dec 1977 105 p refs
(AD-A050765 AFIT/GOR/SM/77D-4) Avail NTIS HC A06/MF A01 CSCL 14/1

This thesis develops and demonstrates a method for improving aircraft readiness by adding specific stocks to specific bases The effect of additional stockage on Not Operationally Ready Supply (NORS) is discussed The relationship of items requisitioned as NORS to NORS aircraft is investigated using eight months of reported NORS for the A7D Using an expression for expected NORS which is developed in the paper a method for improving readiness is presented The potential of the method is demonstrated using data on the F111 FB111 A7D and B52 Increases in readiness equivalent to several additional aircraft are shown to be possible for relatively very low investments A summary of eight months of NORS data for the F111 FB111 A7D B52 and C135 is also included GRA

N78-22025*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
LOW-SPEED AERODYNAMIC CHARACTERISTICS OF A 0 08-SCALE YF-17 AIRPLANE MODEL AT HIGH ANGLES OF ATTACK AND SIDESLIP
Daniel N Petroff Stanley H Scher and Carl E Sutton (ARO Inc Moffett Field Calif) Apr 1978 118 p refs
(NASA-TM-78438 A-7214) Avail NTIS HC A06/MF A01 CSCL 01A

Data were obtained with and without the nose boom and with several strake configurations also, data were obtained for various control surface deflections Analysis of the results revealed that selected strake configurations adequately provided low Reynolds number simulation of the high Reynolds number characteristics The addition of the boom in general tended to reduce the Reynolds number effects Author

N78-22028*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
EFFECTS OF STORES ON LONGITUDINAL AERODYNAMIC CHARACTERISTICS OF A FIGHTER AT SUPERSONIC SPEEDS
Samuel M Dollyhigh, Giuliana Sangiorgio and William J Monta Apr 1978 46 p refs
(NASA-TP-1175 L-11874) Avail NTIS HC A03/MF A01 CSCL 10C

Experimental investigations of single and twin stores representative of advanced elliptical cross section missile concepts were made at Mach numbers from 1 60 to 2 16 to substantiate theoretically predicted results The stores were mounted on the fuselage of a model representing a fighter configuration Store base closure effects in the carriage condition were also obtained through tests with and without base closure fairings Author

N78-22029# Toronto Univ (Ontario)
PRESSURE INSIDE A ROOM SUBJECTED TO SONIC BOOM
Nabil N Wahba May 1977 58 p refs
(UTIAS-TN-207 CN-ISSN-0082-5263) Avail NTIS HC A04/MF A01

The pressure field inside a room subjected to sonic boom was investigated in order to study the problems of dynamic structural response and crack propagation The data obtained *ultimately may be useful for the assessment of structural damage* caused by supersonic transport overflights The problem of a room with an open window exposed to sonic boom was considered to be analogous to that of a Helmholtz resonator which is externally excited The damping of the system was related to such physical quantities as the geometry of the room the size of the open window and the average absorption coefficient of the interior surfaces of the room An analytical method based on a Fourier transform was developed and used to study the effects of room volume, window area and type of N wave on the pressure time variations inside the room Author

N78-22032# ARO Inc Arnold Air Force Station Tenn
A PARAMETRIC INVESTIGATION OF THE ANNULAR JET CONCEPT FOR OBTAINING AFTERBODY DRAG DATA AT TRANSONIC MACH NUMBERS Final Report, 4-12 Nov 1976
Earl A Price, Jr AEDC Feb 1978 177 p refs
(AD-A050891 ARO-PWT-TR-77-69 AEDC-TR-77-104) Avail NTIS HC A09/MF A01 CSCL 20/4

A parametric experimental program was conducted at free-stream Mach numbers of 0 6, 0 9 and 1 2 to investigate the plume simulation characteristics of annular jets Plume simulation evaluation was based upon comparisons of afterbody pressure drag from integration of afterbody pressure measurements Data were obtained on a 15 deg boattail afterbody attached to a strut supported cylindrical centerbody Geometric variables covered a range of sting-to-nozzle exit diameter ratios from 0 to 0 95 and nozzle area ratios from 1 0 to 1 5 High pressure air at ambient temperature was utilized for the exhaust gas The results indicate that matching of the exhaust plume maximum diameter provides a reasonable afterbody drag correlation accounting for effects of annular jet, nozzle exit-to-throat area ratio, and nozzle pressure ratio for conditions where drag follows the classical trend indicative of a plume shape dependence Plume diameter correlation was not successful, for the pressure ratios of this investigation for annular jet configurations having sting-to-nozzle exit diameter ratios of 0 95 at all Mach numbers and 0 866 at Mach number 1 2 There were no significant differences in the trends with angle of attack between the annular and conventional jet configurations over the angle of attack range from -2 to 6 deg Author (GRA)

N78-22033# Advisory Group for Aerospace Research and Development, Paris (France)
UNSTEADY AERODYNAMICS
Feb 1978 609 p refs In ENGLISH partly in FRENCH Presented at the Fluid Dyn Panel Symp Ottawa 26-28 Sep 1977
(AGARD-CP-227, ISBN-92-835-0212-4) Avail NTIS HC A99/MF A01

The effects of unsteadiness on the aerodynamic characteristics of lifting surfaces and bodies are discussed Numerical analysis of three dimensional flow is emphasized

N78-22035*# Virginia Polytechnic Inst and State Univ Blacksburg Dept of Engineering Science and Mechanics
THREE DIMENSIONAL STEADY AND UNSTEADY ASYMMETRIC FLOW PAST WINGS OF ARBITRARY PLANFORMS
O A Kandil E H Atta and A H Nayfeh *In* AGARD Unsteady Aerodyn Feb 1978 19 p refs

(Grant NGR-47-004-090)
Avail NTIS HC A99/MF A01

The nonlinear discrete vortex method is extended to treat the problem of asymmetric flows past a wing with leading edge separation including steady and unsteady flows The problem is formulated in terms of a body fixed frame of reference and the nonlinear-discrete vortex method is modified accordingly Although the method is general only examples of flows past delta wings are presented due to the availability of experimental data as well as approximate theories Comparison of results with experimental results for a delta wing undergoing a steady rolling motion at zero angle of attack demonstrate the superiority of the present method over existing approximate theories in obtaining highly accurate loads Numerical results for yawed wings at large angles of attack are also presented In all cases total load coefficients pressure distributions, and shapes of the free vortex sheets are shown Author

N78-22036*# Boston Univ Mass Dept of Aerospace and Mechanical Engineering
STEADY, OSCILLATORY AND UNSTEADY, SUBSONIC AND SUPERSONIC AERODYNAMICS (SOUSSA) FOR COMPLEX AIRCRAFT CONFIGURATIONS
Luigi Morino and Kadin Tseng *In* AGARD Unsteady Aerodyn Feb 1978 14 p refs
(Grant NGR-22-004-030)
Avail NTIS HC A99/MF A01

The Green s function method and the computer program SOUSSA (Steady Oscillatory and Unsteady Subsonic and Supersonic Aerodynamics) are reviewed The Green s function method is applied to the fully unsteady potential equation yielding an integro-differential-delay equation This equation is approximated by a set of differential-delay equations in time using the finite element method The Laplace transform is used to yield a matrix relating the velocity potential to the normal wash The matrix of the generalized aerodynamic forces is obtained by premultiplying and postmultiplying the matrices relating generalized forces to the potential and the normal wash by the generalized coordinates The program SOUSSA is compared with existing numerical results Results indicate that the program is not only general, flexible and easy to use but also accurate and fast Author

N78-22037# University Coll London (England) Dept of Mechanical Engineering
FORCE MEASUREMENTS ON FINITE WINGS IN OSCILLATORY VERTICAL GUSTS
M H Patel *In* AGARD Unsteady Aerodyn Feb 1978 16 p refs
Avail NTIS HC A99/MF A01

Aerodynamic lift and pitching moment measurements on two finite wings in harmonic vertical oscillatory gusts of varying frequency parameter and gust amplitude are described The variation of aerodynamic force per unit gust amplitude with frequency parameter is shown to be independent of freestream velocity wing incidence and gust amplitude but is strongly influenced by wing sweep The tests on both wings are extended to the determination of aerodynamic force response to periodic vertical gusts which incorporate a combination of two harmonic frequency components The validity of the superposition concept for unsteady attached flow over finite wings is demonstrated by comparing the components of force response at each of the two forcing frequencies to the corresponding response at the single harmonic frequency Further measurements of lift pitching moment and rolling moment are presented for both wings at various attitudes of skew (in yaw) to a harmonic oscillatory gust front The effects of the resultant asymmetric lift distribution on the two wings halves are identified in the results with particular reference to the amplitudes and phases of oscillating rolling moments that are generated Author

N78-22038# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt Goettingen (West Germany) Inst fuer Aeroelastik
CALCULATION OF UNSTEADY AIRLOADS ON OSCILLATING THREE-DIMENSIONAL WINGS AND BODIES
Wolfgang Geissler *In* AGARD Unsteady Aerodyn Feb 1978 13 p refs
Avail NTIS HC A99/MF A01

A numerical method developed to calculate the steady and unsteady pressure distributions on harmonically oscillating three dimensional wings and bodies in subsonic flow is described The method is based on a complex velocity potential represented by appropriate singularity distributions on the real oscillating surfaces The exact geometric boundary condition on the arbitrary body surface is considered Oscillating three dimensional thin wings oscillating bodies at incidence and oscillating three dimensional wings with finite thickness and incidence were investigated intensively Numerical results for a variety of problems were compared to other analytical methods as well as experimental data Agreement was found to be satisfactory Author

N78-22042# National Aerospace Lab Amsterdam (Netherlands)
INVESTIGATION OF THE UNSTEADY AIRLOADS ON WING-STORE CONFIGURATIONS IN SUBSONIC FLOW
J W G VanNunen, R Roos, and J J Meijer *In* AGARD Unsteady Aerodyn Feb 1978 10 p refs

Avail NTIS HC A99/MF A01

The unsteady aerodynamic loading on oscillating wing-store configurations is considered Accurate prediction of the unsteady airforces introduced by wing mounted stores is emphasized Author

N78-22054# Illinois Inst of Tech , Chicago Dept of Mechanics, Mechanical and Aerospace Engineering
FEATURES OF UNSTEADY FLOWS OVER AIRFOILS
L S Gazana A A Rejer and M V Morkovin *In* AGARD Unsteady Aerodyn Feb 1978 11 p refs

Avail NTIS HC A99/MF A01

Sinusoidally oscillating flows over stationary NACA 0012 airfoils were studied at angles of attack close to the angle of stall in steady flow by means of hot wire surveys of the velocity field, surface pressure measurements and diagnostics with surface film gages and tufts At the moderate amplitude of these tests stall occurred at subcritical angle of attack and the flow was quasisteady below and above the angle when the frequency was low At higher frequencies this quasisteady behavior persisted below subcritical angle of attack but the unsteadiness did alter some of the details of the flow Author

N78-22055*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
DYNAMIC STALL OF AN OSCILLATING AIRFOIL
Unmeel B Mehta (Stanford Univ , Calif) *In* AGARD Unsteady Aerodyn Feb 1978 32 p refs Sponsored in part by ARMDL

(Contract NCA2-or745-602 Grant NSG-2253)
Avail NTIS HC A99/MF A01 CSCL 01A

Unsteady separated boundary layers and wakes were studied by investigating flow past an oscillating airfoil which in part models the retreating blade stall on the helicopters The Navier-Stokes equations in terms of the vorticity and stream function for laminar flow were solved to determine the flow field around a modified NACA 0012 airfoil After a fully developed flow was determined at zero incidence, the airfoil was oscillated in pitch through an angle of attack range from 0 deg to 20 deg The computed streamlines during this pitch-up motion are in qualitative agreement with the trajectories of air bubbles observed in water tunnel experiments conducted with a NACA 0012 airfoil under the same conditions During the

pitch-down motion of the airfoil the computed flow patterns cannot be compared with the experiments because the trajectories of air bubbles intersect Author

N78-22056# Georgia Inst of Tech, Atlanta School of Aerospace Engineering
A NUMERICAL STUDY OF UNSTEADY VISCOUS FLOWS AROUND AIRFOILS
J C Wu, S Sampath and N L Senkar *In* AGARD Unsteady Aerodyn Feb 1978 18 p refs

Avail NTIS HC A99/MF A01

The application of an integro-differential approach in the numerical study of unsteady viscous flow about airfoils is described Two different procedures are presented A procedure based on a stream function vorticity formulation and on a transformation technique was in a study of flow about an impulsively started 9% thick Joukowaki airfoil at an angle of attack of 15 deg and a Reynolds number of 1000 Numerical results are presented and compared with available finite difference results A second procedure based on a velocity vorticity formulation and on a hybrid finite difference-finite element technique is used in a study of flow about an oscillating 12% thick Joukowaki airfoil at a Reynolds number of 1000 With either procedure the ability of the integro-differential approach to confine the solution field to the vertical region of the flow was utilized It is shown that this ability offers great computational advantage Author

N78-22057*# Lockheed Missiles and Space Co Sunnyvale, Calif
SCALING PROBLEMS IN DYNAMIC TESTS OF AIRCRAFT-LIKE CONFIGURATIONS
Lars E Ericson and J Peter Reding *In* AGARD Unsteady Aerodyn Feb 1978 11 p refs

(Contracts NAS8-28130 NAS8-30652)
Avail NTIS HC A99/MF A01 CSCL 01C

To extrapolate from subscale wind tunnel tests to full scale flight is a well recognized problem It is especially critical for present day high performance aircraft and the space shuttle orbiter which operate under flight conditions where separated flow effects often dominate the vehicle aerodynamics In the case of dynamic tests it may not be possible to simulate flight conditions at subscale Reynolds number This is illustrated by example from two dimensional dynamic stall tests at low speeds and dynamic tests of fully three dimensional configurations at transonic speeds, such as the space shuttle orbiter It is shown how analytical means can be developed establishing theoretical relationships between dynamic and static aerodynamic characteristics and how such means make it possible to extrapolate analytically from subscale tests to full scale flight The role of future high Reynolds number facilities in establishing such analytic extrapolation tools is discussed Author

N78-22058# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt Goettingen (West Germany)
TWO-DIMENSIONAL VISCOUS-FLOW PAST AN AIRFOIL IN AN UNSTEADY AIRSTREAM
Robert B Kinney (Arizona Univ, Tucson) *In* AGARD Unsteady Aerodyn Feb 1978 14 p refs Sponsored in part by the Alexander von Humboldt Foundation

Avail NTIS HC A99/MF A01

Numerical predictions are made for the viscous flow field near an airfoil in an unsteady airstream of infinite extent Using an extension of techniques familiar to ideal fluid aerodynamic analyses the body is represented by bound vortex singularities These coexist with the free vorticity which forms the boundary layer and wakes Application of the no-slip condition at the airfoil surface plus the law of conservation of total vorticity allows the production of true vorticity at the airfoil surface to be modeled The velocity field is calculated using the law of induced velocities Results are presented for a symmetrical Joukowski airfoil of 9% thickness The airfoil is held fixed and initially the fluid is at rest At some instant the fluid is set into motion Two cases are treated the impulsive gust and the periodic gust Author

N78-22061# Institut de Mecanique des Fluides de Marseille (France)
THE DYNAMIC FLOW ON A WING PROFILE IN THE MOVEMENT OF A SCREEN THE INFLUENCE OF OSCILLATION PARAMETERS [RECOLLEMENT DYNAMIQUE SUR UN PROFIL D'AILE EN MOUVEMENT DE TAMIS INFLUENCE DES PARAMETRES D'OSCILLATION]
J Rebont (CNRS Marseilles (France)) C Maresca (CNRS, Marseilles (France)), D Favier (CNRS, Marseilles (France)) and J Valensi (Aix-Marseilles Univ (France)) *In* AGARD Unsteady Aerodyn Feb 1978 28 p refs In FRENCH

Avail NTIS HC A99/MF A01

The mechanics of dynamic flow were studied qualitatively and quantitatively on a wing profile of a NACA 0012 airfoil The wing placed at a fixed incidence, is moved by harmonic oscillations parallel to the uniform nonperturbated flow Flow characteristics were analyzed by comparing the vector development of total aerodynamic forces static pressure distributions and shear stress at the side of the profile, as well as the instantaneous flow visualizations at different phases in time Transl by B B

N78-22066# Detroit Diesel Allison Indianapolis Ind
AERODYNAMIC PHENOMENA IN AN OSCILLATING TRANSONIC MCA AIRFOIL CASCADE INCLUDING LOADING EFFECTS
Sanford Fleeter and Ronald E Riffel *In* AGARD Unsteady Aerodyn Feb 1978 16 p refs

(Contract N00014-72-C-0351)
Avail NTIS HC A99/MF A01

The steady, quasi-steady, and unsteady aerodynamics were determined for a multiple circular arc (MCA) airfoil cascade which modeled the tip section of an advanced design fan blade The steady airfoil surface aerodynamic performance of the cascade was measured at two levels of aerodynamic loading and correlated with the predictions from a time-marching, steady transonic flow analysis The chordwise distribution of the quasi-static unsteady pressure coefficient for a 0 deg interblade phase angle was determined and correlated with two appropriate predictions one based on the steady transonic analysis and the other on steady inviscid supersonic flat plate theory Finally, the MCA cascade was harmonically oscillated in the torsional mode at a reduced frequency value of 0 14 The fundamental unsteady aerodynamic data was obtained at a Mach number equal to 1 55 over a range of interblade phase angles for two values of the cascade static pressure ratio Results were correlated with the predictions from state-of-the-art unsteady flat plate cascade analyses Author

N78-22067# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany)
DETERMINATION OF THE VORTEX SHEDDING FREQUENCY OF CASCADE WITH DIFFERENT TRAILING EDGE THICKNESS
Hans-J Heinemann and Karl A Buetefisch *In* AGARD Unsteady Aerodyn Feb 1978 11 p refs

Avail NTIS HC A99/MF A01

An electro-optical method developed to determine the shedding frequency of the vortices in the wakes flow is used in testing the flow through various hub- mid- and tip-section turbine cascade for various downstream Mach numbers in the sub-and transonic flow regimes The trailing edge thickness of the blades vary from 0 8 to 5 percent of the blade chord length These trailing edges lead to higher frequencies than thicker ones at constant Mach numbers Author

N78-22068# Defense Systems Management School Fort Belvoir, Va
THE MSG-2 COMMERCIAL AIRLINE CONCEPT A DEPARTMENT OF DEFENSE PROGRAM FOR RELIABILITY-CENTERED MAINTENANCE

Francis William Ahearn Nov 1977 72 p refs
(AD-A050531) Avail NTIS HC A04/MF A01 CSCL 05/1

MSG-2 is a planning and analysis technique developed by the commercial airlines to streamline scheduled maintenance requirements by capitalizing upon the inherent reliability of systems and equipment through greater use of condition monitoring The study examines MSG-2 development in the commercial sector along with the substantial successes realized in reducing support costs that prompted the Department of Defense to incorporate MSG-2 into its own Reliability-Centered Maintenance (RCM) program Army, Navy, and Air Force approaches for implementing RCM are analyzed in detail The current status and future plans for aircraft/equipment programs subjected to the analysis are also examined Features of the three Services' approaches are contrasted and a number of conclusions are drawn concerning RCM training, contract versus organic efforts and new procurement versus existing inventory aircraft systems Finally several recommendations for further research and policy changes are suggested Author (GRA)

N78-22069# Electromagnetic Compatibility Analysis Center Annapolis, Md

PREDICTION MODEL OF ATCRBS TRANSIENT EFFECTS PERFORMANCE Final Report, 1974 - 1975

Norman Theberge (IIT Res Inst Annapolis Md) Jun 1976 53 p
(Contracts DOT-FA70WAI-175, F19628-76-C-0017, FAA Proj 213-661-10 AF Proj 649E)
(AD-A049811/3 ECAC-PR-76-017 FAA-RD-77-75) Avail NTIS HC A04/MF A01 CSCL 17/7

A pulse by pulse simulation of the air traffic control radar beacon system (ATCRBS) was adapted for use with the UNIVAC 1110 computer The model was made more flexible by adding the capability to use automated input information about ATCRBS and aircraft deployment A terrain mode was added so the effects of terrain on coverage can be assessed In addition routines were added that simulate the effects of staggered and jittered PRFs and transponder reply codes so that near synchronous interference problems, broken and false targets and other time-related anomalies can be investigated Code data sampling and code validation functions of the following digital processors were also included in the simulation ARTS III AN/TPX-42 and the AN/FYQ-49 common digitizer Author

N78-22071*# Systems Technology Inc Hawthorne Calif

DEVELOPMENT OF AUTOMATIC AND MANUAL FLIGHT DIRECTOR LANDING SYSTEMS FOR THE XV-15 TILT ROTOR AIRCRAFT IN HELICOPTER MODE

L G Hofmann Roger Hoh H, Wayne F Jewell Gary L Teper and Pradip D Patel Jan 1978 254 p refs
(Contract NAS2-9392)
(NASA-CR-152040 TR-1092-1) Avail NTIS HC A12/MF A01 CSCL 01E

The objective of this effort is to determine IFR approach path and touchdown dispersions for manual and automatic XV-15 tilt rotor landings and to develop missed approach criteria Only helicopter mode XV-15 operation is considered The analysis and design sections develop the automatic and flight director guidance equations for decelerating curved and straight-in approaches into a typical VTOL landing site equipped with an MLS navigation aid These system designs satisfy all known pilot-centered guidance and control requirements for this flying task Performance data obtained from nonstationary covariance propagation dispersion analysis for the system are used to develop the approach monitoring criteria The autoland and flight director guidance equations are programmed for the VSTOLAND 1819B digital computer The system design dispersion data developed through analysis and the 1819B digital computer program are verified and refined using the fixed-base, man-in-the-loop XV-15 VSTOLAND simulation Author

N78-22072 Oklahoma State Univ, Stillwater

AN ANALYTICAL AND EXPERIMENTAL STUDY OF THE DYNAMIC RESPONSE OF A SEMI-MONOCOQUE AIRCRAFT WING STRUCTURE Ph D Thesis

Thomas Denny Jordan 1976 161 p
Avail Univ Microfilms Order No 78-01274

The study was conducted in two phases analytical and experimental A finite element model for the dynamic response of an F-84 aircraft wing was developed that could be easily modified to incorporate structural changes This model was subsequently modified to predict the dynamic response of a damaged F-84 aircraft wing Guyan reduction was applied to the finite element model to minimize computer time storage and cost In conjunction with the analytical work an experimental program was conducted to determine the natural frequencies and mode shapes of the undamaged and damaged configurations The results from both phases are compared to determine the suitability of the analytical model Highly complex semi-monocoque structures could be modeled adequately with rod and shear panel finite elements and lumped mass Dissert Abstr

N78-22073*# National Aeronautics and Space Administration Washington D C

ALTERNATE-FUELED TRANSPORT AIRCRAFT POSSIBILITIES

W S Aiken France Assoc Aeronautique et Astronautique de France 1977 37 p refs Presented at The 13th Congr Intern Aeron Paris 2-3 Jun 1977
(NASA-TM-78330, Note-77-30, ISBN-2-7170-0455-6) Avail NTIS HC A03/MF A01 CSCL 01C

The paper is organized to describe (1) NASA s cryogenically fueled aircraft program (2) LH2 subsonic and supersonic transport design possibilities (3) the fuel system and ground side problems associated with LH2 distribution (4) a comparison of LCH4 with LH2, (5) the design possibilities for LCH4 fueled aircraft and (6) a summary of where NASA s cryogenically fueled programs are headed Author

N78-22074*# Boeing Commercial Airplane Co Seattle Wash Preliminary Design Dept

APPLICATION OF ADVANCED TECHNOLOGIES TO SMALL, SHORT-HAUL AIRCRAFT Final Report

D G Andrews, P W Brubaker S L Bryant, C W Clay, B Giridharadas M Hamamoto T J Kelly D K Proctor C E Myron and R L Sullivan 1 Mar 1978 332 p refs
(Contract NAS2-9506)
(NASA-CR-152089 D6-46320) Avail NTIS HC A15/MF A01 CSCL 01C

The results of a preliminary design study which investigates the use of selected advanced technologies to achieve low cost design for small (50-passenger) short haul (50 to 1000 mile) transports are reported The largest single item in the cost of manufacturing an airplane of this type is labor A careful examination of advanced technology to airframe structure was performed since one of the most labor-intensive parts of the airplane is structures Also preliminary investigation of advanced aerodynamics flight controls ride control and gust load alleviation systems aircraft systems and turbo-prop propulsion systems was performed The most beneficial advanced technology examined was bonded aluminum primary structure The use of this structure in large wing panels and body sections resulted in a greatly reduced number of parts and fasteners and therefore labor hours The resultant cost of assembled airplane structure was reduced by 40% and the total airplane manufacturing cost by 16% - a major cost reduction With further development, test verification and optimization appreciable weight saving is also achievable Other advanced technology items which showed significant gains are as follows (1) advanced turboprop-reduced block fuel by 15 30% depending on range (2) configuration revisions (vee-tail)-empennage cost reduction of 25% (3) leading-edge flap addition-weight reduction of 2500 pounds Author

N78-22075*# National Aeronautics and Space Administration Langley Research Center Langley Station Va

THE PROMISE OF ADVANCED TECHNOLOGY FOR FUTURE AIR TRANSPORTS

Robert E Bower Apr 1978 41 p refs Presented at the SAE Intern Air Transportation Conf Boston 1-4 May 1978
(NASA-TM-78712) Avail NTIS HC A03/MF A01 CSCL 01C

Progress in all weather 4-D navigation and wake vortex attenuation research is discussed and the concept of time based metering of aircraft is recommended for increased emphasis The far term advances in aircraft efficiency were shown to be skin friction reduction and advanced configuration types The promise of very large aircraft, possibly all wing aircraft is discussed, as is an advanced concept for an aerial relay transportation system Very significant technological developments were identified that can improve supersonic transport performance and reduce noise The hypersonic transport was proposed as the ultimate step in air transportation in the atmosphere Progress in the key technology areas of propulsion and structures was reviewed Finally the impact of alternate fuels on future air transports was considered and shown not to be a growth constraint

Author

N78-22076*# Sperry Flight Systems, Phoenix, Ariz

DESCRIPTION AND THEORY OF OPERATION OF THE COMPUTER BY-PASS SYSTEM FOR THE NASA F-8 DIGITAL FLY-BY-WIRE CONTROL SYSTEM Final Report

May 1978 99 p

(Contract NAS4-2248)

(NASA-CR-144865) Avail NTIS HC A05/MF A01 CSCL 01C

A triplex digital flight control system was installed in a NASA F-8C airplane to provide fail operate, full authority control The triplex digital computers and interface circuitry process the pilot commands and aircraft motion feedback parameters according to the selected control laws and they output the surface commands as an analog signal to the servoelectronics for position control of the aircraft's power actuators The system and theory of operation of the computer by pass and servoelectronics are described and an automated ground test for each axis is included

Author

N78-22077# Royal Aircraft Establishment, Farnborough (England)

THE COLLECTION AND ANALYSIS OF FATIGUE DAMAGE OCCURRING IN AIRCRAFT IN SERVICE

H Huth and D Shutz Aug 1977 31 p refs Transl into ENGLISH of "Sammlung und Analyse von im Betrieb von Luftfahrzeugen aufgetretenen ermudungsschaden', Lab fuer Betriebsfestigkeit, Darmstadt, 25 Nov 1976

(RAE-Lib-Trans-1934 BR61905) Avail NTIS HC A03/MF A01

In order to create guidelines for the planning of future research projects aimed at improving the fatigue strength of aircraft structures, data on fatigue damage occurring in service and in full scale tests have been collected and analysed A total of 529 cracks in 27 different samples have been covered These fatigue cracks have been classified, analysed, and evaluated statistically to enable evidence on the main weaknesses and causes of damage to be derived therefrom

Author

N78-22078# Sacramento Air Logistics Center McClellan AFB, Calif Aircraft Systems Engineering

F-111 DEPOT FUSELAGE FUEL TANK DESEAL/RESEAL PROCEDURES Final Report

P Steinweg 29 Apr 1977 226 p Supersedes AEI-200-1060

(AD-A050819, Rept-12AEI-200-1060B) Avail NTIS HC A11/MF A01 CSCL 01/3

The original EC5106 sealant in F-111 aircraft fuel tanks was deteriorating resulting in unacceptable leaks To correct this problem the tanks were to be desealed and resealed with MIL-S-83430 polysulfide sealant However laboratory tests indicated that the MIL-S-83430 sealant alone would be attacked by the reverted EC5106 sealant to the extent that the deseal/reseal process would be required again in about five years It is impossible to remove all the reverted sealant The Physical Sciences Laboratory Section of the Sacramento ALC Industrial Products Division determined by testing that EC2216 epoxy, added as a barrier would prevent damage to the MIL-S-83430 sealant for at least ten years The report establishes procedures to accomplish the complete desealing and resealing of F-111D aircraft, assuring a positive seal throughout all of the fuselage integral fuel tanks

Author (GRA)

N78-22079# Air Force Flight Dynamics Lab, Wright-Patterson AFB, Ohio Flight Vehicle Branch

FLIGHT PERFORMANCE OF THE BQM-34A TARGET DRONE WITH WING-TIP MOUNTED PODS Final Report, Dec 1974 - Jun. 1976

J P Boone, R W Blohm, and Russell F Osborn, Jr Sep 1977 237 p refs

(AD-A050834, AFFDL-TR-77-82) Avail NTIS HC A11/MF A01 CSCL 01/3

Flight performance of the BQM-34A aerial target configured with wing tip mounted pods is documented in this report Aerodynamic analysis along with flight test validation is presented and is used to update charts in the Flight Controller Manual the Technical Order 21M-BQM-34A-1 Data from 23 flights, representing the clean configuration plus three pod configurations, is presented The analysis methods, estimating drag increments caused by the pods are described as well as the data acquisition and processing methods

GRA

N78-22080# Army Inst for Advanced Russian and East European Studies, APO New York 09053

THE SOVIET ATTACK HELICOPTER

Kevin V Culhane Mar 1977 15 p

(AD-A050649) Avail NTIS HC A02/MF A01 CSCL 01/3

This paper examines the evolution of the Soviet attack helicopter through its initial gunship stages to the present sophisticated HIND D' Also it addresses the corresponding changes in Soviet helicopter tactics which have accompanied their increase in both firepower and maneuverability under the influence on Indochina and the Middle East experiences Finally a brief look is taken at possible future development of the attack helicopter force of the Soviet Union Specifically, the author predicts that the Soviets will forsake the present scout, attack and transport abilities of the Hind for a more powerfully equipped and more armored artillery platform type helicopter

Author (GRA)

N78-22081# Boeing Vertol Co Philadelphia, Pa

HLH ROTOR BLADE MANUFACTURING TECHNOLOGY DEVELOPMENT REPORT Final Report

Sep 1977 253 p

(Contract DAAJ01-71-C-0840)

(AD-A050592 D301-10280-1 USAAMRDL-TR-77-39) Avail NTIS HC A12/MF A01 CSCL 01/3

This document describes the manufacturing technology development effort for the HLH/ATC rotor blade Trade-off studies leading to the selection of the manufacturing and tooling concepts and the details of blade fabrication are described herein in addition the nondestructive test and other quality assurance techniques used to ensure development of a flight-worthy rotor blade are described Finally the tooling and fabrication changes being implemented as a result of full-scale blade testing in the last six months of the ATC program are presented The conclusions reached as a result of the 3-year HLH/ATC rotor blade manufacturing development effort have (1) verified the tooling and manufacturing approach utilized and (2) provided convincing evidence that the rotor blade design is cost-effective, producible and has the potential for high-rate low-cost production through automated tooling and manufacturing methods

GRA

N78-22083# Vereinigte Flugtechnische Werke-Fokker G m b H Bremen (West Germany)

BASIC AERODYNAMIC RESEARCH ON THE AIRFRAME INTEGRATION OF HIGH BYPASS ENGINES, PART 1 Final Report

Wolfgang Brix, Franz Fischer, Karl-Dieter Klevenhusen Claus Sommer and Ottmar Wehrmann Bonn Bundesmin fuer Forsch u Technol Nov 1977 192 p refs In GERMAN, ENGLISH summary

(Contract BMFT-LFF-33)

(BMFT-FB-W-77-20) Avail NTIS HC A09/MF A01 ZLDI, Munich DM 40,30

Some results of the VTOL basic research were utilized for investigating the airframe integration of high bypass engines The well known panel method was used for the theoretical work,

including engine jet effects It was necessary after the successful VFW 614 flight testing, to expand and consolidate the experience gained in the development of the VFW 614 in the field of airframe engine integration Research included experimental (force and pressure measurements) and theoretical work The effects of engine positioning on the aircraft aerodynamic coefficient are emphasized The jet effects are of great importance for the aerodynamic efficiency of this type of configuration The importance is confirmed of interference optimal engine positioning with its strong influence on the efficiency and quality of future civil aircraft development Author (ESA)

N78-22084# Vereinigte Flugtechnische Werke-Fokker G m b H, Bremen (West Germany)

SUPPORTING PROJECT ACTIVITIES IN THE CIVIL COMPONENTS PROGRAM 'WING SECTION' Final Report

Manfred Wittmann and Joachim Hempel Bonn Bundesmin fuer Forsch u Technol Oct 1977 58 p refs In GERMAN, ENGLISH summary Prepared jointly with MBB Hamburg
(Contract BMFT-LFK-7511/12)
(BMFT-FB-W-77-26) Avail NTIS HC A04/MF A01 ZLDI, Munich DM 12 20

The supporting project work for the Wing Section program should guarantee the application of the aerodynamic test results for an Airbus type aircraft This was accomplished by determining the market situation up to the 1990's and by taking into consideration the European Airlines Outline Requirements Possible engine-wing combinations including rear fuselage installations, are discussed The final chosen design is similar to the Airbus variant B 10 with a wing area of about 210 sq m The range of 1500 nm corresponds to the requirements of the European Airlines for short/medium haul aircraft Differences with the Airbus program are a reduced sweep angle larger wing thickness and a wing loading comparable to the B 10 X of HSA These changed parameters are strongly related to a supercritical wing profile and serve as inputs to the aerodynamic design of the wing Author (ESA)

N78-22085# Vereinigte Flugtechnische Werke-Fokker G m b H, Bremen (West Germany)

CIVIL COMPONENTS PROGRAM 'WING SECTION' *PRELIMINARY DESIGN OF MODEL WING AND PYLON* MOCK-UPS Final Report

Eckhard Meisel Bonn Bundesmin fuer Forsch u Technol Oct 1977 52 p In GERMAN ENGLISH summary
(Contract BMFT-LFK-7511)
(BMFT-FB-W-77-27) Avail NTIS HC A04/MF A01, ZLDI, Munich DM 10 95

A preliminary design of the large wind tunnel model which will be tested in the Modane S 1 tunnel was conceived Applicability of several structural designs with reference to stress, stiffness, integration of equipment cost, and workshop possibilities was studied A structural design with a welded hollow steel box and solid aluminum alloys deck planks was chosen for the final design Author (ESA)

N78-22086# Vereinigte Flugtechnische Werke-Fokker G m b H Bremen (West Germany)

CIVIL COMPONENTS PROGRAM 'WING SECTION' PRELIMINARY DESIGN OF ENGINE MOUNTING Final Report

Hartmut Drexhage Bonn Bundesmin fuer Forsch u Technol Oct 1977 35 p In GERMAN ENGLISH summary
(Contract BMFT-LFK-7511)
(BMFT-FB-W-77-28) Avail NTIS HC A03/MF A01 ZLDI, Munich DM 7 35

Preliminary design studies are reported on engine mounting and the mounting of the throughflow nacelle for wind tunnel testing The following problems are mentioned possibilities for separate engine mounting and synchronous incidence adjustment, adjustment possibilities adjustment drive, and adjustment control ESA

N78-22087# Vereinigte Flugtechnische Werke-Fokker G m b H Bremen (West Germany)

ENGINE PROCUREMENT FOR THE TEST PROGRAM 'CIVIL COMPONENTS PROGRAM WING SECTION' Final Report

Bernd Viebcke Bonn Bundesmin fuer Forsch u Technol Oct 1977 86 p In GERMAN ENGLISH summary
(Contract BMFT-LFK-7511)
(BMFT-FB-W-77-29) Avail NTIS HC A05/MF A01, ZLDI Munich DM 18,05

A real engine was chosen and modified for optimum simulation of the basic engines CFM 56/F1 B1 and CF 6-45 for experimental configuration studies of lift drag, and momentum A theoretical comparison of model engine characteristics with full scale engine characteristics is given and problems of transferring the results are discussed For the Astafan 2 A-engine of Turbomeca the working envelope of the wind tunnel S1MA in Modane is given and the preliminary tests are planned A rental contract between Turbomeca and VFW-Fokker with corresponding cost estimates was drafted It was found that the Astafan 2 A-engine is suitable for the test program and Turbomeca is willing to make the engine available for testing at ONERA (Modane) Author (ESA)

N78-22088# Vereinigte Flugtechnische Werke-Fokker G m b H, Bremen (West Germany)

CIVIL COMPONENTS PROGRAM 'WING SECTION' WING STRUCTURE PARAMETER STUDY Final Report

Rainer vomBaur and Herbert Sadowski Bonn Bundesmin fuer Forsch u Technol Oct 1977 67 p refs In GERMAN ENGLISH summary
(Contract BMFT-LFK-7511)
(BMFT-FB-W-77-30) Avail NTIS HC A04/MF A01 ZLDI Munich DM 14,10

The results of this parameter studied should facilitate the recording of the influence on the wing weight due to the change of essential wing parameters, especially in the early stage of the project phase It is known to be problematical to state correctly the weight changes of varying importance arising from parameter variation without carrying out thorough analytical examinations While elaborating this study several steps had to be passed in order to describe concisely in a diagram the influence of parameters varying the wing weight Results are discussed and some aspects of the production procedure and cost particularly the development and procurement cost and the direct operation cost are dealt with Author (ESA)

N78-22089# Vereinigte Flugtechnische Werke-Fokker G m b H, Bremen (West Germany)

CIVIL COMPONENTS PROGRAM 'WING SECTION' CONCEPT FOR LARGE MODEL TESTS AT MODANE Final Report

Gerhard Anders Eberhard Graewe, and Volker Renken Bonn Bundesmin fuer Forsch u Technol Oct 1977 76 p refs
(Contract BMFT-LFK-7511)
(BMFT-FB-W-77-31) Avail NTIS HC A05/MF A01 ZLDI Munich DM 16

The concept is introduced for the large scale model tests to be carried out in the large transonic windtunnel S 1 at Modane France The model arrangement and the testing concept is described The following subjects are discussed measuring system, data processing, and presentation A preliminary test program is presented for time and cost planning A time schedule gives a general survey of the whole project Author (ESA)

N78-22090# Messerschmitt-Boelkow-Blohm G m b H Hamburg (West Germany)

CIVIL COMPONENTS PROGRAM 'WING SECTION' POSITION OF STRUCTURE TRANSITION JOINTS, ARRANGEMENT OF LANDING GEAR Final Report

Karl Lettow and Hans Fischer Bonn Bundesmin fuer Forsch u Technol Nov 1977 26 p In GERMAN ENGLISH summary
(Contract BMFT-LFK-7512)
(BMFT-FB-W-77-36) Avail NTIS HC A03/MF A01, ZLDI, Munich DM 5,45

Proposals are made for the wing structure transition joints The space required for a retracted landing gear assuming a given profile and a given aircraft basic design was investigated ESA

N78-22091# Messerschmitt-Boelkow-Blohm G m b.H , Hamburg (West Germany)
CIVIL COMPONENTS PROGRAM 'WING SECTION'. MATERIALS SELECTION Final Report
Hans-Juergen Tilch Bonn Bundesmin fuer Forsch u Technol Nov 1977 53 p refs In GERMAN, ENGLISH summary
(Contract BMFT-LFK-7512)
(BMFT-FB-W-77-37) Avail NTIS HC A04/MF A01, ZLDI, Munich DM 10,70

The materials used for the wing main components of a number of modern transport aircraft are listed and a review is presented of new light metal alloys of high strength The possible use of composites is dealt with in particular This, in the case of a transporter of the 80 s, is restricted to certain structural component parts (fail-safe parts for security of testing) Material recommendations resulting herefrom, in regard to the main components of a new wing, refer mainly to aluminum alloys. These materials in view of their strength and price, will be the basic structural material in future civil aircraft Author (ESA)

N78-22092# Rolls-Royce Ltd , Derby (England)
SOME PRACTICAL LIMITATIONS TO FUEL-CONSERVATIVE CIVIL ENGINE TECHNOLOGY
P H Young Paris Assoc Aeron et Astronautique de France 1977 21 p refs Presented at the 13th Intern Aeron Congr , Paris, 3 Jun 1977
(AAAF-NT-77-29, ISBN-2-7170-0454-8) Avail NTIS HC A02/MF A01, CEDOCAR, Paris FF 15 (France and EEC) FF 19 (others)

The propulsion of future medium and long range subsonic civil aircraft launched before 1990 is discussed The engines will operate well into the 21st century when natural petroleum sources will dry up It is forecast that industry will find some means of providing the necessary fuel, which will be similar to current aviation fuels and even if it has to be manufactured from coal or shale, its price need not exceed 70 cents/USF at 1976 equivalent prices Hence lowest possible direct operating costs will continue to be the goal of engine optimization The predicted long term fuel price is shown to not significantly change the relative importance of weight and specific fuel consumption Also the future medium and long range engines will have the same overall pressure ratio and specific thrust The long term shortage of natural fuel does not improve the position of the heat exchanger cycle Research should continue to concentrate on weight reduction and component efficiency improvement The absolute importance in terms of money of first costs and part costs will not change The long term future of supersonic travel depends, apart from the problem of noise, on the achievement of direct operating costs similar to those of the subsonic competition ESA

N78-22093# Advisory Group for Aerospace Research and Development, Paris (France)
TECHNICAL EVALUATION REPORT ON THE MULTI-PANEL SYMPOSIUM ON FIGHTER AIRCRAFT DESIGN
H Andrews (Dept of the Navy, Washington, D C) and R J Balmer (British Aerospace Aircraft Group Kingston-Upon-Thames (England)) Feb 1978 14 p Symp held at Florence, 3-6 Oct 1977
(AGARD-AR-119 ISBN-92-835-1275-8) Avail NTIS HC A02/MF A01

The proceedings of a symposium on fighter aircraft design were evaluated The primary conclusions of the report are that technology is available in all areas of fighter design, to meet the military requirements for the 80's However, the cost of using the most advanced technology to meet every conceivable requirement can be exorbitant Cost-effectiveness is of vital importance Operational requirements must be carefully developed and clearly defined so as to ensure the most economical solution Fighter aircraft must be designed with sufficient flexibility to meet the changing needs during their service life Research and development should be directed towards those areas offering the most cost-effective solutions Author

N78-22094 Illinois Univ , Urbana-Champaign
DESIGN OF PROPELLERS FOR MINIMUM NOISE Ph.D. Thesis
Chung-Jin Woan 1977 205 p
Avail Univ Microfilms Order No 78-04196

The investigation was concerned with the theoretical design of propellers to obtain minimum noise, subject to constrains on the aerodynamic performance and wake configuration In this analysis which was based on both acoustic and aerodynamic considerations, attention was given only to the rotational noise due to static sources Based on lifting surface theory, the functional relation between the mean line at any radius the distribution of loading (circulation) and propeller blade thickness was developed Also developed was the functional relation between the ensemble mean square of acoustic pressure and the distribution of circulation and propeller blade thickness From these relations, a general problem of propeller design for minimum noise was stated In order to achieve a tractable numerical formulation of this general problem, the lifting surface model was further approximated by a lifting-line model Dissert Abstr

N78-22095 Maryland Univ , College Park
TURBOJET ENGINE PERFORMANCE AT HIGH TURBINE ENTRY TEMPERATURES WITH TRANSPIRATION COOLED TURBINE BLADING Ph.D. Thesis
Stuart William Greenwood 1977 186 p
Avail Univ Microfilms Order No 78-04493

An analytical and computational investigation was conducted on the design-point performance of turbojets operating at high turbine entry temperatures at combustor equivalence ratios as high as unity The turbines were transpiration cooled where necessary, by air fed from the compressor delivery and performance was examined for engines fitted with both single stage and two stage turbines The flight conditions considered were takeoff, subsonic cruise, and supersonic cruise at Mach 2 1 and Mach 2 7 The turbine design selected was a NASA turbine with geometric characteristics considered desirable for high temperature engines and incorporated thick blade sections, low blade solidity and blunt leading and trailing edges An analytical investigation was conducted to relate the secondary flow losses for this turbine to the two dimensional losses at the mean blade section Dissert Abstr

N78-22096*# Pratt and Whitney Aircraft Group, East Hartford, Conn
F100(3) PARALLEL COMPRESSOR COMPUTER CODE AND USER'S MANUAL Contractor Report, Mar. 1977 - Feb 1978
R S Mazzawy, D A Fulkerson D E Haddad and T A Clark May 1978 52 p refs
(Contract NAS3-20610)
(NASA-CR-135388 PWA-5549-8) Avail NTIS HC A04/MF A01 CSCL 21E

The Pratt & Whitney Aircraft multiple segment parallel compressor model has been modified to include the influence of variable compressor vane geometry on the sensitivity to circumferential flow distortion Further, performance characteristics of the F100 (3) compression system have been incorporated into the model on a blade row basis In this modified form, the distortion's circumferential location is referenced relative to the variable vane controlling sensors of the F100 (3) engine so that the proper solution can be obtained regardless of distortion orientation This feature is particularly important for the analysis of inlet temperature distortion Compatibility with fixed geometry compressor applications has been maintained in the model Author

N78-22098*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio
REDUCTION OF AIRCRAFT GAS TURBINE ENGINE POLLUTANT EMISSIONS Status Report
Larry A Diehl 1978 17 p refs Proposed for presentation at 71st Ann Meeting of the Air Pollution Control Assoc , Houston, Tex 26-30 Jun 1978
(NASA-TM-78870, E-9601) Avail NTIS HC A02/MF A01 CSCL 21E

To accomplish simultaneous reduction of unburned hydrocarbons, carbon monoxide, and oxides of nitrogen required major modifications to the combustor The modification most commonly used was a staged combustion technique While these designs are more complicated than production combustors, no insurmountable operational difficulties were encountered in either high pressure rig or engine tests which could not be resolved with additional normal development The emission reduction results indicate that reductions in unburned hydrocarbons were sufficient to satisfy both near and far-termed EPA requirements Although substantial reductions were observed, the success in achieving the CO and NOx standards was mixed and depended heavily on the engine/engine cycle on which it was employed Technology for near term CO reduction was satisfactory or marginally satisfactory Considerable doubt exists if this technology will satisfy all far-term requirements Author

N78-22099*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio

LEAN COMBUSTION LIMITS OF A CONFINED PREMIXED-PREVAPORIZED PROPANE JET

Kenneth L. Huck and Cecil J Marek Apr 1978 23 p refs (NASA-TM-78868, E-9453) Avail NTIS HC A02/MF A01 CSCL 21B

Lean blowout limits were reported for a premixed prevaporized propane jet issuing into a cylindrical combustor A single hole in a flat plate was used as a flameholder Flameholders with various hole diameters were used Jet velocities were varied from 3 to 290 meters per second The combustor cross sectional area was changed by using different quartz liners of 12 7 and 22 2 millimeters diameters As a result the combustor Reynolds number varied from 1000 to 9000 Stability was achieved at laminar as well as turbulent conditions Three zones of flame stability were observed The blowout equivalence ratio varied with step size and the combustor and jet Reynolds numbers The combustor inlet mixture temperature was 395 K, and the combustor pressure was 1 atmosphere Author

N78-22100*# Rockwell International Corp Columbus, Ohio Aircraft Div

STATIC TESTS OF A LARGE SCALE SWIVEL NOZZLE THRUST DEFLECTOR

John F Federspiel Feb 1978 44 p refs (Contract NAS2-9176) (NASA-CR-152091 NR78H-10) Avail NTIS HC A03/MF A01 CSCL 21E

Tests were conducted on a swivel nozzle thrust deflector installed on a 91 centimeter (36 inch) low pressure ratio tip turbine fan Fan power was supplied by a J-85 hot gas generator The configuration was typical of a vertical/short takeoff and landing (V/STOL) aircraft propulsion system employing lift cruise fans The performance was compared to results obtained on an 0 15 scale cold flow model Data were obtained at fan pressure ratios from 1 1 to 1 2 and at nozzle deflections from cruise (0 deg) to VTOL (90 deg) The nozzle thrust performance was in good agreement with small scale VTOL thrust coefficients Configurations with increased nozzle area showed lower performance Fan operation was routine and nozzle rotation caused no circumferential distortions of the fan exit flow Nozzle flow characteristics did not repeat small scale model results Measured flow coefficients were smaller on the large scale test It was concluded that lack of simulation of pressure and temperature profiles of the tip driven fan was the most probable cause of the discrepancy Author

N78-22101*# National Aeronautics and Space Administration Lewis Research Center, Cleveland Ohio

IN-PLACE RECALIBRATION TECHNIQUE APPLIED TO A CAPACITANCE-TYPE SYSTEM FOR MEASURING ROTOR BLADE TIP CLEARANCE

John P Barranger Apr 1978 35 p refs (NASA-TP-1110 E-9395) Avail NTIS HC A03/MF A01 CSCL 20E

The rotor blade tip clearance measurement system consists of a capacitance sensing probe with self contained tuning elements a connecting coaxial cable, and remotely located electronics Tests show that the accuracy of the system suffers from a strong dependence on probe tip temperature and humidity A novel inplace recalibration technique was presented which partly overcomes this problem through a simple modification of the electronics that permits a scale factor correction This technique, when applied to a commercial system significantly reduced errors under varying conditions of humidity and temperature Equations were also found that characterize the important cable and probe design quantities Author

N78-22103# Naval Ship Research and Development Center, Bethesda, Md Aviation and Surface Effects Dept

THE EFFECTS OF CAM AND NOZZLE CONFIGURATIONS ON THE PERFORMANCE OF A CIRCULATION CONTROL ROTOR PNEUMATIC VALVING SYSTEM Final Report, Oct. 1973 - Jan 1974

Kenneth R Reader Nov 1977 49 p refs (AD-A050494, DTNSRDC/ASED-393) Avail NTIS HC A03/MF A01 CSCL 13/11

Basic research was conducted on the sensitivity of such component parts of a cam-type pneumatic valving system as cam eccentricity nozzle aspect ratio, nozzle shape nozzle endplates, slot exit area, and transition zone between the nozzle and blade entrance Data are presented which show how systematic variations of these components affect the total pressure loss coefficient, the mass flow rate, and the jet velocity Information on the sensitivity of these parameters enhances the capabilities to design a cam-type pneumatic valve It was concluded that cam eccentricity had no effect on the characteristic curve for total pressure loss coefficient versus area coefficient GRA

N78-22104# Borst (Henry V) and Associates, Wayne, Pa

AERODYNAMIC DESIGN AND ANALYSIS OF PROPELLERS FOR MINI-REMOTELY PILOTED AIR VEHICLES. VOLUME 1. OPEN PROPELLERS Final Report, Jun. 1976 - Aug 1977

Henry V Borst Jan 1978 131 p refs (Contract DAAJ02-76-C-0031, DA Proj 1F2-62209-AH-76) (AD-A050593 USAAMRDL-TR-77-45A-Vol-1) Avail NTIS HC A07/MF A01 CSCL 01/3

This report presents the design and analysis of propellers applied to mini-remotely piloted vehicles Modifications to the airfoil data used for predicting the profile drag losses were necessary to account for operation at the low Reynolds number encountered by mini-RPV propellers Due to the lack of two-dimensional airfoil data the correction to the drag coefficient is only a function of the design lift coefficient and Reynolds number Using the revised methods of propeller analysis, six optimum propellers were designed and analyzed for two different RPVs The analysis showed that improved performance can be obtained with the new designs A ducted propeller with sufficiently low blade tip clearances was also analyzed This configuration appears to have superior performance to the open type propellers considered as well as a potential for reduced noise Propellers with variable blade angles also appear to offer advantages from both the noise and performance standpoints GRA

N78-22106# General Motors Corp Indianapolis, Ind Detroit Diesel Allison Div

THE EFFECT OF ROTOR-STATOR AXIAL SPACING ON THE TIME-VARIANT AERODYNAMIC RESPONSE OF A COMPRESSOR STATOR Final Report, 1 Nov. 1976 - 31 Oct. 1977

Sanford Fleeter, Robert L Jay and William A Bennett Dec 1977 161 p refs (Contract F49620-77-C-0024) (AD-A050648 DDA-EDR-9379, AFOSR-78-0165TR) Avail NTIS HC A08/MF A01 CSCL 21/5

The overall objective of this experimental program was to quantify the effects of rotor-stator axial spacing on the fundamental time-variant aerodynamics relevant to forced response in turbomachinery This was accomplished in a large-scale, low-speed, single-stage research compressor which permitted two rotor-stator axial spacing ratios representative of those found in advanced design compressors to be investigated At each value of the axial spacing ratio the aerodynamically induced fluctuating surface pressure distributions on the downstream vane row with

the primary source of excitation being the upstream rotor wakes were measured over a wide range of compressor operating conditions The velocity fluctuations created by the passage of the rotor blades were measured in the non-rotating coordinate system Data obtained described the variation of the rotor wake with both loading and axial distance from the rotor as parameters This data also served as a reference in the analysis of the resulting time-variant pressure signals on the vane surfaces GRA

N78-22107# Royal Netherlands Aircraft Factories Fokker Schiphol-Oost

GENERATION AND SUPPRESSION OF FAN-COMPRESSOR NOISE

S L Sarin 1977 22 p refs

(FOK-3-1823) Avail NTIS HC A02/MF A01

The generation mechanism of fan-compressor noise during the landing phase of an aircraft is dealt with Various techniques (reduction of interaction tones at the source flow choking use of acoustic liners) to suppress this component of total aircraft noise are described It is concluded that the choice of an optimum liner for the maximum possible suppression demands a predictive capability with regard to liner optimum impedance, and its translation into a real hardware and liner performance ESA

N78-22108# Vereinigte Flugtechnische Werke-Fokker G m b H , Bremen (West Germany)

LOW NOISE PROPULSION SYSTEM FOR GENERAL AVIATION Final Report on Definition Phase

Bernd Berdrow, Ekkehard Busch Bernd-Hagen Gruenewald Siegfried Heine Ulrich Kraemer Klaus Zimmermann Peter Giese Peter Schmidt-Stiebitz, Peter Limbach Friedrich Welbhoff et al Bonn Bundesmin fuer Forsch u Technol Dec 1977 384 p refs In GERMAN ENGLISH summary Prepared jointly with DFVLR Brunswick, Propellerwerk Hoffmann GmbH Rhein-Flugzeugbau GmbH Moenchengladbach Sportavia-Puetzer GmbH Dahlem Limbach-Motorenbau, Koenigswinter and Tech Hochschule Aachen

(Contract BMFT-LFK-7551-2)

(BMFT-FB-W-77-23) Avail NTIS HC A17/MF A01 ZLDI Munich DM 80 65

The program described is aimed at the development of low noise propulsion systems of up to 200 HP for general aviation The study is broken down into three stages (definition production and testing) The objective of the program is a noise reduction of 10 dB(A) in comparison to the 1975 LBA noise economy derived from standard passenger car engines A comprehensive noise study on possible propellers (including shrouded propellers) forms the basis for the propeller rpm s required for low noise propulsion systems The conversion of the high rpm s normal for passenger car engines to the low propeller rpm s required is via gearboxes, which are a fundamental problem dealt with The solution to the problem is given in the definition stage Studies on the installation of propulsion systems in existing airframes do not show particular problems Author (ESA)

N78-22109# Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Paris (France)

AMELIORATION OF VARIOUS COMPONENTS OF A SUBSONIC TRANSPORT AIRCRAFT ENGINE [L'AMELIORATION DES DIFFERENTS COMPOSANTS DE L'INSTALLATION MOTRICE D'UN AVION SUBSONIQUE DE TRANSPORT]

Jean Devriese Assoc Aeron et Astronautique de France 1977 21 p In FRENCH Presented at the 13th Intern Aeron Congr Paris 2-3 Jun 1977

(AAAF-NT-77-31 ISBN-2-7170-0456-4) Avail NTIS HC A02/MF A01, CEDOCAR Paris FF 15 (France and EEC) FF 19 (others)

Possibilities to further improve the third generation transport aircraft engines Rolls Royce RB 211 Pratt & Whitney JT 9D and General Electric CF6/50 notably as regards losses in the thermodynamic cycle are discussed The following topics are dealt with reduction of compressor losses reduction of turbine losses, mixers and exchangers and energy saving ESA

N78-22110# Environmental Protection Agency, Ann Arbor Mich Emission Control Technology Div

COST-EFFECTIVENESS ANALYSIS OF THE PROPOSED REVISIONS IN THE EXHAUST EMISSION STANDARDS FOR NEW AND IN-USE GAS TURBINE AIRCRAFT ENGINES BASED ON INDUSTRY SUBMITTALS

Richard S Wilcox and Richard Munt Dec 1977 30 p refs (PB-276508/9 AC-77-02) Avail NTIS HC A03/MF A01 CSCL 21E

Analysis of several control strategies were provided Those studied were the control of newly manufactured gas turbine engines in 1981 for HC and CO only retrofit of in use gas turbine engines in 1985 for HC and CO only, and the control of newly manufactured gas turbine engines in 1984 for HC CO and NOx Author

N78-22111# Advisory Group for Aerospace Research and Development, Paris (France)

AERODYNAMICS OF CASCADES

Norbert Scholz Jan 1978 604 p refs Transl into ENGLISH from Aerodynamik der Schaufelgitter West Germany 1965

(AGARD-AG-220) Avail NTIS HC A99/MF A01

Physical-phenomenological and the theoretical aspects of two dimensional cascade flows were examined as well as various experimental techniques and three dimensional flow problems Author

N78-22112# Toronto Univ (Ontario)

A REVIEW AND APPLICATION OF THE EQUIVALENT DETERMINISTIC VARIABLE TECHNIQUE THE ESTIMATION OF A STOL AIRCRAFT'S RESPONSE TO TURBULENCE

A B Markov and L D Reid Feb 1978 57 p refs

(Grants NRC A-7934 AF-AFOSR-3028-76A)

(UTIAS-221 CN-ISSN-0082-5255) Avail NTIS HC A04/MF A01

The equivalent deterministic variable technique is a method for determining the RMS response of a linear constant coefficient system to random inputs The mathematical development of this theory is reviewed The theory was applied to the prediction of the response of a STOL aircraft to low altitude turbulence The outstanding and limition features of the procedure are discussed from an applications point of view Author

N78-22113# Boeing Vertol Co Philadelphia Pa

HEAVY LIFT HELICOPTER FLIGHT CONTROL SYSTEM VOLUME 1 PRODUCTION RECOMMENDATIONS Final Report, Jul 1971 - Jul 1975

A J Niven Sep 1977 91 p refs

(Contract DAAJ01-71-C-0840)

(AD-A050618, D301-10322-1 USAAMRDL-TR-77-40A) Avail NTIS HC A05/MF A01 CSCL 01/3

This report defines the requirements for the Heavy Lift Helicopter (HLH) flight control system Production recommendations concerning the fly-by-wire mechanization concepts and the stability and control characteristics requiring augmentation are developed This report constitutes Volume 1 of the overall HLH flight control system study Associated documents are Volume 2 - Primary Flight Control System Development and Feasibility Demonstration and Volume 3 - Automatic Flight Control System Development and Feasibility Demonstration Volumes 2 and 3 expand the basic requirements set forth in this volume Author (GRA)

N78-22114# Dornier-System G m b H Friedrichshafen (West Germany)

OPEN LOOP GUST ALLEVIATION Final Report

Manfred Buchstaller Johannes Schroeder Peter Wuest, and Horst Wuennenberg Bonn Bundesmin fuer Forsch u Technol Nov 1977 113 p refs In GERMAN ENGLISH summary

(Contract BMFT-LFF-7606-6)

(BMFT-FB-W-77-22) Avail NTIS HC A06/MF A01 ZLDI Munich DM 23 10

The effectiveness of a simple gust alleviation system to improve ride quality during flights in rough air was studied with emphasis on the reduction of gust effects within the low and

medium frequency range The investigations were based on the data of an improved DO-28 and were carried out for both the open and the closed-loop philosophy Analog simulations and digital computations were performed The layout criterion was the reduction of the vertical accelerations due to turbulence The elevator and the ailerons were used as lift flaps for control inputs Results show very good effectiveness of both systems within the relevant frequency range A combination of the open and closed loop principle showed the best possible results The closed loop layout showed a remarkable result since a significant gust alleviation can be realized by using the elevator alone
Author (ESA)

N78-22115*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
APPARATUS FOR MEASURING AN AIRCRAFT'S SPEED AND HEIGHT Patent Application
William R Young and Charles W Stump inventors (to NASA) Filed 9 Mar 1978 14 p
(NASA-Case-LAR-12275-1 US-Patent-Appl-SN-885065) Avail NTIS HC A02/MF A01 CSCL 14B

The invention consists essentially of two ground positioned television cameras 11 and 12 separated by a measured distance and placed in line with the projection 13 of the expected path 14 of an aircraft 15 The circuitry is used to start the count on counter 26 when the aircraft passes through the field of view of camera 11 and to stop the count on counter 26 when the aircraft passes through the field of view of camera 12 The resulting count on counter 26 is proportional to the speed of the aircraft The count on counter 27 starts when the aircraft first enters the field of view of camera 11 and stops when the aircraft leaves the field of view of camera 11 After the speed has been determined the resulting count on counter 27 is proportional to the height of the aircraft
NASA

N78-22116# Transportation Research Board Washington, D C
BIBLIOGRAPHY AIRPORTS
Oct 1977 163 p
(Contract DOT-FA76WA-3872)
(AD-A049879/0 FAA-EM-77-15) Avail NTIS HC A08/MF A01 CSCL 01/5

The bibliography was prepared to illustrate input-output procedures that were proposed for the implementation of an Air Transportation Research Information Service (ATRIS) The proposed subject scope for ATRIS covers 21 areas that range from aircraft to travel and tourism The subject of airports was selected as the area for initial input to the ATRIS data base from which this bibliography has been produced The bibliography has 10 chapters on major aspects of airports, including access, environmental impact, planning and design safety and security, operations, and management The bibliography contains nearly 800 references that represent initial input to the machine-readable ATRIS data base The implementation plan calls for extending the data base to full coverage of all subject areas and to provide both on-line and off-line services to the air transport community A major purpose for the bibliography is to inform ATRIS users of the services that might be provided and through feedback from recipients of the bibliography to learn more about the needs and wants of users of air transport information
Author

N78-22117# Federal Aviation Administration Washinton, D C Office of Aviation System Plans
ESTABLISHMENT CRITERIA FOR VISUAL APPROACH SLOPE INDICATOR (VASI) Final Report
Jose Roman Jr May 1977 42 p refs
(AD-A043785, FAA-ASP-76-2) Avail NTIS HC A03/MF A01 CSCL 01/5

Revised establishment and discontinuance criteria were developed for visual approach slope indicator (VASI) which provide visual flight rules (VFR) guidance only Criteria are based upon detailed benefit/cost methodology which takes into account the number of aircraft landings by user class with variations depending upon whether or not the runway is equipped with an instrument landing system Benefits derived from a VASI are principally in the area of safety which are obtained by improved guidance during final VFR approaches Revised criteria require that a ratio value be computed for each of the three types of operations (air carrier, air taxi, and general aviation including military) The three ratios are then added to obtain a total ratio value and this is multiplied by the runway utilization to obtain a net ratio value If this net ratio value is equal to 1 or greater, then the runway is a candidate for a VASI In short term it is estimated that 590 runways now without a VASI will qualify Over the next ten years, and additional 388 runways are expected to qualify for a VASI

N78-22118# Army Engineer Waterways Experiment Station, Vicksburg, Miss Soil and Pavements Lab
DESIGN AND CONSTRUCTION OF CONTINUOUSLY REINFORCED CONCRETE AIRPORT PAVEMENTS Final Report
Gary G Harvey Aug 1977 93 p refs
(Contract DOT-FA71WAI-218)
(AD-A049970/7, AEWES-TR-S-77-11, FAA-RD-74-37) Avail NTIS HC A05/MF A01 CSCL 01/5

Design procedures recommended for immediate use in the construction of continuously reinforced concrete (CRC) airport pavements are presented The basic physical-mathematical model and applicable analyses are discussed Thickness design procedures for both new CRC pavements and CRC overlays are presented for both civil and military aircraft Methods for designing steel reinforcement, construction joints, and terminal treatment systems are included
Author

N78-22120# Army Engineer Waterways Experiment Station, Vicksburg, Miss
LAKE ERIE INTERNATIONAL JETPORT-MODEL FEASIBILITY INVESTIGATION REPORT 17-9. RESULTS OF NUMERICAL THREE-DIMENSIONAL WIND-DRIVEN CIRCULATION ANALYSIS FOR THERMALLY STRATIFIED LAKE CONDITIONS
Donald L Durham and Donald C Raney Jan 1978 88 p refs
(AD-A050614 AEWES-MP-H-76-3-9) Avail NTIS HC A05/MF A01 CSCL 04/2

The wind-driven circulation for thermally stratified lake conditions in a 16-mile by 16-mile nearshore region offshore Cleveland, Ohio is studied for existing conditions and conditions as modified by a proposed jetport island A steady-state 12 mph west wind which produced maximum jetport effects in a previous WES study of the steady-state wind-driven circulation for well-mixed lake conditions in the nearshore region offshore Cleveland, Ohio was chosen as the wind field for the model study
GRA

N78-22161*# Lockheed-California Co , Burbank
FLIGHT SERVICE EVALUATION OF KEVLAR-49 EPOXY COMPOSITE PANELS IN WIDE-BODIED COMMERCIAL TRANSPORT AIRCRAFT Annual Flight Service Report no 4
R H Stone Apr 1978 65 p refs
(Contract NAS1-11621)
(NASA-CR-145326, AR-4) Avail NTIS HC A04/MF A01 CSCL 11D

Kevlar-49 fairing panels, installed as flight service components on three L-1011s were inspected after four years service, and found to be performing satisfactorily The Kevlar-49 components were all found to be performing satisfactorily in service with no major problems, or any condition requiring corrective action The only defects noted were minor impact damage, and a minor degree of fastener hole fraying and elongation These are for the most part comparable to damage noted on fiberglass fairings A concurrent investigation was conducted on Kevlar-49/epoxy coupons exposed to an outdoor environment over a three year period at various locations providing a variety of climatic conditions Weight changes and retention of mechanical properties were determined after one and three years exposure A net weight loss occurred due to ultraviolet effects on the unpainted specimens Mechanical property retentions were satisfactory with most specimens retaining well over 80% of their original value
Author

N78-22165# TRW, Inc , Cleveland, Ohio
FRS COMPOSITES FOR ADVANCED GAS TURBINE ENGINE COMPONENTS Final Report
W D Brentnall Aug 1977 45 p refs
(Contract N62269-76-C-0355)
(AD-A050595, TRW-ER-7887-F, NADC-76077-30) Avail NTIS HC A03/MF A01 CSCL 11/4

Continued property characterization and fabrication process development of fiber reinforced superalloy (FRS) composites are described The current investigations included determination of impact toughness, low cycle fatigue properties, and thermal fatigue behavior of angle plied specimens in the W-1ThO2/FeCrAlY system Additionally, process feasibility studies were performed in the areas of monotape fabrication secondary bonding and hollow simulated airfoil fabrication The feasibility of using the Pre-consolidated monotape FRS blade fabrication process was demonstrated Author (GRA)

N78-22170# Association Aeronautique et Astronautique de France, Paris
BORON ALUMINUM COMPOSITE MATERIALS [LES MATERIAUX COMPOSITES BORE-ALUMINIUM]
Jean-Pierre Ferte 1977 28 p refs In FRENCH Presented at the Colloq on New Mater Bordeaux 20-22 Apr 1977
(AAAF-NT-77-38) Avail NTIS HC A03/MF A01 CEDOCAR, Paris FF 25 (France and EEC) FF 29 (others)

Boron aluminum composite materials, belonging to the most developed metal matrix composites, are discussed Manufacturing processes discussed are hot pressing in the semi-liquid phase, hot pressing in the solid phase, quick bonding and eutectic bonding The following mechanical properties are dealt with modulus of elasticity, rupture resistance, and thermal fatigue The influence of the environment on the properties of boron aluminum composites is also discussed influence of temperature on longitudinal resistance, extrusion thermal cycles, thermal dilatation, and impact resistance Applications in the aeronautical and aerospace industry, notably in compressor blades aircraft structure, and space vehicles, are mentioned ESA

N78-22211# Pratt and Whitney Aircraft Group West Palm Beach Fla Government Products Div
MACHINE CASTING OF HIGH TEMPERATURE ALLOYS FOR TURBINE ENGINE COMPONENTS Final Report, 1 Mar. 1976 - 30 Apr 1977
L F Schulmeister J D Hostetler, and C C Law Sep 1977 91 p refs
(Contract DAAG46-76-C-0029 ARPA Order 2267)
(AD-A050698, FR-8984, AMMRC-CTR-77-21) Avail NTIS HC A05/MF A01 CSCL 13/8

A program has been initiated to evaluate the capability of machine casting for fabricating components for gas turbine engines such as compressor airfoils The goal is to evaluate the capability of the process to produce an end product of high quality on an economic basis During this contract machine casting activity consisted of equipment modification to an existing machine casting unit which included mechanization of the process Concurrently statistical assessment of process parameter effects using Rheocast Haynes Alloy 31 (cobalt-base alloy) as a vehicle was performed Machine casting preforms containing varying volume fractions of solid were inspected at different die temperatures and injection speeds and were evaluated both non-destructively and metallographically Results indicated that quality of high volume fraction parts was improved using high injection speeds and low die temperatures An alternate die design was also evaluated Heat treatment response studies were also performed on machine cast specimens Results indicated that long term anneals followed by aging yielded microstructures similar to cast and heat treated Haynes 31 Mechanical property evaluation consisted of room temperature, 1000 F and 1450 F tensile testing 1450 F stress rupture and room temperature high cycle fatigue (HCF) testing Tensile data indicated that tensile design goals could be achieved Stress rupture and HCF goals were achieved through the use of hot isostatic capacitation to reduce internal porosity in the machine cast specimens GRA

N78-22223# Aubert et Duval Neuilly-sur-Seine (France)
MEDIUM AND HIGH RESISTANCE STEELS [ACIERS A MOYENNE ET HAUTE RESISTANCE]
R Ravez Paris Assoc Aeron et Astronautique de France 1977 17 p In FRENCH Presented at the Colloq on New Mater Bordeaux, 20-22 Apr 1977
(AAAF-NT-77-36 ISBN-2-7170-0461-0) Avail NTIS HC A02/MF A01 CEDOCAR, Paris FF 15 (France and EEC) FF 19 (others)

Some steels for aeronautical application are presented The steels are classified according to their resistance very high, high or medium The properties and applications of the most important steels of each group are discussed, with special emphasis on the new steels 300 M (very high resistance), 25 HP 9-4 (high resistance) 17-4 PH (high resistance, stainless) and maraging stainless (high resistance) It is concluded that although in aeronautics the utilization of steels decreases because wherever possible they are replaced by lighter materials steels are still useful, especially for the most critical components for which as yet no substitutes have been found ESA

N78-22240# Avions Marcel Dassault, Saint-Cloud (France)
STUDIES ON REINFORCED PLASTICS [DEVELOPPEMENT DES ETUDES SUR LES PLASTIQUES RENFORCES]
Maurice Emont Paris Assoc Aeron et Astronautique de France 1977 20 p In FRENCH Presented at the Colloq on New Mater Bordeaux 20-22 Apr 1977
(AAAF-NT-77-40 DGT-11-393/A ISBN-2-7170-0465-3) Avail NTIS HC A02/MF A01 CEDOCAR Paris FF 15 (France and EEC) FF 19 (others)

Experience gained in the use of boron fiber composite coatings of the internal grid structure of the rudders of modern aircraft is presented The coatings of such grids are exposed to both traction and compression Boron was therefore chosen because of the excellent properties in compression of boron preimpregnated epoxies It is concluded that in using boron coatings no major difficulties were encountered ESA

N78-22285# Naval Ocean Systems Center San Diego, Calif
COVERT COMMUNICATIONS BETWEEN PATROL AIRCRAFT IN RENDEZVOUS MILLIMETRE-WAVE AND ELECTROOPTICAL TECHNOLOGIES COMPARED WITH UHF LINK 4 FOR P-3 TO P-3 HAND-OVER IN A MARITIME ENVIRONMENT Final Report
L B Stotts, R T Kihm, R L Mather M E Hyde, and G C Mooradian 8 Nov 1977 121 p refs
(AD-A050771, NOSC/TR-174) Avail NTIS HC A06/MF A01 CSCL 17/2

In response to the fleet operational requirement for covert hand over between two P-3 patrol aircraft engaged in maritime surface/subsurface surveillance, trade-offs were addressed between two separate communication systems designed for such service - the first based on millimetre-wave technology, the other on electro-optical technology Under the most ideal interception conditions millimetre-wave and electro-optical technologies give comparable performance levels and both restrict communication to significantly lower maximum detectable range than do present UHF communication techniques Author (GRA)

N78-22383# Avions Marcel Dassault-Breguet Aviation, Saint-Cloud (France)
ELECTRON BEAM WELDING TITANIUM ELEMENTS OF AN AIRCRAFT STRUCTURE [ETUDE DU SOUDAGE PAR FAISCEAU D'ELECTRONS D'ELEMENTS EN TITANE DE STRUCTURE D'UN AVION]
Paris Assoc Aeron et Astronautique de France 1977 35 p In FRENCH Presented at the Colloq on Mater Bordeaux 21 Apr 1977
(AAAF-NT-77 4¢ DGT-12-675 ISBN-2-7170-0469-6) Avail NTIS HC A03/MF A01 CEDOCAR Paris FF 25 (France and EEC) FF 29 (others)

Electron beam welding of vital aircraft titanium alloy parts is dealt with Parameters for optimum welding are considered welding speed, power requirement, and focusing These parameters were determined from metallurgical and mechanical tests,

mainly fatigue tests Characteristics of the welded joints and their control after welding, are reported The following results were obtained welding speed 1 4 m/mn power 9 to 10 kW (50 kV 180 to 200 mA) focusing low A fatigue resistance reduction of the joint with respect to the base metal of the order of 10 % should be taken into account ESA

N78-22388# Royal Aircraft Establishment, Farnborough (England)
APPLICATION TO LIFE PREDICTION OF DESIGN DATA DERIVED FROM FATIGUE TESTS WITH SERVICE-LIKE LOAD SEQUENCES
D Schuetz and H Lowak Aug 1977 53 p refs Transl into ENGLISH of Zur Verwendung Von Bessungsunterlagen aus Versuchen mit Betriebsahnlichen Lastfolgen zur Lebensdauerabschatzung', Rept FB-109 Lab fuer Betriebsfestigkeit, Darmstadt, 1976
(RAE-Lib-Trans-1939 BR62233 FB-109) Avail NTIS HC A04/MF A01

Statistically verified life curves were established for a load sequence and cumulative frequency distribution typical of the wing structure of a transport aircraft It was demonstrated how life curves for other sequences could be predicted from this test data, using a relative miner rule data It was found that for large differences between the sequence for which an estimate was to be made and that for which design data was available, use of the relative miner rule does not predict life better than the use of usual miner rule A suitable correction was applied to the specimens using empirically derived data, and provided an effective refinement to the relative miner rule giving very accurate life predictions Author

N78-22551# National Oceanic and Atmospheric Administration Boulder Colo Wave Propagation Lab
ATMOSPHERIC PRESSURE JUMPS MEASURED WITH ARRAYS OF SENSITIVE PRESSURE SENSORS IN THE VICINITY OF CHICAGO'S O'HARE INTERNATIONAL AIRPORT
A J Bedard, Jr Oct 1977 32 p refs
(PB-277518/7, NOAA-TM-ERL-WPL-28) Avail NTIS HC A03/MF A01 CSCL 04B

An experiment designed to evaluate the use of arrays of sensitive pressure sensors for gustfront detection is described First results of the experiment demonstrated the feasibility of predicting the motion of such density currents by using an array of such sensors Using data sets obtained in June through August of 1976 implications for the design of arrays to provide warnings of gust front systems in airport environments are discussed Although over 80% of the pressure jumps over the O'Hare system were tracked, several events went undetected at two or more of the outer array locations It is therefore concluded that the optimum array density will involve a compromise between practicality and a need for high reliability in detection GRA

N78-22858*# Minnesota Univ Minneapolis Saint Anthony Falls Hydraulic Lab
ON AN ACOUSTIC FIELD GENERATED BY SUBSONIC JET AT LOW REYNOLDS NUMBERS
Kingo Yamamoto and Roger E A Arndt Mar 1978 215 p refs
(Grant NGR-39-009-270)
(NASA-CR-156182 Proj-Rept-170) Avail NTIS HC A10/MF A01 CSCL 20A

An acoustic field generated by subsonic jets at low Reynolds numbers was investigated This work is motivated by the need to increase the fundamental understanding of the jet noise generation mechanism which is essential to the development of further advanced techniques of noise suppression The scope of this study consists of two major investigation One is a study of large scale coherent structure in the jet turbulence and the other is a study of the Reynolds number dependence of jet noise With this in mind extensive flow and acoustic measurements in low Reynolds number turbulent jets (8 930 less than or equal to M less than or equal to 220 000) were undertaken using miniature nozzles of the same configuration but different diameters at various exist Mach numbers (0 2 less than or equal to M less than or equal to 0 9) Author

N78-22861*# Aeronautical Research Associates of Princeton Inc N J
APPLICATION OF THE BERNOULLI ENTHALPY CONCEPT TO THE STUDY OF VORTEX NOISE AND JET IMPINGEMENT NOISE Final Report
John E Yates NASA Washington Apr 1978 84 p refs
(Contract NAS1-14503)
(NASA-CR-2987) Avail NTIS HC A05/MF A01 CSCL 20A

A complete theory of aeroacoustics of homentropic fluid media is developed and compared with previous theories The theory is applied to study the interaction of sound with vortex flows for the DC-9 in a standard take-off configuration The maximum engine-wake interference noise is estimated to be 3 or 4 db in the ground plane It is shown that the noise produced by a corotating vortex pair departs significantly from the compact M scaling law for eddy Mach numbers (M) greater than 0 1 An estimate of jet impingement noise is given that is in qualitative agreement with experimental results The increased noise results primarily from the nonuniform acceleration of turbulent eddies through the stagnation point flow It is shown that the corotating vortex pair can be excited or de-excited by an externally applied sound field The model is used to qualitatively explain experimental results on excited jets Author

N78-23016*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
OPTIMUM HORIZONTAL GUIDANCE TECHNIQUES FOR AIRCRAFT
Heinz Erzberger and Homer Q Lee *In* NASA Washington Fourth Inter-Center Control Systems Conf Jan 1978 p 175-184 refs
Avail NTIS HC A22/MF A01 CSCL 17G

Some problems of automatic guidance of an aircraft in the horizontal plane are described The horizontal guidance tasks which such a flight control system should be capable of performing were identified as being of three types guiding the aircraft from any initial location and initial heading to (1) any final location and heading (2) intercept and fly along a line of specified direction and (3) a final location with arbitrary final heading Guidance problems such as capturing an ILS beam at a specified point on the beam intercepting a VOR radial and point-to-point navigation can be formulated in terms of these problems The guidance laws minimize the arc distance to fly between initial and final conditions subject to constraints on the minimum turning radius Author

N78-23017*# National Aeronautics and Space Administration Electronics Research Center Cambridge Mass
INERTIALLY-AIDED, ALL-WEATHER LANDING SYSTEMS FOR C/TOL
Robert J Pawlak *In* NASA Washington Fourth Inter-Center Control Systems Conf Jan 1978 p 185-197 refs

Avail NTIS HC A22/MF A01 CSCL 17G

Ways to improve significantly all-weather landing systems technology for conventional take-off and landing vehicles primarily, the large commercial jets, were studied It was concluded that there is a great deal to be gained by extensive use of inertial navigation system derived information primarily the translational information inherent in an inertial navigator for improving all-weather landing system performance Author

N78-23018*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
AN APPROACH TO THE DETERMINATION OF AIRCRAFT HANDLING QUALITIES USING PILOT TRANSFER FUNCTIONS
James J Adams and Howard G Hatch Jr *In* NASA Washington Fourth Inter-Center Control Systems Conf Jan 1978 p 199-216 refs
Avail NTIS HC A22/MF A01 CSCL 01C

It was shown that a correlation exists between pilot-aircraft system closed-loop characteristics determined by using analytical expressions for pilot response along with the analytical expression for the aircraft response and pilot ratings obtained in many previous flight and simulation studies Two different levels of preferred pilot response were used These levels were

(1) a static gain and a second-order lag function with a lag time constant of 0 2 second and (2) a static gain a lead time constant of 1 second and a 0 2-second lag time constant If a system response with a pitch-angle time constant of 2 6 seconds and a stable oscillatory mode of motion with a period of 2 5 seconds could be achieved with the first-level pilot model it was shown that the pilot rating will be satisfactory for that vehicle Author

N78-23019*# National Aeronautics and Space Administration Electronics Research Center Cambridge Mass
A FREQUENCY DOMAIN APPROACH TO HANDLING QUALITIES DESIGN
William A Wolovich *In* NASA Washington Fourth Inter-Center Control Systems Conf Jan 1978 p 217-236 refs

Avail NTIS HC A22/MF A01 CSCL 01C
A method for designing linear multivariable feedback control systems based on desired closed loop transfer matrix information is introduced The technique which was employed to achieve the final design was based on a theoretical result known as the structure theorem The structure theorem was a frequency domain relationship which simplified the expression for the transfer matrix (matrix of transfer functions) of a linear time-invariant multivariable system The effect of linear state variable feedback on the closed loop transfer matrix of the system was also clarified Author

N78-23020*# National Aeronautics and Space Administration Flight Research Center Edwards Calif
OPTIMAL REGULATOR OR CONVENTIONAL? SETUP TECHNIQUES FOR A MODEL FOLLOWING SIMULATOR CONTROL SYSTEM
Dwain A Deets *In* NASA, Washington Fourth Inter-Center Control Systems Conf Jan 1978 p 237-252 refs

Avail NTIS HC A22/MF A01 CSCL 14B
Optimal regulator technique was compared for determining simulator control system gains with the conventional servo analysis approach Practical considerations, associated with airborne motion simulation using a model-following system, provided the basis for comparison The simulation fidelity specifications selected were important in evaluating the relative advantages of the two methods Frequency responses for a JetStar aircraft following a roll mode model were calculated digitally to illustrate the various cases A technique for generating forward loop lead in the optimal regulator model-following problem was developed which increases the flexibility of that approach It appeared to be the only way in which the optimal regulator method could meet the fidelity specifications Author

N78-23021*# National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif
QUASI-OPTIMAL CONTROL OF A MOVING-BASE SIMULATOR
Elwood C Stewart *In* NASA Washington Fourth Inter-Center Control Systems Conf Jan 1978 p 253-259 refs

Avail NTIS HC A22/MF A01 CSCL 14B
The optimal control of a degree-of-freedom moving-base simulator is considered The quasi-optimal control method due to Friedland was utilized The problem in broad terms, was to determine a control law for moving the simulator cab so that its motion would (1) best approximate the desired aircraft response and (2) not exceed the limited translational capability of the simulator A variety of optimal responses were obtained by the method which emphasized different features of the response which were thought to be important in motion perception Examples of such results are given and the considerations important in initial subjective evaluations by experienced flight personnel are discussed Author

N78-23023*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
NORMAL SHOCK AND RESTART CONTROLS FOR A SUPERSONIC AIRBREATHING PROPULSION SYSTEM
George H Neiner Gary L Cole and Francis J Paulovich *In* NASA Washington Fourth Inter-Center Control Systems Conf Jan 1978 p 299-321 refs

Avail NTIS HC A22/MF A01 CSCL 21E
Results of experimental investigations to control a supersonic mixed-compression inlet coupled to a turbojet engine are presented Special instrumentation and servoactuators were developed to have sufficiently fast dynamic response so that basic propulsion system dynamics were the main limitation to controllability In some cases servoactuator input signals were electronically limited to simulate moderate performance flight hardware Author

N78-23024*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio
OPTIMAL CONTROL OF A SUPERSONIC INLET TO MINIMIZE FREQUENCY OF INLET UNSTART
Bruce Lehtinen, John R Zeller and Lucille C Geyser *In* NASA Washington Fourth Inter-Center Control Systems Conf Jan 1978 p 323-335 refs
Avail NTIS HC A22/MF A01 CSCL 21E
A preliminary investigation into the use of modern control theory for the design of controls for a supersonic inlet is described In particular the task of controlling a mixed-compression supersonic inlet is formulated as a linear optimal stochastic control and estimation problem An inlet can exhibit an undesirable instability due to excessive inlet normal shock motion For the optimal control formulation of the inlet problem, a non quadratic performance index which is equal to the expected frequency of inlet unstarts is used This physically meaningful performance index is minimized for a range of inlet disturbance and measurement noise covariances Author

N78-23028*# National Aeronautics and Space Administration Flight Research Center Edwards Calif
A NEW FORMULATION FOR THE EPSILON METHOD APPLIED TO THE MINIMUM-TIME-TO-CLIMB PROBLEM

Lawrence W Taylor Jr and Harriet J Smith *In* NASA Washington Fourth Inter-Center Control Systems Conf Jan 1978 p 423-434 refs
Avail NTIS HC A22/MF A01 CSCL 01C
Balakrishnan s epsilon technique is used to compute minimum-time profiles for the F-104 airplane This technique differs from the classical gradient method in that a quadratic penalty on the error in satisfying the equation of motion is included in the cost function to be minimized as a means of eliminating the requirement of satisfying the equations of motion Although the number of unknown independent functions is increased to include the state variables the evaluation of the gradient of the cost function is simplified resulting in considerable computational savings thereby making it appear feasible to use the epsilon method for real-time application Author

N78-23029*# National Aeronautics and Space Administration Langley Research Center, Langley Station, Va
DETERMINATION OF OPTIMAL CONTROL USING IMBEDDING OF THE TERMINAL CONDITIONS
Raymond C Montgomery *In* NASA Washington Fourth Inter-Center Control Systems Conf Jan 1978 p 435-442 refs
Avail NTIS HC A22/MF A01 CSCL 01C
The utility of a method to solve optimal control problems is discussed with emphasis placed on the solutions of singular optimal control problems The method involves imbedding the optimization problem of interest in a family of optimization problems which are parameterized by their terminal conditions The solution to the optimization problem is obtained by collapsing the terminal conditions of the family of problems onto those of the original problem, while appropriately modifying the control function to account for the changing terminal conditions The utility of this method is illustrated by obtaining the solution to an aerial attack problem where the attacking vehicle must maneuver subject to control limitations so as to place the enemy

in a certain relative position for launching a missile in the shortest possible time Author

N78-23038# European Space Agency, Paris (France)
METROLOGY OF AIRCRAFT OVERFLIGHT NOISE ERRORS DUE TO ITS NONSTATIONARY CHARACTER
Max Ernoult *In its* La Rech Aerospatiale, Bi-monthly Bull No 1977-4 (ESA-TT-428) Nov 1977 p 66-86 refs Transl into ENGLISH from La Rech Aerospatiale Bull Bimestriel (Paris) no 1977-4, Jul-Aug 1977 p 245-254 Original report in FRENCH previously announced as A77-50441

Avail NTIS HC A05/MF A01

Techniques for measuring noise during aircraft overflights are described, with emphasis on the correction of errors due to the nonstationary nature of the received acoustic signals Acoustic noise received by a fixed ground microphone is modeled as a Gaussian, nonstationary random process, the estimation bias, variance and mean square error are calculated for a stationary process modulated by an exponential Optimal integration times for minimizing the mean square error are given The results of the analysis, presented in graphical form may be of use in interpreting spectral analyses of the acoustic noise and in choosing the most appropriate parameters for the analysis Author (ESA)

N78-23047*# National Aeronautics and Space Administration Langley Research Center, Langley Station Va
PROGRESS IN SUPERSONIC CRUISE AIRCRAFT TECHNOLOGY
Cornelius Driver May 1978 19 p refs Presented at the CTOL Transport Tech Conf Hampton, Va 28 Feb - 3 Mar 1978
(NASA-TM-78695, L-12274) Avail NTIS HC A02/MF A01 CSCL 02A

The Supersonic Cruise Aircraft Resarch (SCAR) program identified significant improvements in the technology areas of propulsion aerodynamics, structures, take-off and landing procedures, and advanced configuration concepts A brief overview of the highlights of the NASA supersonic technology program is presented Author

N78-23049 Georgia Inst of Tech , Atlanta
NUMERICAL STUDY OF LAMINAR UNSTEADY FLOW OVER AIRFOILS Ph D Thesis
Narayanamoorthy Lakshmi Sankar 1977 207 p
Avail Univ Microfilms Order No 78-04528

A numerical scheme for the solution of two dimensional incompressible Navier-Stokes equations was developed with *special emphasis on laminar flow around oscillating airfoils* An explicit integral relationship was used to determine the velocity field in terms of vorticity and velocity boundary conditions The *accuracy and the flexibility of the method were demonstrated* by considering two test cases involving bodies of simple geometry The method was applied to the study of viscous flow over an oscillating Joukowski 12% airfoil The viscous drag coefficient was found to be the chief contributor to the total drag whenever the separated flow region on the upper surface of the airfoil was not appreciably large Dissert Abstr

N78-23050 Georgia Inst of Tech , Atlanta
PRESSURE MEASUREMENTS NEAR THE TIP OF A HOVERING MODEL ROTOR BLADE AND A PRELIMINARY INVESTIGATION OF THE FLOW IN THE ROTOR WAKE Ph D Thesis
Tumkur Parameswaraiah Shivananda 1977 212 p
Avail Univ Microfilms Order No 78-04529

Pressure measurements were made over the tip region of a hovering rotor blade with the aim of understanding more about the generation of the tip vortex Blade tip surface pressures were measured in detail for blade pitch angles of 0 deg 6 2 deg and 11 4 deg These angles correspond to thrust coefficients of 0 0 0026 and 0 0055 The pressure measurements were made at six radial stations outboard of the 94% radial location on the rotor blade At 0 deg pitch angle the measured pressure distribution in the tip region was in good agreement with the pressure distribution obtained from semi-infinite wing theory Instantaneous velocity components were measured in detail in the near-wake of the rotor at several radial and axial stations by using a hot-film vector anemometer Dissert Abstr

N78-23052*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
EXPERIMENTAL RESULTS OF WINGLETS ON FIRST, SECOND, AND THIRD GENERATION JET TRANSPORTS
Stuart G Flechner and Peter F Jacobs May 1978 19 p refs Presented at the CTOL Transport Tech Conf Hampton Va , 28 Feb - 3 Mar 1978
(NASA-TM-72674 L-12263) Avail NTIS HC A02/MF A01 CSCL 01A

The results of wind tunnel investigations of winglets on four *jet transport configurations are presented* Performance and wing root bending moment data were given Additionally detailed aerodynamic characteristics are presented at the design condition and also at several off design conditions for one configuration Results of the investigations indicate that the winglets improve the cruise lift to drag ratio between 4 and 8 percent These data also show that the ratios of relative aerodynamic gain to relative structural weight penalty for winglets are 1 5 to 2 5 times the ratios for wing tip extensions The comprehensive investigation of the effects of winglets indicated that winglets produce no adverse effects on buffet onset lateral directional stability and aileron control effectiveness Author

N78-23054*# National Aeronautics and Space Administration *Langley Research Center Langley Station Va*
A COMPUTER PROGRAM FOR CALCULATING SYMMETRICAL AERODYNAMIC CHARACTERISTICS AND LATERAL-*DIRECTIONAL STABILITY DERIVATIVES OF WING-BODY* COMBINATIONS WITH BLOWING JETS
C Edward Lan (Kansas Univ Lawrence) Sudhir C Mehrotra (*Kansas Univ Lawrence*) and Charles Fox Mar 1978 177 p refs
(NASA-TM-78684) Avail NTIS HC A09/MF A01 CSCL 01A

The necessary information for using a computer program to calculate the aerodynamic characteristics under symmetrical flight conditions and the lateral-directional stability derivatives of wing-body combinations with upper-surface-blowing (USB) or over-wing-blowing (OWB) jets are described The following new features were added to the program (1) a fuselage of arbitrary body of revolution has been included The effect of wing-body interference can now be investigated and (2) all nine lateral-directional stability derivatives can be calculated The program is written in FORTRAN language and runs on CDC Cyber 175 and Honeywell 66/60 computers Author

N78-23056*# National Aeronautics and Space Administration Hugh L Dryden Flight Research Center Edwards Calif
FLIGHT-MEASURED BUFFET CHARACTERISTICS OF A SUPERCRITICAL WING AND A CONVENTIONAL WING ON A VARIABLE-SWEEP AIRPLANE
Richard C Monaghan May 1978 39 p refs
(NASA-TP-1244 H-991) Avail NTIS HC A03/MF A01 CSCL 01A

Windup-turn maneuvers were performed to assess the buffet characteristics of the F-111A aircraft and the same aircraft with a supercritical wing which is referred to as the F-111 transonic aircraft technology (TACT) aircraft Data were gathered at wing sweep angles of 26 35 and 58 deg for Mach numbers from 0 60 to 0 95 Wingtip accelerometer data were the primary source of buffet information The analysis was supported by wing strain-gage and pressure data taken in flight, and by oil-flow photographs taken during tests of a wind tunnel model In the transonic speed range the overall buffet characteristics of the aircraft having a supercritical wing are significantly improved over those of the aircraft having a conventional wing Author

N78-23059# Air Force Systems Command Wright-Patterson AFB Ohio Foreign Technology Div
SUPERSONIC FLOW-AROUND OF THIN BODIES WITH MACH NUMBER CLOSE TO UNITY

G F Sigalov 20 Dec 1977 6 p refs Transl into ENGLISH from Dopov Akad Nauk Ukr RSR Ser A (Kiev) v 33 no 11 1977 p 1023-1027
(AD-A051884 FTD-ID(RS)T-1784-77) Avail NTIS HC A02/MF A01 CSCL 20/4

Problem solving of full approximation of non-linear differential equation of supersonic gas dynamics in a physical space is investigated by means of linear equation of space approximation Author (GRA)

N78-23060# ARO Inc Arnold Air Force Station Tenn
AN AERODYNAMIC COEFFICIENT PREDICTION TECHNIQUE FOR SLENDER BODIES WITH LOW ASPECT RATIO FINS AT MACH NUMBERS FROM 0.6 TO 3.0 AND ANGLES OF ATTACK FROM 0 TO 180 DEGREES Final Report, 1 Jul 1974 - 1 Aug 1977
William B Baker, Jr Mar 1978 361 p refs
(AD-A051797 AEDC-TR-77-97) Avail NTIS HC A16/MF A01 CSCL 20/4

In order to extend the state-of-the-art aerodynamic coefficient prediction methodology at high angles of attack a semi-empirical prediction technique has been developed for the prediction of normal force and pitching moment coefficients for slender body alone and slender body plus fin configurations Additionally installed fin normal force root bending and hinge moment coefficients are calculated The semi-empirical prediction technique is valid for slender bodies with low aspect ratio fins at Mach numbers from 0.6 to 3.0 and angles of attack from 0 to 180 degrees The range of validity of the prediction technique for the low aspect ratio fins is aspect ratio from 0.5 to 2.0, taper ratio from 0 to 1.0 and span ratio from 0.3 to 0.5 Wind tunnel testing was accomplished in order to provide the data base from which the prediction technique was derived The data base provides the first parametric set of data at angles of attack from 0 to 180 degrees, and not only provided the base for the semi-empirical prediction technique developed herein, but will provide a standard of comparison for high angle of attack prediction methodology developed in the future Author (GRA)

N78-23062# Air Force Systems Command, Wright-Patterson AFB Ohio Foreign Technology Div
METHOD OF CALCULATION OF NONSTATIONARY AERODYNAMIC CHARACTERISTICS OF A LOW-FLYING WING WITH A CYLINDRICAL FUSELAGE
L G Tsvetkov 20 Oct 1977 17 p refs Transl into ENGLISH from Tr Leningrad Koroblestroitelnogo Inst (USSR) no 80, 1972 p 115-123
(AD-A051978, FTD-ID(RS)T-1818-77) Avail NTIS HC A02/MF A01 CSCL 20/4

Algebraic formulas are derived for determining the velocities of various horseshoe-shaped vortices on the wing Zhukovskiy formulas are then used to determine the total aerodynamic characteristics of a lifting wing with a cylindrical fuselage A R H

N78-23064# Naval Ship Research and Development Center Bethesda Md Aviation and Surface Effects Dept
THE PERFORMANCE OF A CONCEPTUAL MULTIMISSION POWER-AUGMENTED-RAM WING-IN-GROUND EFFECT VEHICLE Final Report, Jun - Sep. 1977
Basil S Papadales, Jr Sep 1977 40 p refs
(AD-A051433 DTNSRDC/ASED-395) Avail NTIS HC A03/MF A01 CSCL 01/3

Results of a conceptual design study of a power augmented ram wing-in-ground effect vehicle are presented The vehicle is designed for sea control operations Four vertical/short takeoff and landing aircraft are carried for these operations Alternative payloads designed for transoceanic transport, strategic deterrence, and theater air defense missions are investigated Vehicle performance for the various operations is shown to provide a unique military capability assuming reasonable advances in power augmented ram wing-in-ground effect technology Author (GRA)

N78-23067# Royal Aircraft Establishment Farnborough (England) Structures Dept
THEORETICAL DETERMINATION OF SUBSONIC OSCILLATORY AIRFORCE COEFFICIENTS
D E Davies London Aeron Res Council 1978 116 p refs Supersedes RAE-TR-76059, ARC-36914
(ARC-R/M-3804 RAE-TR-76059, ARC-36914) Avail NTIS HC A06/MF A01 HMSO £9 PHI $34 70

The theoretical method presented for the calculation of the linearized values of generalized airforce coefficients on a harmonically oscillating flat plate wing in subsonic flow is a further development of the lifting surface theory of Multhopp type and has been justified mathematically The method of spanwise integration is refined and the number of upwash points taken may be greater than the number of basic functions used in the approximation for the loading The refined method of spanwise integration leads to improved accuracy in the evaluated values of upwash especially near the perimeter of the planform By taking more upwash points than the number of basic loading functions more accurate values should be obtained for the generalized airforce coefficients for a given number of basic functions The procedure was programmed in ICL 1900 FORTRAN The program was used to obtain results for tapered swept and rectangular wings Author (ESA)

N78-23068# Royal Aircraft Establishment Farnborough (England) Aerodynamics Dept
VORTEX BREAKDOWN SOME OBSERVATIONS IN FLIGHT ON THE HP 115 AIRCRAFT
L J Fennell London Aeron Res Council 1977 21 p refs Supersedes RAE-TR-71177 ARC-34400
(ARC-R/M-3805, RAE-TR-71177 ARC-34400) Avail NTIS HC A02/MF A01 HMSO £3 PHI $11 55

A technique for observing flow in vortex cores in flight is presented and the results of flight tests to study vortex breakdown using the HP 115 aircraft are presented ESA

N78-23070*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
FLIGHT EXPERIMENTS TO IMPROVE TERMINAL AREA OPERATIONS
Seymour Salmirs and Samuel A Morello May 1978 31 p refs Presented at the CTOL Transport Tech Conf Hampton Va 28 Feb - 3 Mar 1978
(NASA-TM-78685 L-12235) Avail NTIS HC A03/MF A01 CSCL 17G

A brief description is given of the objectives and activities of the terminal configured vehicle (TCV) program and of some of the airborne facilities A short analysis of some particular problems of CTOL operations in the terminal area is also presented to show how the program s technical objectives are related to the defined problems The test aircraft was flown both manually and automatically with manual monitoring over paths including 130 deg intercepts and 2.0 km (1.1 n mi) and 0.8 km (0.44 n mi) finals Some statistical data are presented from these and other flight profiles designed to address specific terminal in the next biennium and their application to the terminal area A description of work being undertaken to study the addition of adjacent traffic information to present map displays is also given Author

N78-23071# Army Research and Technology Labs Fort Eustis Va
A STUDY OF THE DESIRABILITY AND FEASIBILITY OF IN-FLIGHT ESCAPE FROM ARMY HELICOPTERS
John F Tansey Nov 1977 32 p refs
(DA Proj 1L2-62209-AH-76)
(AD-A051153 USARTL-TN-27) Avail NTIS HC A03/MF A01 CSCL 06/7

This report reviews the feasibility and desirability of helicopter emergency escape systems from the Army s viewpoint Accident statistics, nap-of-the-earth flight human reaction times and crashworthy designs are considered and the positions of various U S Army organizations are included The escape systems reviewed include ejection and extraction seats and passenger helicopter systems Author (GRA)

N78-23073# Technische Universitaet Brunswick (West Germany) Sonderforschungsbereich 58 - Flugfuehrung
FLIGHT SAFETY HAZARDS BY SHEAR WINDS

Peter Krauspe Sep 1977 22 p refs In GERMAN, ENGLISH summary
(TUBS/SFB58/62) Avail NTIS HC A02/MF A01

The existing aircraft landing and takeoff procedures are examined in view of their wind shear compatibility Meteorological wind shear is described from a flight technical point of view Aircraft reactions to wind shear are outlined for several flight phases (landing-takeoff) The possibility of wind shear elimination is discussed and relevant effects to wind shear problems are reviewed ESA

N78-23074# IIT Research Inst Annapolis Md
PROPOSED METHODS AND CRITERIA FOR ATCRBS PRF ASSIGNMENT Final Report, 1974 - 1975
C Randall Crawford Aug 1976 47 p refs
(Contracts DOT-FA70-WAI-175 F19628-78-C-0006)
(AD-A050050/4 ECAC-PR-76-030 FAA-RD-77-89) Avail NTIS HC A03/MF A01 CSCL 17/7

A model was designed to aid in selecting a pulse repetition frequency (PRF) for the air traffic control radar beacon system (ATCRBS) A discussion of the mechanisms of near synchronous interference and the various remedies available is presented Both false target inducing near synchronous replies and transponder lockout were considered Among the considerations for reducing near synchronous interference are pulse repetition period separations distance separations between sites with like PRF s staggered and jittered PRF s target detection parameter adjustments Author

N78-23075# Rome Air Development Center Griffiss AFB N Y
ANALYSIS AND TEST OF THE REDUCED HEIGHT PERFORMANCE OF THE AN/GRN-27 ILS SYSTEM COURSE AND CLEARANCE NEAR FIELD DETECTOR ANTENNAS
J McIlvenna, C Paprocki C Drane and E Christopher Nov 1977 33 p refs
(AD-A051456 RADC-TR-77-392) Avail NTIS HC A03/MF A01 CSCL 09/5

The report consists of three parts The first is a computer analysis of the reduced height performance of a four-element Yagi antenna over a variety of real earth conditions The second is a computer analysis of the Yagi antennas as near field detectors in the AN/GRN-27 ILS system Coupled to this is an analysis and experimental check of the reduced height Yagi performance in the MRN-7 localizer antenna modification to the GRN-27 ILS system The last part is an analysis and prediction of the Yagi performance in a second modification to the GRN-27 system that uses a log periodic type of a localizer antenna Author (GRA)

N78-23078# Standard Electrik Lorenz A G Stuttgart (West Germany)
DME-BASED SYSTEM FOR ENROUTE/TERMINAL NAVIGATION, ALL-WEATHER LANDING AND AIR TRAFFIC CONTROL
K D Eckert [1976] 13 p
Avail NTIS HC A02/MF A01

The DME system, which has found wide spread worldwide application in the civil and military area as well includes due to its ingenious signal format and the very economic channeling scheme, a considerable potential for additional applications Today s navigation and air traffic control systems have at least partly reached their limits of improvement and extension as the call for a Microwave Landing System (MLS) proves The growth potential of the ICAO-standardized Distance Measuring Equipment (DME) allows for various operational extensions by improving the distance measuring system to Precision Distance Measuring System (PDME) and using DME interrogations by direction finders on the ground measuring azimuth and elevation The operational applications of these features are the DME-based Landing System (DLS), the FRGs contribution to the international MLS competition of ICAO the additional use of the DLS-A ground subsystem as TMA-navaid, the extension of this principle to the enroute-navigation called DENS for DME-based Enroute Navigation System, the universal DLS/DME/DENS = DLENS airborne equipment and last but not least the step into the ATC/CAS-field with DACS (DME-based Air traffic Control System) The paper explains the systematic and technical background of this aeronavigational system An analysis of the various subsystems detailing these advantages compared to today s installations dealing with the areas of operational performance and economic efficiency mainly is given Author (ESA)

N78-23080*# Lockheed-California Co , Burbank
FLIGHT SERVICE EVALUATION OF AN ADVANCED COMPOSITE EMPENNAGE COMPONENT ON COMMERCIAL TRANSPORT AIRCRAFT PHASE 1 ENGINEERING DEVELOPMENT Final Report, 9 Jun - 31 Dec 1975
A Ary, C Axtell, L Fogg, A Jackson, A James, B Mosesian, J Vanderwier and J VanHamersveld May 1976 199 p refs
(Contract NAS1-14000)
(NASA-CR-144986 LR-27543) Avail NTIS HC A09/MF A01 CSCL 01C

The empennage component selected for this program is the vertical fin box of the L-1011 aircraft The box structure extends from the fuselage production joint to the tip rib and includes the front and rear spars Various design options were evaluated to arrive at a configuration which would offer the highest potential for satisfying program objectives The preferred configuration selected consists of a hat-stiffened cover with molded integrally stiffened spars, aluminum trussed composite ribs and composite miniwich web ribs with integrally molded caps Material screening tests were performed to select an advanced composite material system for the Advanced Composite Vertical Fin (ACFV) that would meet the program requirements from the standpoint of quality reproducibility and cost Preliminary weight and cost analysis were made, targets established and tracking plans developed These include FAA certification ancillary test program quality control and structural integrity control plans Author

N78-23081*# Mississippi State Univ Mississippi State Dept of Aerophysics and Aerospace Engineering
PILOT EVALUATION OF SAILPLANE HANDLING QUALITIES Final Report
A G Bennett, Jr May 1978 91 p refs
(Grant NsG-1284)
(NASA-CR-2960) Avail NTIS HC A05/MF A01 CSCL 01C

The evaluation sailplanes were found generally deficient in the area of cockpit layout The pilots indicated general dissatisfaction with high pitch sensitivity especially when ctoupled with inertially induced stick forces While all sailplanes were judged satisfactory for centering thermals and in the ease of speed control in circling flight pilot opinions diverged on the maneuvering response pull-out characteristics from a dive, and on phugoid damping Lateral-directional control problems were noted mainly during takeoff and landing for most sailplanes with the landing wheel ahead of center of gravity Pilot opinion of in-flight lateral-directional stability and control was generally satisfactory Five of the evaluation sailplanes exhibited a very narrow airspeed band in which perceptible stall warning buffet occurred However this characteristic was considered not objectionable when stall recovery was easy The pilots objected to the characteristics of a wide airspeed band of stall warning followed by a stall with yawing and rolling tendency and substantial loss of altitude during the stall Glide path control for the evaluation sailplanes was found to be generally objectionable Author

N78-23082# AiResearch Mfg Co Phoenix Ariz
EVALUATION OF A PRESSURIZED AIR START SYSTEM FOR ADVANCED ARMY HELICOPTERS Final Technical Report
J A Rhoden Nov 1977 181 p
(Contract DAAJ02-77-C-0007 DA Proj 1L2-62209-AH-76)
(AD-A051967 USAAMRDL-TR-77-46 AiResearch-41-1810A)
Avail NTIS HC A09/MF A01 CSCL 21/5

This report presents the results of an evaluation of a pressurized air start system (PASS) for advanced Army helicopters PASS is a new concept for starting gas turbine propulsion engines that currently use electric starters in conjunction with nickel-cadmium batteries PASS is a stored energy start system using air as the working fluid In addition to starting the engine by pressurized air the engine can be started using pneumatic ground

carts or bleed air from another engine The study included a design evaluation of a PASS for both single- and twin-engine helicopters In addition a comparison of a PASS and an equivalent electric start system was made on the basis of performance weight reliability maintainability vulnerability and life-cycle cost The logistics of operating the PASS using current and planned ground support equipment was studied The results of the comparison indicated that PASS offers the following improvements over electric starting Engine start times can be reduced significantly System weight is lower Maintenance requirements can be reduced Reliability is improved significantly and Life-cycle cost can be reduced 30 to 40 percent

Author (GRA)

N78-23083# Army Research and Technology Labs Fort Eustis Va

A TECHNIQUE FOR MONITORING FLIGHT-TEST ENVELOPE EXPANSION Final Report

Donald N Arents Dec 1977 16 p refs

(DA Proj 1L2-63211-D-157)

(AD-A051163 USARTL-TN-28) Avail NTIS HC A02/MF A01 CSCL 01/3

A technique for monitoring flight-test envelope expansion is described This Smart Book technique was used for the successful helicopter mode envelope expansion of the XH-59A Advancing Blade Concept (ABC) technology demonstrator aircraft The technique contributed to the safety and success of the XH-59A program provided control over the envelope expansion and constituted a technical focal point that enhanced coordination between the Government and contractor test team members

Author (GRA)

N78-23085# National Aerospace Lab Amsterdam (Netherlands) Structures and Materials Div

A NON-STATIONARY MODEL FOR ATMOSPHERIC TURBULENCE PATCHES FOR THE PREDICTION OF AIRCRAFT DESIGN LOADS

R Noback 19 Nov 1976 68 p refs

(Contract NIVR-1775)

(NLR-TR-76131-U) Avail NTIS HC A04/MF A01

A model for atmospheric turbulence is proposed based on the assumption that atmospheric turbulence appears in patches and that within the patches the turbulence can be described as a modulated Gaussian process Statistical properties of this model and of atmospheric turbulence are compared Using data from various sources a probability distribution function for patch lengths is derived and the relation between patch-intensity and patch length is investigated Author (ESA)

N78-23086# Royal Aircraft Establishment Bedford (England) Structures Dept

A FLIGHT INVESTIGATION OF THE SPANWISE LIFT REQUIREMENTS OF A HELICOPTER ROTOR BLADE

M J Riley London Aeron Res Council 1978 37 p refs Supersedes RAE-TR-76117 ARC-37080

(ARC-R/M-3812 RAE-TR-76117 ARC-37080) Avail NTIS HC A03/MF A01 HMSO £4 PHI $15 30

Surface roughness was applied systematically to portions of the leading edge of the blades of a Wessex helicopter to reduce the local value of the maximum lift coefficient The extent to which the inner portions of the blade could sustain a reduced maximum lift coefficient without reaching limiting control loads was investigated In this way some measure of the degree to which reflex camber with the associated small reduction in maximum lift coefficient might be used inboard to offset the undesirable pitching moments of high performance sections nearer the blade tip was obtained In a similar way but using local radial bands of roughness in the tip region those areas of the blade which can provide the largest potential gain from an improved lifting capability have been identified Author (ESA)

N78-23087# Air Force Instrument Flight Center Randolph AFB Tex

EVALUATION OF JET 2 INCH STANDBY FLIGHT INSTRUMENT SYSTEM Final Report

James F Barnette 5 Jan 1978 19 p

(AD-A051798 USAFIFC-TR-78-1) Avail NTIS HC A02/MF A01 CSCL 01/4

A pilot factors evaluation of a 2 inch Standby Flight Instrument System has been conducted to determine its acceptability for use in Air Force aircraft The standby system consists of an attitude indicator airspeed/Mach indicator altimeter and directional gyro indicator Ten subject pilots selected from USAFIFC personnel and students attending the USAF Instrument Pilot Instructor School participated in the evaluation Overall subject pilot performance on the 2 inch display was excellent however a higher level of effort and concentration was required to obtain desired performance on the display than the subject pilots normally expended on their primary instrument systems The attitude indicator airspeed/Mach indicator and altimeter are acceptable for installation in US Air Force aircraft with only minor cosmetic changes GRA

N78-23088*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio

SUPERSONIC THROUGH-FLOW FAN ENGINES FOR SUPERSONIC CRUISE AIRCRAFT

Leo C Franciscus Apr 1978 53 p refs

(NASA-TM-78889 E-9626) Avail NTIS HC A04/MF A01 CSCL 21E

Engine performance weight and mission studies were carried out for supersonic through flow fan engine concepts The mission used was a Mach 2 32 cruise mission The advantages of supersonic through flow fan engines were evaluated in terms of mission range comparisons between the supersonic through flow fan engines and a more conventional turbofan engine The specific fuel consumption of the supersonic through flow fan engines was 12 percent lower than the more conventional turbofan The aircraft mission range was increased by 20 percent with the supersonic fan engines compared to the conventional turbofan Author

N78-23089*# General Electric Co Cincinnati Ohio

QCSEE TASK 2 ENGINE AND INSTALLATION PRELIMINARY DESIGN Final Report

R Neitzel R Lee and A J Chamay Jun 1973 350 p refs

(Contract NAS3-16726)

(NASA-CR-134738) Avail NTIS HC A15/MF A01 CSCL 21E

High-bypass turbofan engines with features required for commercial short haul powered lift transports were designed Two engines were configured for each of the externally blown flap installations under-the-wing and over-the-wing Estimates of installed and uninstalled performance noise and weight were defined for each propulsion system Author

N78-23090# Cambridge Univ (England) Dept of Engineering

EXPERIMENTAL STUDY ON BLADE BENDING VIBRATION

T Matsuura 1977 32 p refs

(CUED/A-Turbo/TR-88 ISSN-0309-6521) Avail NTIS HC A03/MF A01

Experiments were performed on the forced vibration of cascade blades due to the upstream periodic wakes The resonance vibration amplitude and phase of the 1st bending mode were measured in a compressor rotor with the h/t ratio of 0 4 Smith's unsteady lift coefficients were used, and the mechanical damping of the blade was introduced to predict the resonance amplitude and phase Reasonable agreement was seen between the measured results and the prediction The results show that Smith's theory can well be applied to the prediction of the resonance vibration of the three dimensional cascade blades if the mechanical damping and the vibration mode shape are taken into account

Author

N78-23091# Cambridge Univ (England) Whittle Lab

THE MEASUREMENT AND INTERPRETATION OF FLOW WITHIN ROTATING STALL CELLS IN AXIAL COMPRESSORS

I J Day and N A Cumpsty 1977 58 p refs
(CUED/A-Turbo/TR-90) Avail NTIS HC A04/MF A01

Detailed measurements have been made with hot wires and fast response pressure transducers in axial compressors operating in rotating stall Builds with from one to four stages have been studied as well as a rotor alone build The degree of reaction was 50% for three different values of design flow coefficient, and in addition a 65% reaction machine was used From the results it has been possible to describe the flow in stalled compressors The pattern is very different from that normally assumed in particular it has been proved that flow is continually entering the cell on one side and leaving on the other Systematic changes in cell structure with compressor designs have been described and these have been related to the overall properties of the stages such as pressure ratio and torque Author

N78-23092# Cambridge Univ (England) Dept of Engineering

A COMPARISON OF EXPERIMENTAL RESULTS AND THREE-DIMENSIONAL THEORETICAL PREDICTIONS FOR A COMPRESSOR ROTOR WITH INLET-DISTORTION, WITH SPECIAL REFERENCE TO STALLING

N A Mitchell 1978 44 p
(CUED/A-Turbo/TR-91) Avail NTIS HC A03/MF A01

This report contains a comparison between the inlet distortion measurements on a low speed axial flow compressor rotor and a three-dimensional inlet distortion analysis of these experiments The experimental compressor is shown diagrammatically illustrating how the inlet distortion (a 180 deg square wave stagnation pressure defect) is produced by a wire gauze upstream of the rotor The results of these theoretical-experimental comparisons are used to show how the 3-D theory may be used to predict stall regions in inlet distorted axial flow compressors Author

N78-23093*# National Aeronautics and Space Administration Langley Research Center Langley Station Va

COMBUSTION OF HYDROGEN IN A TWO-DIMENSIONAL DUCT WITH STEP FUEL INJECTORS

James M Eggers Patricia G Reagon and Paul B Gooderum May 1978 56 p refs
(NASA-TP-1159 L-11981) Avail NTIS HC A04/MF A01 CSCL 21E

An investigation of the combustion of hydrogen perpendicularly injected from step fuel injectors into a Mach 2 72 2100 K vitiated test gas was conducted The model simulated the flow between the center and side struts of an integrated scramjet module at Mach 7 flight and an altitude of 29 km Parametric variation included equivalence ratio fuel dynamic pressure ratio and area distribution of the model The overall area ratio of the model was held constant at 2 87 The data analysis indicated that no measurable improvement in mixing or combustion efficiency was obtained by varying the fuel dynamic pressure ratio from 0 79 to 2 45 Computations indicated approximately 80 percent of the fuel was mixed so that it could react however only approximately 50 percent of the mixed fuel actually reacted in two test configurations and 74 percent in later tests where less area expansion of the flow occurred Author

N78-23094*# National Aeronautics and Space Administration Langley Research Center Langley Station Va

INTERACTION BETWEEN STEP FUEL INJECTORS ON OPPOSITE WALLS IN A SUPERSONIC COMBUSTOR MODEL

Charles R McClinton May 1978 61 p refs
(NASA-TP-1174 L-11811) Avail NTIS HC A04/MF A01 CSCL 21E

Results are presented from an experimental investigation of perpendicular hydrogen fuel injection and combustion from opposing walls in a scramjet combustor model using a longitudinally staged laterally inline step-injection configuration The model represents a portion of the flow in the Langley integrated modular scramjet engine combustor operating at a flight Mach number of 7 When operating at a ratio of jet pressure to free-stream dynamic pressure of 3 the injectors produce a bulk equivalence ratio of unity This investigation represents part of a continuing study of the modular engine fuel injectors and is specifically designed to eliminate the adverse lateral pressure gradient observed at the injector location in a previous test Flow survey contours at three axial locations, ranging from one-third of the engine combustor length to the total engine combustor length, are used to determine mixing efficiency and fuel distribution Wall static pressures are analyzed by using one-dimensional theory to determine the combustion efficiency Results show a significant improvement over previous injector designs tested in this duct geometry Author

N78-23095*# National Aeronautics and Space Administration Lewis Research Center, Cleveland Ohio

ALTITUDE CALIBRATION OF AN F100, S/N P680063, TURBOFAN ENGINE

Thomas J Biesiadny, Douglas Lee, and Jose R Rodriguez May 1978 23 p refs
(NASA-TP-1228 E-9355) Avail NTIS HC A02/MF A01 CSCL 21E

An airflow and thrust calibration of an F100 engine was conducted in coordination with a flight test program to study airframe-propulsion system integration characteristics of turbofan-powered high-performance aircraft The tests were conducted with and without augmentation for a variety of simulated flight conditions with emphasis on the transonic regime Test results for all conditions are presented in terms of corrected airflow and corrected gross thrust as functions of corrected fan speed for nonaugmented power and an augmented thrust ratio as a function of fuel-air ratio for augmented power Comparisons of measured and predicted data are presented along with the results of an uncertainty analysis for both corrected airflow and gross thrust Author

N78-23097# Avco Lycoming Div Stratford Conn

TURBINE TIP-CLEARANCE MEASUREMENT Final Report, Jul 1975 - Sep 1977

Steven D White Dec 1977 128 p
(Contract DAAJ02-75-C-0051 DA Proj 1F2-62209-AH-76)
(AD-A052042 LYC-77-46 USARTL-TR-77-47) Avail NTIS HC A07/MF A01 CSCL 21/5

This report describes the analysis and measurement of turbine tip clearance over the full range of operation of an advanced gas turbine engine The first-stage turbine of the Lycoming advanced gas generator was used as the test vehicle for analytic and experimental evaluation Tip-clearance response of the stage was analyzed for steady-state and transient operating conditions through the use of a one-dimensional tip clearance calculation technique Measurement was accomplished with three laser tip-clearance measurement probes that operate on an optical beam triangulation principle Comparison of analytic and measured tip-clearance results showed measured clearance to be tighter than predicted over the entire power spectrum This differential was attributed primarily to a two-dimensional thermal strain distribution in the shroud which had not been accounted for by the analytic technique Excellent correlation was obtained between the transient tip clearance response characteristics resulting from analysis and measurement Comparison of measured and predicted component temperatures under steady-state and transient operating conditions verified the accuracy of the thermal analysis procedure Component distortion as well as response to transient engine operation was found to have significant impact on minimum operating tip clearance Author (GRA)

N78-23098# National Physical Lab Teddington (England)

NOISE FROM ENGINE THRUST REVERSAL OF LANDING AIRCRAFT

R F Higginson and A J Rennie Aug 1977 63 p refs
(NPL-Ac-83) Avail NTIS HC A04/MF A01

Measurements were made of aircraft noise with particular reference to the levels of engine thrust reversal noise of different aircraft types at and near to London Airport - Gatwick The object was to determine the contribution of reverse thrust noise to the total noise exposure at points on the ground The results show that generally this contribution is small in relation to that of the principal sources of noise aircraft taking off and climbing

out However it was found that the noise levels of reverse thrust are sufficient to cause disturbance at times when aircraft landings are the only air traffic movements taking place and the background noise is otherwise low Author (ESA)

N78-23099# Environmental Protection Agency Ann Arbor, Mich Emission Control Technology Div
AIRCRAFT TECHNOLOGY ASSESSMENT STATUS OF THE GAS TURBINE PROGRAM
Richard Munt and Eugene Danielson Dec 1976 291 p refs (PB-277351/3 EPA-460/3-76-036) Avail NTIS HC A13/MF A01 CSCL 21E

Advances that were made in the control of aircraft gas turbine engine emissions are reported Two technologies of differing complexities evolved The success of the first which controls only hydrocarbons and carbon monoxide is attributable to innovations in engine operation the fuel injection system and the airflow patterns within the combustor The simplicity of the system gives it wide applicability The second technology capable of controlling oxides of nitrogen, in addition to HC and CO, uses exotic methods of fuel preparation and multiple zones of combustion GRA

N78-23100*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
OPTIMAL GUIDANCE AND CONTROL FOR INVESTIGATING AIRCRAFT NOISE-IMPACT REDUCTION
Elwood C Stewart and Thomas M Carson May 1978 58 p refs
(NASA-TP-1237 A-7121) Avail NTIS HC A04/MF A01 CSCL 01C

A methodology for investigating the reduction of community noise impact is reported This report is concerned with the development of two models to provide data a guidance generator and an aircraft control generator suitable for various current and advanced types of aircraft The guidance generator produces the commanded path information from inputs chosen by an operator from a graphic scope display of a land-use map of the terminal area The guidance generator also produces smoothing at the junctions of straight-line paths The aircraft control generator determines the optimal set of the available controls such that the aircraft will follow the commanded path The solutions for the control functions are given and shown to be dependent on the class of aircraft to be considered that is whether the thrust vector is rotatable and whether the thrust vector affects the aerodynamic forces For the class of aircraft possessing a rotatable thrust vector the solution is redundant, this redundancy is removed by the additional condition that the noise impact be minimized Information from both the guidance generator and the aircraft control generator is used by the footprint program to construct the noise footprint Author

N78-23101# Naval Test Pilot School Patuxent River Md
FIXED WING STABILITY AND CONTROL, THEORY AND FLIGHT TEST TECHNIQUES
S D Langdon and W V Cross 1 Aug 1977 661 p refs Revised
(AD-A051864 USNTPS-FTM-103-Rev) Avail NTIS HC A99/MF A01 CSCL 01/1

This manual is primarily a guide for pilots and engineers attending the U S Naval Test Pilot School However it may be used as a guide in any fixed wing flying qualities investigation The text presents basic fixed wing stability and control theory, qualitative and quantitative test and evaluation techniques and data presentation methods In most sections more than one technique is described for each test Generally the best technique for a particular investigation will depend on the purpose of the investigation the amount of instrumentation available and the personal preference of the individual test pilot The approach of the qualitative stability and control testing presented herein is an attempt to associate all flying qualities tests with particular pilot tasks required in the performance of the total mission of the airplane The pilot s opinion of a particular flying quality will consequently depend primarily on the pilot workload while performing the desired task Quantitative evaluation techniques presented may be used to substantiate pilot opinion or gather data for documentation of airplane characteristics The performance of both qualitative testing and quantitative evaluation is considered essential for any successful flying qualities investigation Author (GRA)

N78-23102# Air Force Systems Command Wright-Patterson AFB Ohio Foreign Technology Div
INVARIANT AUTOMATIC STABILIZATION SYSTEM OF VERTICAL TAKEOFF AND LANDING AIRCRAFT (VTOL) UNDER STEADY FLIGHT CONDITIONS
R M Maresh and V T Vigovskiy 19 Oct 1977 25 p refs Transl into ENGLISH of the book Primeneniye Invariantnykh Sistem Avtomaticheskogo Upravleniya Moscow Nauka Press, 1970 p 168-176
(AD-A051637 FTD-ID(RS)T-1783-77) Avail NTIS HC A02/MF A01 CSCL 01/3

The possibility of using lift engines and jet controls in steady flight conditions in order to provide invariance of the coordinates of the VTOL during automatic stabilization of longitudinal movement and different types of disturbing effects was explored Equations for longitudinal disturbed movement were given in dimensionless form and used to determine an invariant system for longitudinal stabilization during gusts and load discharge The introduction of an additional signal in the control law of the automatic pilot can provide invariance with respect to both disturbances A R H

N78-23103# Scientific Systems Inc , Cambridge, Mass
GLOBAL STABILITY AND CONTROL ANALYSIS OF AIRCRAFT AT HIGH ANGLES-OF-ATTACK Annual Technical Report, 1 Jun 1976 - 31 May 1977
Raman K Mehra William C Kessel and James V Carroll 30 Jun 1977 258 p refs
(Contract N00014-76-C-0780)
(AD-A051850 SSI-TR-77-1, ONR-CR215-248-1AR-1) Avail NTIS HC A12/MF A01 CSCL 01/3

Aircraft dynamic behavior at high angles-of-attack is highly non-linear and, in the past there has been a lack of suitable techniques for analyzing the global behavior of nonlinear systems This report describes a new approach based on Bifurcation Analysis and Catastrophe Theory Methodology (BACTM) The approach has been applied to specific jump hysteresis and limit cycle phenomena such as roll-coupling, pitch-up, wing rock, buffeting, departure and divergence Three different aircraft have been considered for comparison purposes and it has been shown how different types of instabilities and families of limit cycles arise as the control variables are varied A complete representation of the aircraft equilibrium and bifurcation surfaces is given in an eight dimensional space consisting of roll rate pitch rate yaw rate angle-of-attack, sideslip angle, elevator aileron and rudder deflections Two dimensional projections of the equilibrium and bifurcation surfaces provide pictorial representations of the aircraft global stability and control behavior at high angles-of-attack The use of BACTM for spin entry spin prevention, stability augmentation at high angles-of-attack and nonlinear system identification are also considered Author (GRA)

N78-23104# Royal Aircraft Establishment Bedford (England) Structures Dept
MEASUREMENTS OF CONTROL-SURFACE OSCILLATORY DERIVATIVES ON A SWEPTBACK, TAPERED MODEL WING IN TWO TRANSONIC TUNNELS
N C Lambourne, K C Wight and B L Welsh London Aeron Res Council 1977 54 p refs Supersedes RAE-TR-76007, ARC-36716
(ARC-R/M-3806 RAE-TR-76007 ARC-36716) Avail NTIS HC A04/MF A01, HMSO £5 PHI $19 20

Results of measurements of control-surface oscillatory derivatives on a sweptback tapered half-model of a lifting surface of aspect ratio 2 are presented The measurements were obtained during the development of a derivative rig which measures normal force pitching moment, wing bending moment and hinge moment due to control surface oscillation They were made in the 18 in X 14 in (0 46 m X 0 36 m) NPL Teddington tunnel and the 3 ft (0 91 m) RAE Bedford tunnel the rig being found to

operate satisfactorily in both situations Mach number was varied from 0 4 to 1 0 and stagnation pressure from 0 5 to 2 3 bar With this combination of Mach number and stagnation pressure Reynolds number varied from 1 to 6 million based on mean chord The effects of varying the control surface deflection amplitude from 0 4 to 1 6 degrees and the oscillation frequency from 20 to 70 Hz were examined The effect of tunnel interference was assessed by measurements in ventilated and closed wall working sections in each tunnel Most of the tests were carried out with transition bands on the model but a few tests were made with the bands removed The measured derivatives are compared with those obtained by theoretical methods of calculation Author (ESA)

N78-23105*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
NUMERICAL DESIGN OF STREAMLINED TUNNEL WALLS FOR A TWO-DIMENSIONAL TRANSONIC TEST
Perry A Newman and E Clay Anderson (DCW Industries Inc Studio City Calif) Apr 1978 24 p refs
(Contract NAS1-14517)
(NASA-TM-78641) Avail NTIS HC A02/MF A01 CSCL 14B

An analytical procedure is discussed for designing wall shapes for streamlined nonporous two-dimensional transonic wind tunnels It is based upon currently available 2-D inviscid transonic and boundary layer analysis computer programs Predicted wall shapes are compared with experimental data obtained from the NASA Langley 6 by 19 inch Transonic Tunnel where the slotted walls were replaced by flexible nonporous walls Comparisons are presented for the empty tunnel operating at a Mach number of 0 9 and for a supercritical test of an NACA 0012 airfoil at zero lift Satisfactory agreement is obtained between the analytically and experimentally determined wall shapes Author

N78-23106*# National Aeronautics and Space Administration Washington D C
THE FUTURE OF WIND TUNNEL TECHNOLOGY IN GERMANY
Berndt Ewald May 1978 22 p Transl into ENGLISH of conf paper from Aero/Thermodynamics Dept VFW Fokker GmbH Munich Presented at 9th DGFLE Jahrestagung Munich 14 16 Sep 1976 Original language document was announced as A77-16576
(Contract NASw-2790)
(NASA TM-75244 Paper 76-170) Avail NTIS HC A02/MF A01 CSCL 14B

The practical value of a wind tunnel which is not dependent solely on size or achievable Reynolds number was examined Measurement interpretative and evaluative procedures developed in small facilities were also studied Author

N78-23107# Civil and Environmental Engineering Development Office Tyndall AFB Fla
FIRE FIGHTER TOOLS Final Report, 1 Oct 1976 - 31 Oct 1977
Norman D Knowles Jan 1978 36 p
(AF Proj 414N)
(AD-A051687 CEEDO-TR-78-2) Avail NTIS HC A03/MF A01 CSCL 13/12

The Civil and Environmental Engineering Development Office (CEEDO) conducted an evaluation of aircraft crash rescue/fire fighters tools and equipment This study was necessitated due to the continued growth and development of new tools and the ever increasing numbers of tools being acquired by Air Force Fire Protection Organizations The purpose of the study was to verify the concepts for fire fighting and rescue operations to identify the tools and equipment presently carried on fire fighting and rescue vehicles to determine the usefulness of all inventoried tools and equipment and to determine a basic selection of tools and equipment that should be carried on fire fighting and rescue vehicles GRA

N78-23108# General Electric Co Daytona Beach Fla
WIDE-ANGLE, MULTIVIEWER INFINITY DISPLAY DESIGN Final Report, Jul. 1976 - Jul 1977
L W Shaffer and J A Waldelich Wright-Patterson AFB Ohio AFHRL Sep 1977 117 p refs
(Contract F33615-76-C-0064)
(AD-A051158 AFHRL-TR-77-67) Avail NTIS HC A06/MF A01 CSCL 14/2

There has long been a need in aircraft simulation for a wide angle visual display that will accommodate the entire crew of a large aircraft type such as a bomber or tanker This study is concerned with the approach and design of a wide angle display for multiple crew members in large aircraft simulators The study traces the development of a concept from existing simulation methods Throughout its 180 by 60 deg field of view which accommodates pilot, copilot and instructor pilot the final design meets most of the requirements of the original specification Because of its relatively large optical components the fabrication of the display will be of a developmental nature itself Author (GRA)

N78-23109# Princeton Univ N J Dept of Aerospace and Mechanical Sciences
A HELICOPTER SIMULATOR STUDY OF CONTROL DISPLAY TRADEOFFS IN A DECELERATING APPROACH M S Thesis
James Craig Adamson May 1977 81 p refs Sponsored by the Army
(AD-A051242) Avail NTIS HC A05/MF A01 CSCL 01/3

A total force nonlinear analog model of the UH-1 helicopter was developed which simulates the entire low speed flight envelope from hover to 60 knots Classical multiloop control theory was applied to design five levels of automatic stabilization which were used as test variables along the control axis of the test matrix An integrated display was used which superimposes analog symbology over a terrain image The basic display format which had been used successfully in flight tests was modified to provide four levels of display augmentation These four levels were used as test variables along the display axis of the test matrix Four helicopter test pilots acted as test subjects and furnished pilot ratings in each cell of the test matrix In each cell the subject was required to fly the same prescribed flight profile involving a low level decelerating approach to a hover The data was evaluated based on significant differences among the test cells and conclusions were drawn concerning the nature of the control and display augmentation most beneficial to the pilot GRA

N78-23152# United Technologies Research Center East Hartford Conn
EVALUATION OF TANTALUM FIBER REINFORCED Si3N4 Final Report, 1 Mar 1976 - 1 Mar 1977
John J Brennan 1 Apr 1977 68 p refs
(Contract N62269-76-C-0104)
(AD-A051657 UTRC-R77-912538-4 NADC-75207-30-A) Avail NTIS HC A04/MF A01 CSCL 11/5

Ceramic materials by virtue of their high melting points and oxidation resistance can offer large gains in gas turbine performance provided some serious limitations can be overcome These are poor thermal shock resistance and, more critically low impact strength Hot-pressed silicon nitride currently the leading candidate for use as a high temperature vane material has not only good oxidation resistance but also very good thermal shock resistance for a ceramic material However, its use is still limited by its relatively low impact strength It is the solution of this problem that UTRC has emphasized in the current contract with NADC on improving the impact strength of Si3N4 through the use of fiber or wire reinforcements This approach provides energy absorption modes not available in monolithic materials By tailoring the properties of the composite it is possible not only to maximize energy absorption during impact but to control the type of fracture as well Small fragments breaking out of vanes are probably tolerable under abnormal impact loads whereas total failure is unacceptable Author (GRA)

N78-23214# National Bureau of Standards Washington D C
THE MACROSCOPIC DETECTION OF CORROSION IN ALUMINUM AIRCRAFT STRUCTURES WITH THERMAL NEUTRON BEAMS AND FILM IMAGING METHODS

Donald A Garrett 7 Dec 1977 42 p refs Sponsored in part by Naval Air Systems Command
(PB-277074/1 NBSIR-78-1434) Avail NTIS HC A03/MF A01 CSCL 11F

The primary objective was to determine the feasibility of detecting corrosion in aluminum naval aircraft components with neutron radiographic interrogation and the use of standard corrosion penetrameters Secondary objectives included the determination of the effect of object thickness on image quality the defining of minimum levels of detectability and a preliminary investigation of a means whereby the degree of corrosion could be quantified with neutron radiographic data GRA

N78-23235# Naval Air Development Center Warminster Pa Air Vehicle Technology Dept
EVALUATION OF SOIL RESISTANT COATINGS FOR EXTERIOR AIRCRAFT SURFACES Final Report
E Charves 2 Jun 1977 81 p refs
(AD-A051449 NADC-77182-30) Avail NTIS HC A05/MF A01 CSCL 11/3

Fluorinated polyepoxy and polyurethane base coatings developed by the Naval Research Laboratory Washington D C were evaluated as possible candidate coatings for use on exterior surfaces of naval aircraft When laboratory tested against the linear urethane MIL-C-81773B coatings the fluorinated coatings were found to be lower in initial gloss properties while exhibiting similar properties in adhesion corrosion resistance engine and lubricating oil resistance heat resistance flexibility soil resistance and weathering properties Author (GRA)

N78-23258# European Space Agency, Paris (France)
BORON COMBUSTION IN COMBINATORY PROPULSION
A Boussios Feb 1978 14 p refs Transl into ENGLISH of Borverbrennung in Kombinationsantrieben' DFVLR Trauen West Ger Report DLR-IB-456-77/8 1977 Original report in GERMAN previously announced as N78-18229
(ESA-TT-462, DLR-IB-456-77/8) Avail NTIS HC A02/MF A01

The application of boron to replace kerosine in combination propulsion systems is discussed The state of the art of boron as propellant is presented, the influence of N2O4-N2H4-N2 or N2O4-N2H4 as propellant addition is discussed and the energy yield in comparison with ramjet propulsion is considered ESA

N78-23285# Arinc Research Corp , Annapolis, Md
A STUDY OF THE ECONOMIC IMPACT OF SELECTED COMMUNICATIONS ALTERNATIVES, PRESENT SYSTEM DEFINITION
P Woodie and W Kolb Mar 1978 48 p refs
(Contract DOT-FAA77WA-4018)
(AD-A052162 Rept-1339-01-1-1723) Avail NTIS HC A03/MF A01 CSCL 17/2

This report provides a description of the present FAA communications system The data base described herein will be incorporated in a communications cost model being developed for the Federal Aviation Administration (FAA) by ARINC Research Corporation The economic data presented were obtained primarily from three sources (1) the Aviation Cost Allocation Study Working Paper No 2 (Office of Policy Review DOT 1972) for one-time facilities and equipment (F and E) costs (2) the Airways Facilities Maintenance Cost Study (Project Memorandum PPA FP-604 1976) for operation and maintenance (O and M) costs and (3) the DECCO Circuit File for recurring leased costs Defining such a comprehensive communications cost data base was complicated by the fact that there is no clear definition within the FAA of what constitutes communications For the purposes of the present cost-modeling effort however it is convenient to classify costs into two groups (1) traditional FAA communications services including Air/Ground Ground/Ground Remote Link Weather Net AFTN Service B Computer B and a miscellaneous category of additional communications functions and (2) services in which some (incidental) communications is required for the functioning of basic FAA systems viz air traffic control, surveillance and navigation GRA

N78-23307# European Space Research and Technology Center, Noordwijk (Netherlands)
AEROSAT COMMUNICATION MANAGEMENT
J Louet 18 Oct 1977 20 p Presented at the Intern Conf on Electron Systems and Navigation Aids Paris 14-18 Nov 1977
Avail NTIS HC A02/MF A01

Work done by the participants in the Aerosat program is reported relating to services to be provided the communication management proposed and an analysis of the potential capabilities of the system The design of the common system was checked by fast time simulations and it was shown to be not only capable of handling the message traffic envisaged but also flexible and relatively insensitive to wide variations of this traffic ESA

N78-23310# European Space Agency Paris (France)
THE GEOMETRICAL THEORY OF DIFFRACTION - A METHOD FOR THE SOLUTION OF ELECTROMAGNETIC BOUNDARY PROBLEMS OF COMPLICATED STRUCTURES IN THE HIGH FREQUENCY CASE
A Schrott Apr 1978 251 p refs Transl into ENGLISH of Die geometrische Beugungstheorie - Ein Verfahren zur Loesung elektromagnetischer Randwertprobl bei komplizierten Strukturen *im Hochfrequenzfall* DFVLR, *Oberpfaffenhofen West Ger Report* 1977 Original report in GERMAN previously announced as N78-18290
(ESA-TT-435) Avail NTIS HC A12/MF A01

Determination of the radiation characteristic of antennas on complicated structures such as satellites and aircraft and the scattering at these structures in the high frequency case with the aid of the geometrical theory of diffraction is dealt with The complicated structures are divided into canonical forms which can be analyzed by rigorous asymptotic methods The most important canonical problems like the diffraction at an edge are treated extensively The diffraction coefficients for the computation of the diffracted field are presented Ray tracing is carried out for several structures The computation of the field at caustics with the aid of equivalent edge currents or correction factors respectively is discussed in detail The field of application and the accuracy of the geometrical theory of diffraction is demonstrated with numerous computational examples Author (ESA)

N78-23311# European Space Agency Paris (France)
THE INTEGRAL EQUATION METHOD - A COMPUTATIONAL METHOD FOR DIFFRACTED AND SCATTERED FIELDS OF COMPLICATED STRUCTURES
V Stein Apr 1978 215 p refs Transl into ENGLISH of Die Integralgleichungsmethode - ein Verfahren zur Berechnung der Beugungs- u Streufelder komplizierter Koerper' DFVLR Oberpfaffenhofen West Ger Report 1977 Original report in GERMAN previously announced as N78-18291
(ESA-TT-436) Avail NTIS HC A10/MF A01

Determination of the radiation and scattering behavior of complicated structures with the aid of the integral equation method is dealt with These structures may be complicated isolated radiators or shapes like helicopters or satellites which are excited by an electromagnetic wave The real structure is substituted by a mathematical model for the solution of the electric and magnetic field integral equations by means of the method of moments In order to reduce the computer storage requirements special procedures such as the numerical Green function are used The combination of both integral equations for the investigation of special problems like the resonance case is discussed in some detail The field of application and the accuracy of the integral equation method are demonstrated with numerous computational examples Author (ESA)

N78-23325# Air Force Geophysics Lab Hanscom AFB Mass
IONOSPHERIC EFFECTS ON SATELLITE NAVIGATION AND AIR TRAFFIC CONTROL SYSTEMS
J A Klobuchar *In* AGARD Recent Advan in Radio and Opt Propagation for Mod Commun Navigation and Detection Systems Apr 1978 11 p refs
Avail NTIS HC A12/MF A01

Major effects of the ionosphere on radio waves discussed include (1) time delays greater than the free space wave velocity

(2) polarization rotation of linearly polarized waves (3) angular refraction or bending of the ray from a geometric straight line and (4) phase advance of the carrier phase with respect to the free space phase scintillation Various techniques of correcting for these effects are described J M S

N78-23345# Pisa Univ (Italy) Ist di Elettrotecnica
THE CURRENTS ABSORBED BY THE MOTOR WITH DOUBLE ROTOR CASING DURING OPERATION EXPRESSED BY MEANS OF PARAMETERS TO BE DETERMINED EXPERIMENTALLY [LE CORRENTI ASSORBITE DAL MOTORE A DOPPIA GABBIA NEL TRANSITORIO ESPRESSE TRAMITE PARAMETRI DETERMINABILI SPERIMENTALMENTE]
G Carrara and A Moretti [1977] 13 p refs In ITALIAN
(Rept-1600) Avail NTIS HC A02/MF A01

The course of the currents absorbed by an asynchronous motor with double rotor casing during the electromagnetic transient phases under operational conditions was determined analytically To speed up the analytical process the equivalent biaxial machine with straight axis was considered containing two sets of windings on the stator and four on the rotor two being equivalent to the external casing and two to the internal one The differential equations of the electromagnetic equilibrium containing the parameters of the machine and the angular velocity are resolved by operational calculus The number is reduced from 6 to 3 introducing complex numbers relative to the power supply stator current and currents in the casings This permits the graphical determination of the currents absorbed by the machine through the space described by the vector representing the complex number relative to the stator currents The theoretical results were compared with the experimental ones with optimal results ESA

N78-23389*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
CONFIGURATION HEATING FOR A HYPERSONIC RESEARCH AIRPLANE CONCEPT HAVING A 70 DEG SWEPT DOUBLE-DELTA WING
Pierce L Lawing May 1978 74 p refs
(NASA-TP-1143 L-11841) Avail NTIS HC A04/MF A01 CSCL 20D

The heating on a candidate hypersonic research airplane configuration has been examined experimentally at Mach 6 by the phase-change-paint technique The configuration has a double-delta wing with tip fins Phase-change-paint diagrams give heating data for the model top side and bottom with and without deflected elevons for an angle-of-attack range of 0 deg to 24 deg Nominal Reynolds numbers are on the order of 15 000 000 with supplementary data at length Reynolds number of 4 000 000 which moves the model from the predominantly turbulent into the predominantly laminar regime Also intermediate Reynolds numbers were investigated on the lee side for one angle of attack Author

N78-23392# Rockwell International Corp Columbus Ohio Aircraft Div
AN INVESTIGATION OF CORNER SEPARATION WITHIN A THRUST AUGMENTER HAVING COANDA JETS
Final Report, 30 Jun 1976 - 23 Dec 1977
Milton R Seiler Dec 1977 80 p refs
(Contract N62269-76-C-0402 WR02302001)
(AD-A052131, NR77H-18 NADC-76153-30) Avail NTIS HC A05/MF A01 CSCL 20/4

An investigation was conducted to determine the way separation develops in the corners of thrust augmenter wings having Coanda jets Hot film surface sensors and pressure transducers were used and the results indicated that separation on the test augmenter began at a corner very close to the augmenter exit and then rapidly proceeded upstream Measurements of the velocity and pressure fields in the corner region indicated that a modified form of the Stratford criterion could be used to predict the onset of separation Author (GRA)

N78-23438# Boeing Vertol Co, Philadelphia, Pa
ENGINEERING SERVICES TO CONDUCT QUALIFICATION TESTING OF PRECISION FORGED SPIRAL BEVEL GEARS
Final Report, Jul 1974 - Oct 1977
Raymond J Drago Oct 1977 63 p
(Contract DAAJ01-74-C-1052)
(AD-A051542 D210-11142-1, USAAVRADCOM-76-45) Avail NTIS HC A04/MF A01 CSCL 13/9

This report presents the results of a program to evaluate the relative surface load capacity of CH-47C transmission spiral bevel gears manufactured by the integrally forged method (forged and ground) as compared to conventional current production gears (cut and ground) A three phase test program was conducted Phase 1 included the deflection test of one set of conventional baseline gears and rotating load tests of two sets each of the integrally forged and conventional baseline gears All gears were run at torque levels equivalent to 50,100, and 150 percent of the CH-47C single engine rating Phase 2 included rotating load tests of two additional conventional based line and five additional integrally forged gear sets in the Boeing Vertol test stand at loads of 100 to 130 percent of single engine rating for 340 hours Phase 3 involved extended surface-fatigue testing of four precision integrally forged gear sets in the test stand at 100 percent of single engine rating for 800 hours The results of this testing indicate that the surface-load capacity of the integrally forged gear sets is at least equivalent to that of the conventional baseline gears Author (GRA)

N78-23469 Engineering Sciences Data Unit London (England)
BUCKLING OF STRUTS LIPPED AND UNLIPPED Z SECTIONS
Nov 1977 12 p
(ESDU-77030 ISBN-0-85679-203-9) For information on availability of series, sub-series and other individual data items, write NTIS, attn ESDU Springfield, Va 22161 HC $242 50

For the first time a complete set of curves which gives the buckling stress of practical thin, Z-section struts are provided All buckling modes and their interactions are included and the presentation is arranged so that the detail geometry of the strut can be chosen to improve the resistance of the section to buckling The presentation automatically yields the buckling wavelength For the case of local buckling, plasticity corrections are provided Typical applications include aircraft ribs, and floor and seat supports ESDU

N78-23875*# National Aeronautics and Space Administration Langley Research Center, Langley Station, Va
NOISE PREDICTION TECHNOLOGY FOR CTOL AIRCRAFT
John P Raney May 1978 16 p refs Presented at the CTOL Transport Tech Conf, Hampton, Va 28 Feb - 3 Mar 1978
(NASA-TM-78700 L-12234) Avail NTIS HC A02/MF A01 CSCL 20A

The application of a new aircraft noise prediction program to CTOL noise prediction is outlined Noise prediction is based on semiempirical methods for each of the propulsive system noise sources such as the fan the combustor the turbine, and jet mixing with noise-critical parameter values derived from the thermodynamic cycle of the engine Comparisons of measured and predicted noise levels for existing CTOL aircraft indicate an acceptable level of accuracy Author

N78-23876*# National Aeronautics and Space Administration Langley Research Center Langley Station, Va
HIGH FREQUENCY SOUND ATTENUATION IN SHORT FLOW DUCTS
J W Posey May 1978 25 p refs Presented at the 95th Meeting of the Acoust Soc of Am Providence 16-19 May 1978
(NASA-TM-78708) Avail NTIS HC A02/MF A01 CSCL 20A

A geometrical acoustics approach is proposed as a practical design tool for absorbent liners in such short flow ducts as may be found in turbofan engine nacelles As an example, a detailed methodology is presented for three different types of sources in a parallel plate duct containing uniform ambient flow A plane wave whose wavefronts are not normal to the duct walls, an arbitrarily located point source, and a spatially harmonic line

source are each considered Optimal wall admittance distributions are found and it is shown how to estimate the insertion loss for any admittance distribution The extension of the methodology to realistic source distributions in variable area cylindrical or annular ducts containing arbitrary flow is shown to be conceptually straightforward and computationally practical on a vector-hardware digital computer Author

N78-23879# Army Construction Engineering Research Lab Champaign Ill

ROTARY-WING AIRCRAFT OPERATIONAL NOISE DATA Final Report

Brian Homans Lincoln Little and Paul D Schomer Feb 1978 72 p refs

(DA Proj 4A7-62720-A-896)

(AD-A051999 CERL-TR-N-38) Avail NTIS HC A04/MF A01 CSCL 20/1

This report presents Sound Exposure Level (SEL) vs distance curves for eight models of Army rotary-wing aircraft (OH-58 AH-1G UH-1M UH1-1H UH-1B CH-47B CH-54 and TH-55) performing dynamic operations and Equivalent Sound Level contours for the same aircraft in static operations The dynamic operations consisted of level flyovers ascents descents turns takeoffs and landings static operations included in-ground and out-of-ground effect hovers Results are grouped according to model and type of operation and are suitable for use in manual or computerized programs for predicting noise impact from rotary-wing aircraft Author (GRA)

N78-23882# Southampton Univ (England) Inst of Sound and Vibration Research

JET NOISE MODELLING BY GEOMETRIC ACOUSTICS PART 2 THEORY AND PREDICTION INSIDE THE CONE OF SILENCE

C L Morfey and V M Szewczyk Oct 1977 84 p refs Sponsored by Natl Gas Turbine Estab Pyestock, Engl 3 Vol (ISVR-TR-92-Pt-2) Avail NTIS HC A05/MF A01

A geometric acoustics model of jet mixing noise is extended to describe far-field radiation within the cone of silence The relevant acoustic-mean flow interactions are modeled by an approximation to the WKB type solution The original monopole solution is generalized to yield high-frequency solutions for the dipole and quadrupole sources used to model jet mixing noise The exponential decay factor encountered within the cone of silence is theoretically predicted to be almost proportional (in decibels) to the shear layer thickness Analysis of a wide range of isothermal jet noise data leads to inferred values of the ratio of shear layer thickness at the source location to the nozzle diameter as a function of Strouhal number These are in excellent agreement with the results of source location and flow profile measurements Author (ESA)

N78-23883# Southampton Univ (England) Inst of Sound and Vibration Research

JET NOISE MODELLING BY GEOMETRIC ACOUSTICS PART 3 A COMPUTER PROGRAM FOR THE PREDICTION OF JET MIXING NOISE

C L Morfey and V M Szewczyk Oct 1977 29 p Sponsored by Natl Gas Turbine Estab Pyestock, Engl 3 Vol (ISVR-TR-93-Pt-3) Avail NTIS HC A03/MF A01

A prediction program for far-field jet mixing noise is documented The theory is based upon Morfey s geometric acoustics model of jet mixing noise The program is valid for radiation angles greater than 30 deg to the jet axis and for any jet static temperature ratio Any velocity ratio may be predicted outside the cone of silence but there is at present an upper limit inside the cone of silence Sound pressure levels in 1/3 octave bands are predicted for a source Strouhal number range of 0 1 to 3 16 corresponding to a frequency range of 5 octaves centered approximately on the peak 1/3 octave frequency Author (ESA)

N78-23885# National Physical Lab Teddington (England)

PRACTICE AND PRINCIPLE IN ENVIRONMENTAL NOISE RATING

D W Robinson Apr 1977 24 p refs

(NPL-Ac-81) Avail NTIS HC A02/MF A01

The possibility to derive a comprehensive noise index was studied to abandon established practices Some classes of noise evaluation and planning problems are soluble only within a unified system These are outlined together with brief reviews of progress on standardization in UK USA, and ISO The scale of noise measurement on which such progress is possible is the A-weighted equivalent continuous sound level Leq This is not an ideal quantity though its physical properties are attractively simple The principles which underlie the concept of a unified noise index are outlined and a brief account is given of possible future developments Experimental work will be needed to determine the direction which these should take bearing in mind that there are conflicting factors of complexity and faithfulness to the purpose that is to represent community reaction in numerical terms It is argued that the scientific principles can best be studied in a program of laboratory experiments while the determination of acceptability levels must entail field work and surveys Author (ESA)

N78-23981# Defense Systems Management School Fort Belvoir, Va

A PROPOSED MINI-MANAGEMENT INFORMATION SYSTEM FOR THE PROGRAM MANAGER FOR AVIONICS NAVAL AIR SYSTEMS COMMAND HEADQUARTERS

Benjamin F Short Nov 1977 43 p refs

(AD-A052113) Avail NTIS HC A03/MF A01 CSCL 05/2

The report describes selected functions within the Avionics Division of the Naval Air Systems Command Headquarters which could be incorporated into a computer base mini-Management Information System (MIS) The data and information upon which to base the report was derived from interviews books and articles on MIS and personal experience having been assigned to the Avionics Division If a computer were to be made available to the Division to execute the MIS functions, the Division Director/ Program Manager for Avionics would be better able to track the cost schedule and technical performance of the many assigned projects Additionally many administrative functions could more efficiently be performed if incorporated into the computer/MIS With more complete information available the Division director/PM could more efficiently manage the assigned projects Author (GRA)

N78-23986# Air Force Systems Command Wright-Patterson AFB Ohio Foreign Technology Div

AERONAUTICAL KNOWLEDGE, SELECTED ARTICLES

Chii Fan and Kuo Fang Tsing 30 Nov 1977 16 p Transl into ENGLISH from Hang K ung Chih Shih (China), no 3 Mar 1977 p 22-23 and 34-35

(AD-A051710, FTD-ID(RS)T-1986-77) Avail NTIS HC A02/MF A01 CSCL 01/2

Contents Weather and Aviation Safety -- A sketch on a Civilian Plane Trip, and Earthquake Prediction by Artificial Satellites GRA

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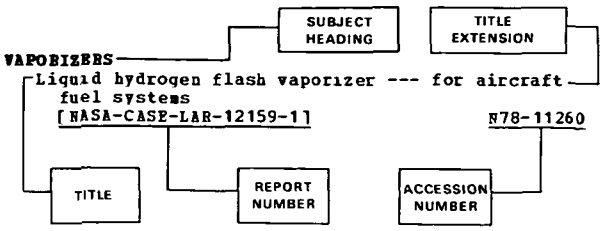

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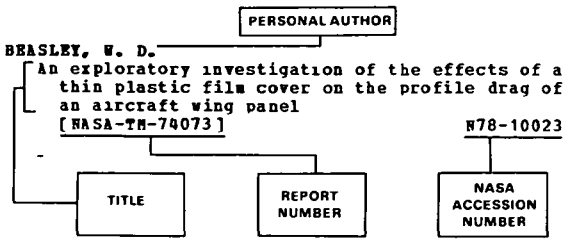

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15 Supplementary Notes

16 Abstract

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