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AERONAUTICAL ENGINEERING

A SPECIAL BIBLIOGRAPHY WITH INDEXES

Supplement 93

FEBRUARY 1978

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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NASA SP-7037 (93)

AERONAUTICAL ENGINEERING

A Special Bibliography

Supplement 93

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INTRODUCTION

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This supplement to *Aeronautical Engineering -- A Special Bibliography* (NASA SP-7037) lists 339 reports, journal articles, and other documents originally announced in January 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.

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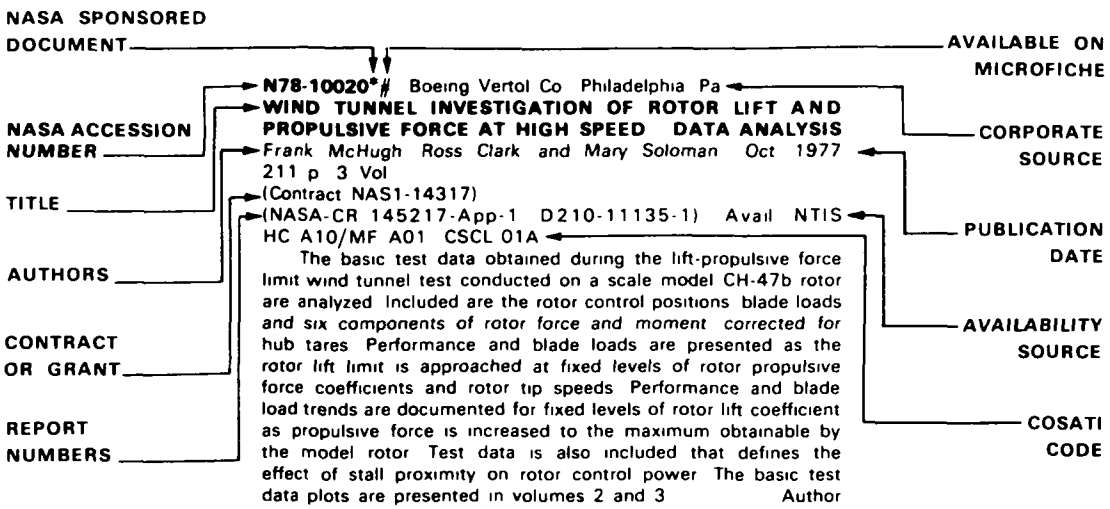

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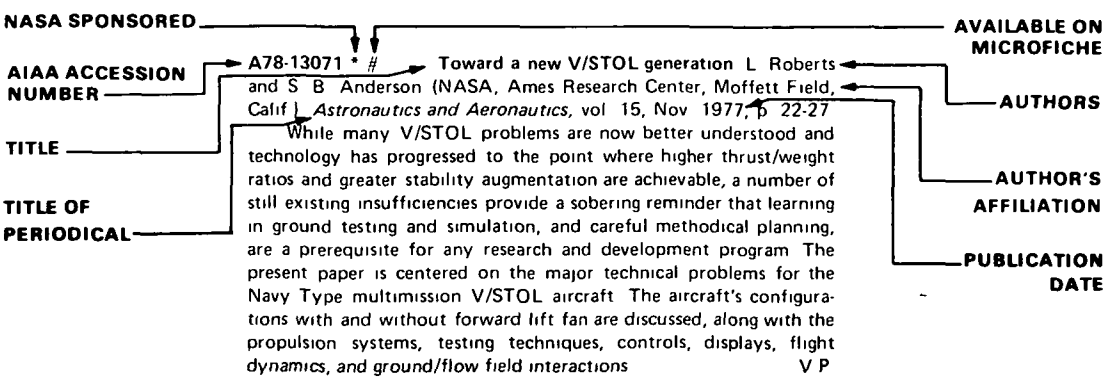


AERONAUTICAL ENGINEERING

A Special Bibliography (Suppl. 93)

FEBRUARY 1978

IAA ENTRIES

A78-10192 # **The timing of technology for commercial transport aircraft** J E Steiner (Boeing Co., Seattle, Wash.) *Astronautics and Aeronautics,* vol 15, Oct 1977, p 42-55

Many aspects of the future development of commercial transport aircraft, from the present to about 1986-1990, are projected Attention is given to the future distribution of seats among airliner types, the number of airliners by type, world revenue passenger miles, open market distribution by aircraft size, U S airlines' potential replacement requirement and purchasing power, changes in traffic and earnings, fuel savings from technology advances, and world commercial aircraft annual deliveries It is concluded that fuel- and cost-saving technology will enter commercial aviation slowly until deliberate development steps drastically reduce its risk to match projected benefits B J

A78-10267 **Investigation of turbine blade endurance during thermal cycling and vibration in a gas stream** A I Petrenko (Akademiia Nauk Ukrainskoi SSR, Institut Problem Prochnosti, Kiev, Ukrainian SSR) *(Problemy Prochnosti,* Jan 1977, p 28-33) *Strength of Materials,* vol 9, no 1, Oct 1977, p 26-31 7 refs Translation

An experimental procedure for studying the service life of gas turbine blades is described, and some results obtained with blades made of EP220 alloy are diagrammed The stress strain and thermal states of blades under conditions of thermal cycling and vibration (50 Hz) are analyzed for thermal cycles of 350-900 C and 425-900 C A relation for evaluating the service life of turbine blades for a two-frequency loading process is proposed The influence of the vibration stress level on service life under the test conditions is determined V P

A78-10304 **Interferometer design for elevation angle estimation** R J McAulay (MIT, Lexington, Mass.) *IEEE Transactions on Aerospace and Electronic Systems,* vol AES 13, Sept 1977, p 486-503 16 refs Contract No F19628-76-C-0002

Radars that are developed for the purpose of monitoring aircraft landings in the terminal air traffic control system can be designed to exploit the relatively high signal-to-noise ratio that characterizes the power budgets calculated for such a link In this paper an optimal tradeoff between the width of the sub-array aperture and the width of the interferometer baseline is performed that achieves a specific elevation angle estimation error while minimizing the overall height of the interferometer configuration The algorithm searches through the class of antenna patterns that can be synthesized from so-called finite impulse response, linear phase digital filters The design of a separate sensor for resolving the interferometer ambiguities is formulated as a hypothesis testing problem and solved using statistical decision theory. A bound on the probability of an ambiguity error is derived that accounts for the effects of ground reflection multipath and receiver noise (Author)

A78-10315 **Semi-analytical calculation of temperature transients in jointed structures (Semi-Analytische Berechnung instationarer Temperaturen in gefugten Strukturen)** C Haberland and F. Kohler (Berlin, Technische Universitat, Berlin, West Germany). *Warme- und Stoffubertragung,* vol 10, no. 3, 1977, p. 153-158. 8 refs. In German.

A semi-analytical method is presented for calculating temperature transients in skin-web-configurations including the effect of a thermal joint resistance at the web-skin (flange) junction. Based on the temperature functions independently developed for both elements at given boundary conditions and constant junction temperature the joint resistance can be taken into account easily by formulation of a heat balance above and below the joint The method, here applied to aircraft structures (stiffened panel, wing box) for the step functions of fluid temperature and heat transfer coefficient can also be extended to similar problems in other engineering fields of application (Author)

A78-10416 # **Airfoil trailing edge noise measurements with a directional microphone** R H Schlinker (United Technologies Research Center, East Hartford, Conn.) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 4th, Atlanta, Ga., Oct 3-5, 1977, Paper 77-1269* 17 p 13 refs Research sponsored by the United Technologies Corp

A78-10463 # **Some laser velocimeter measurements in the turbulent wake of a supersonic jet** R D Flack, Jr (Virginia, University, Charlottesville, Va.) and H D Thompson (Purdue University, West Lafayette, Ind.) *AIAA Journal,* vol 15, Oct 1977, p 1507-1509 12 refs Research supported by Purdue University, University of Virginia, Grant No DAAH01-72-C-0089

Laser velocimeter measurements were taken on the near wake of a supersonic jet (Mach 2 2) Mean flow data are compared to earlier supersonic pitot probe data, and turbulence intensities are compared to earlier subsonic hot-wire data Potential sources of laser velocimeter biases are discerned, and unbiased data are exhibited for a supersonic jet wake region where Mach numbers are important Compressibility effects and different mixing region widths are held responsible for the differences in data reported here and earlier R D V

A78-10600 **The time response of an aspirating probe in gas sampling** A E Perry (Melbourne, University, Melbourne, Australia) *Journal of Physics E - Scientific Instruments,* vol 10, Sept 1977, p 898-902 7 refs Contract No N00014-67-A-0037 NR Project 062-431

Choked-nozzle aspirating probes for gas density measurements are currently used to study the mixing of two dissimilar gases in unsteady free-shear layers In the present paper, the flow near the tip of such a probe is analyzed, and the response of the probe to a step change in gas species is computed, using asymptotic limit analysis (the limits corresponding to small and large suction) Such a step change will occur when an interfacing vortex sheet that separates the gas species passes over the probe The approach employed is shown

to hold for a tip of any shape Analysis and calculation are carried out for a probe tip of half-Rankine-body shape, assuming axisymmetric flow The wave form of the percentage volume of the given gas to the total gas volume being sampled is shown to be approximately exponential by numerical curve fitting The effect of viscosity is assessed, and a criterion for limiting its unfavorable influence is established V P

A78-10964 185 W/kg solar array for naval sea control systems W Luft (TRW Defense and Space Systems Group, Redondo Beach, Calif) and H Crecraft (U S Navy, Naval Research Laboratory, Washington, D C) In Photovoltaic Specialists Conference, 12th, Baton Rouge, La , November 15-18, 1976, Conference Record (A78-10902 01-44) New York, Institute of Electrical and Electronics Engineers, Inc , 1976, p 413-417.

A 185-W/kg, 10-kW solar array was designed to power the propulsion system of a high-altitude super pressure powered aerostat The array must also charge the secondary battery energy storage system for night operation and power the payload system The specific solar array requirements were 1-kW modularity, low weight, high flexibility to withstand the balloon launch environment, and ability to operate at 18 km altitude and withstand temperature cycling between -65 and 70 C for three months Component development and environmental testing have been completed and indicate that the array will meet requirements P T H

A78-11103 Energy conservation in aeronautical ground testing R W Hensel (ARO, Inc , Arnold Air Force Station, Tenn) In Energy crisis An evaluation of our resource potential, Proceedings of the Third Annual UMR-MEC Conference on Energy, Rolla, Mo , October 12-14, 1976 North Hollywood, Calif , Western Periodicals Co , 1977, p 391-403 10 refs

Some USAF ground test facilities are described, and procedures for conserving energy at these facilities are considered Energy costs are examined Energy conservation methods are analyzed in terms of utilizing optimum operating techniques, reducing test conditions, improving aerodynamic efficiency, taking data faster, eliminating unnecessary data, and optimizing power contract management Infrared scanning in heat-transfer measurements and short-duration turbine engine testing are described The effectiveness of different approaches to energy conservation at test facilities is discussed M L

A78-11400 Fatigue research on bonded carbon fibre composite/metal joints M A Smith and R Hardy (Royal Aircraft Establishment, Structures Dept , Farnborough, Hants , England) *(Society of Environmental Engineers, Conference on Fatigue of Fibre-Reinforced Plastics, London, England, June 29, 1977) Composites,* vol 8, Oct 1977, p 255-261 5 refs

Fatigue tests are performed on bonded carbon fiber composite (cfc) joints noting their possible application to aircraft structures A 2-1/2 bonded scarf joint is selected for the experiments as it provides a smooth surface to the component (important in aerospace usage) and a gradual load transfer between the adherends Testing is performed using a 25 kN Instron electrohydraulic fatigue machine with hydraulic wedge grips under a simple form of variable amplitude loading (narrow band random), and constant amplitude loading (yielding basic stress-life, S-N, data) Results are obtained with regard to failure modes, cumulative damage behavior, and the effects of testing frequency Future areas of research will include mechanical joints, the effect of environment on fatigue life, and the effect of compressive loading. S C S

A78-11488 Changes in ground noise levels of general aviation aircraft derived from changes in cockpit noise levels G D Curtis (R A Darby and Associates, Kailua, Hawaii) *Acoustical Society of America, Journal,* vol 62, Oct 1977, p 1045, 1046

It is suggested that measurements of changes in cockpit (cabin) noise levels can be used to estimate the noise levels associated with various power settings of general aviation aircraft in their operations about an airport Data on cabin noise levels during takeoff and landing would be used to adjust data obtained under a standard 1000-ft high power condition so that it would apply to climb, cruise, and other conditions Changes in cabin sound levels as a function of flight condition are presented for a single-engine type and a twin-engine type aircraft Ground measurements of noise changes were obtained for one of the aircraft types in order to test the validity of the procedure M L

A78-11631 Three-dimensional flow in highly-loaded axial turbomachines J E McCune (MIT, Cambridge, Mass) *Zeitschrift fur angewandte Mathematik und Physik,* vol 28, Sept 25, 1977, p 865-878 18 refs Grant No AF-AFOSR-75-2784

Three-Dimensional Flows through axial compressor blade rows are analyzed by new techniques, similar to wing theory, which generalize earlier, strictly linear, perturbation analysis The major advance is accomplished by treating the three-dimensional aspects of the flow as perturbations about the axi-symmetric mean flow, which can be treated exactly The non-linear feature of the theta-averaged flow are retained, thereby allowing study of three-dimensional effects in highly-loaded turbomachinery, with pressure ratios and swirl taken at values consistent with actual practice In the present paper, two quite different examples of practical analysis of this type are given, showing the effects of different kinds of vorticity, both present in the wakes of the blades The flow fields induced by these various types of vorticity are determined It is shown that for operating conditions of present practical interest, significant changes in the flow angles and the pressure field are likely Methods are suggested for determining the downstream shapes of wake surfaces, with significant improvement of accuracy, as compared with earlier analyses The acoustic field associated with compressor blade rows, first discussed by N Rott can, in certain cases, be modified significantly by the swirl induced by working compressor stages (Author)

A78-11634 A note on adaptive-wall wind tunnels W R Sears (Arizona, University, Tucson, Ariz) *Zeitschrift fur angewandte Mathematik und Physik,* vol 28, Sept 25, 1977, p 915 927 Grant No AF AFOSR-76-2954

The scheme proposed by Ferri/Baronti and by Sears, in which the walls of a wind tunnel are iteratively adjusted in accordance with certain flow-perturbation measurements, is reviewed briefly The iterative process is then simulated, within the scope of the theory of small perturbation subsonic flows, for three cases of sinusoidal bodies in two-dimensional and circular tunnels One of these cases is that of a lifting sinusoidal wing of small span tested in a circular tunnel It is shown that convergence occurs in all cases if the 'relaxation parameter' k, which is the fraction of the measured discrepancy distribution employed after each iteration, is chosen anywhere within a rather wide range of positive values It is suggested that the results of this study cast light on the adaptive-wall scheme in general (Author)

A78-11635 Stratford's turbulent separation criterion for axially-symmetric flows A M O Smith (California, University, Los Angeles,Calif) *Zeitschrift fur angewandte Mathematik und Physik,* vol 28, Sept 25, 1977, p 929-939 12 refs

The investigation is concerned with the extension of a formula which had been introduced by Stratford (1959) for predicting the point of turbulent separation in two-dimensional flow At times an equivalent formula for axially symmetric flow is desirable Stratford's formula is extended to accommodate compressible flow The obtained form is similar to but somewhat different from an extension provided by Gadd (1962) G R

A78-11636 On the boundary layer displacement effect near the trailing edge of an aft-loaded airfoil F W Spaid and R J Hakkinen (McDonnell Douglas Research Laboratories, St Louis, Mo) *Zeitschrift fur angewandte Mathematik und Physik,* vol 28, Sept 25, 1977, p 941-950 8 refs Research supported by the McDonnell Douglas Independent Research and Development Program

An investigation is conducted regarding the interaction of the rear upper surface boundary layer with the outer flowfield of an aft-loaded (supercritical) airfoil It is pointed out that the standard computational procedure of adding a calculated displacement thickness to the basic airfoil shape generally underestimates the interaction effect near the trailing edge, even in subcritical flow and in the absence of extensive separation The investigation uses a set of available experimental results including details of the boundary layer Attention is given to the experimental background, the interaction effect of measured versus calculated boundary layers, displacement thickness concepts, and the determination of the effective airfoil shape G R

A78-11699 # **Increasing the resources of jet fuels (Ob uvelichenii resursov reaktivnykh topliv)** E D Radchenko, I V Rozhkov, B A Englin, M V Khokhlacheva, M D Khaikin, and A V Guseva (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Neftianoi Promyshlennosti, Moscow, USSR) *Khimiia i Tekhnologiia Topliv i Masel*, no 10, 1977, p 8 12 13 refs In Russian

Some aspects of the problem of increasing jet fuel resources by increasing the crystallization point from the present Soviet specification of -60 C to -40 C and 50 C foreseen in the ASTM Standards are discussed Data are given on the dependence on the crystallization point of the content of jet fuel fractions in oils from new oil fields in West Siberia and the Komi ASSR V P

A78-11799 **World commercial air transport market to 1991** J P Geddes *Interavia*, vol 32, Oct 1977, p 987-990

Graphical and tabular data are presented on a worldwide scale referable to some parameters of commercial air transport extrapolated from the present epoch (1974 on) through a decade and a half ahead Forecasts of passenger traffic (revenue passenger miles, capacity and production), types of aircraft and their service status (1975 through 1991, yearly estimates), passenger traffic growth, cargo fleet capacity and demand are covered Bottoming-out of the current slump is predicted for 1977 Increased deliveries ahead are expected with the introduction of new quieter aircraft for short and medium hauls Fuel prices are expected to have an impact, but fuel availability problems are discounted Increased capacity and lower costs are anticipated for wide-bodied air freighters R D V

A78-11821 **Ku Band linear phased array** J Barker and M E Davis (General Electric Co , Aircraft Equipment Div , Utica, N Y) *Microwave Journal*, vol 20, Oct 1977, p 44-46, 58 Contract No F19628-73-C-0002

It is shown that a cost-effective phased array can be obtained on the basis of a suitable selection of array architecture and fabrication techniques The HOWLS (Hostile Weapons Locator System) Experimental Radar System was designed to provide a test bed for investigating the use of coherent radar and rapid electronic scan in locating fixed artillery weapons in a ground clutter environment A description is presented of the antenna chosen for the HOWLS radar The antenna is a Ku Band linear phased array, 2 5 meters in length Attention is also given to subarray design and array performance G R

A78-11951 **The domestic airline industry** D D Wyckoff (Harvard University, Cambridge, Mass) and D H Maister (British Columbia, University, Vancouver, Canada) Lexington, Mass , D C Heath and Co , 1977 280 p 16 refs $17

The relative importance of air transport in domestic transportation is considered along with the structure of the air transport industry, the regulatory environment, the airline cost structure, questions of competition and strategy, aspects of finance, and case synopses Attention is given to Southwest Airlines, the cargo operations of United Air Lines, Braniff International, the Flying Tiger Line, Eastern Airlines December schedule, Southern Airways, the Federal Express Corporation, manning problems regarding the Boeing B-737, CP Air passenger reservations, and aspects of airline industry terminology G R

A78-12030 **Adaptation for economization, or adaptation for the economization of energy (Adaptation pour l'économie ou adaptation pour l'économie d'énergie)** P Lecomte (Societe Nationale Industrielle Aérospatiale, Division Avions, Paris, France) *(Association Aéronautique et Astronautique de France and International Civil Aviation Organization, Congres International Aéronautique, 13th, Paris, France, June 2, 3, 1977) L'Aéronautique et l'Astronautique*, no 65, 1977, p 3 12 12 refs In French

Tradeoffs between overall economies and fuel economies in the design and operation of aircraft are discussed It is suggested that turboprop craft with a cruise speed between Mach 0 6 and 0 7 could be used for efficient freight transport, advanced turboprop designs may also offer attractive economic passenger transport In addition, a medium-range straight-wing airplane with a cruise speed of Mach 0 75 may provide both efficient use of fuel and an attractive mode of transport Economies obtained through the modification of braking systems, landing gear, as well as mass reductions in the design phase, are mentioned J M B

A78-12031 **Energy savings - The viewpoint of an aircraft manufacturer (Les économies d'énergie - Point de vue d'un avionneur)** P Amblard (Avions Marcel Dassault Breguet Aviation, Vaucresson, Hauts-de-Seine, France) *(Association Aéronautique et Astronautique de France and International Civil Aviation Organization, Congres International Aéronautique, 13th, Paris, France, June 2, 3, 1977) L'Aéronautique et l'Astronautique*, no 65, 1977, p 13-18 In French

Technological developments leading to the design of aircraft which consume less fuel than present models are reviewed In particular, high bypass ratio engines, supercritical wingspans, active control, and the use of light-weight composite materials for both secondary and primary aircraft structures are considered Advanced techniques in aerodynamic analysis, especially in the field of boundary layer control, are also mentioned It is suggested that the aircraft design process should be more closely coordinated with the long-range planning of commercial airlines J M B

A78-12034 **The influence of runway irregularities on the dynamic behavior of aircraft at takeoff (Influence des irrégularités de piste sur le comportement dynamique des avions au décollage)** J -P Drevet (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France) *L'Aéronautique et l'Astronautique*, no 65, 1977, p 37-42 In French (ONERA, TP no 1977-147)

A hybrid (both analogical and numerical) computer simulation technique is employed to analyze the dynamic behavior of such aircraft as the Concorde during takeoff A number of simulated and real runways are studied with the simulation, which takes into account the nonlinearities of the aircraft under-carriage In particular, sinusoidal runway irregularities are investigated, and standards for the control of potentially dangerous runway fluctuations of various wavelengths are proposed J M B

A78-12035 **The attack helicopter Hughes YAH-64 (L'hélicoptère d'attaque Hughes YAH-64)** G Bruner (Centre de Documentation de l'Armement, Paris, France) *L'Aéronautique et l'Astronautique*, no 65, 1977, p 43-53 In French

The general configuration and the performance of the attack helicopter YAH-64 are presented The various features of the aircraft, including the fuselage, wing, tail unit, landing gear, main rotor, tail rotor, engines, drive devices, flight controls, and weapons, are also described The effort to enhance invulnerability, the layout of the electronic and optical devices, the maintenance facilities, and the capacity for transport for the vehicle are reviewed The second phase of the development program for the craft is also discussed (Author)

A78-12068 **Reliability prediction for composites under periodic proof tests in service** J N Yang (George Washington University, Washington, D C) In Composite materials Testing and design, Proceedings of the Fourth Conference, Valley Forge, Pa , May 3, 4, 1976 Philadelphia, Pa , American

Society for Testing and Materials, 1977, p 272-295 24 refs Contract No F33615-75-C-5112

An exploratory reliability analysis of composites under periodic proof tests in service is presented The ultimate strength of composites is a random variable A residual strength degradation model for composites under service loads is employed Failure occurs as soon as the residual strength of composites is exceeded by *statistical service loads, for example, gust turbulence and maneuver* loads Meanwhile, the composites are subjected to periodic proof tests in order to eliminate weak components and ensure an acceptable level of reliability When a component fails under the proof test, a new component is manufactured and proof-tested for replacement, so that the strength of composites is renewed Taking into account the statistical strengths, strength degradation characteristics, statistical service loads, design stresses, periodic proof tests, and renewal processes due to replacement, the probability of composite failure in service is derived Two numerical examples, a boron/titanium bonded joint of a fighter aircraft and a glass/epoxy component of a transport-type aircraft, are worked It is demonstrated that significant fatigue reliability improvement for composites can be achieved by the application of periodic proof tests (Author)

A78-12073 * Boron/aluminum skins for the DC-10 aft pylon S Y Elliott (Douglas Aircraft Co , Long Beach, Calif) In Composite materials Testing and design, Proceedings of the Fourth Conference, Valley Forge, Pa , May 3, 4, 1976 Philadelphia, Pa , American Society for Testing and Materials, 1977, p 358-371 Contract No NAS1-13029

Three boron/aluminum aft pylon 'boat tail' skins were designed, fabricated, and installed on three DC-10 aircraft for a five-year flight service demonstration test Inspection and tests of the skins will establish the ability of the composite to withstand long-time flight service exposures to high temperatures, sonic fatigue, and flutter The results of a preliminary testing program yielded room and elevated temperature data on the tension, compression, in-plane shear, interlaminar shear, bolt bearing, and tension fatigue properties of the oriented eleven-ply boron/aluminum laminates, and this information, together with a stress analysis, was used to obtain Federal Aviation Administration approval Present state-of-the-art technology was used in the fabrication of the skins, and these were installed on the existing titanium substructure with the same number and size mechanical fasteners as are used for the present titanium skins (Author)

A78-12080 Environmental sensitivity tests of graphite-epoxy bolt bearing properties D J Wilkins (General Dynamics Corp , Fort Worth, Tex) In Composite materials Testing and design, Proceedings of the Fourth Conference, Valley Forge, Pa , May 3, 4, 1976 Philadelphia, Pa , American Society for Testing and Materials, 1977, p 497-513 Research sponsored by the General Dynamics Corp

Over 200 tests were performed to study the effects of moisture and temperature on typical graphite-epoxy bolted joints Three test specimen types were used unnotched control laminates, filled-hole specimens containing an unloaded fastener, and bearing specimens Five typical laminate orientations were studied Standard 1/4-in straight-shank fasteners were used with bolt torques varying from zero to specification values Two types of moisture conditioning were employed hygrothermal and conditioning with thermal spikes to 300 F superimposed on the hygrothermal background Test temperatures were 75 and 200 F A summary of results shows that *many of the test conditions produced no significant effects* The maximum reduction from room temperature, dry performance to hot, wet performance was 18 percent (Author)

A78-12174 # Small ballooning serves the Navy W F Cross (U S Navy, Office of Naval Research, Twin Cities, Minn) *Naval Research Reviews,* vol 30, Aug 1977, p 1-11 11 refs

Small balloons (i e lighter-than-air free balloons with maximum inflation or displacement of air at ground level up to 150 lbs) have long been used for scientific experiments Areas covered include atmosphere and near-space observations, biological, chemical, and astrophysical research, and the development of communications and surveillance systems Current projects utilizing the method include balloon-borne rockets (the ROCKOON program), the Arctic expeditions (Project SKYHOOK 'Buckshot') Launch techniques include a conventional hand-launched method and a bubble restraint method *Applications of small balloon technology are planned for various* types of data acquisition such as the in situ sampling of stratospheric trace constituents in regions not presently accessible to aircraft or remote satellites S C S

A78-12213 The Dash 7 - An aircraft for today's environment A F Toplis (Spar Aerospace Product, Ltd , Toronto, Canada) *Engineering Journal,* vol 60, Sept Oct 1977, p 10, 12-14

The Dash 7, a high wing 50 passenger turboprop aircraft with a T tail and retractable landing gear, is described The aircraft, which has STOL capability, was designed to be acceptable in an urban environment, and aircraft features which promote quietness, low emissions of engine pollutants, land conservation, fuel economy, and profitability are considered The flaps, by covering some 80% of the wing trailing edge outboard of the fuselage, contribute to the low take-off and landing speeds and hence to the short distance required for runways The Dash 7 is described as the quietest commercial transport aircraft in the world, the area within the 80 PNdB contour is 2 5 sq mi M L

A78-12225 # Optimization of helicopter design I (Optymalizacja projektu smiglowca I) K Szumanski *Technika Lotnicza i Astronautyczna,* vol 32, Aug 1977, p 24-26 In Polish

Computer-aided optimized helicopter design is outlined A mathematical model is developed and stages in the conceptual design are detailed Compressibility bounds are computed in 2-D and 3-D Generalized parameters used in the design procedure are defined Attention is paid to sensitivity problems, and to changes in helicopter loading resulting from slight changes in weights assigned to components in the design, and to lower and upper bounds for flow separation R D V

A78-12226 Digital Avionics Systems Conference, 2nd, Los Angeles, Calif , November 2-4, 1977, Collection of Technical Papers and Supplement Conference sponsored by the American Institute of Aeronautics and Astronautics New York, American Institute of Aeronautics and Astronautics, Inc , 1977, Collection of Technical Papers, 372 p , Supplement, 92 p Members, $35 , nonmembers, $45

Papers are presented in a wide range of subjects dealing with digital avionics, including the current avionics program of NASA, methods for the evaluation of advanced aircraft systems by the FAA, fiber optic multiplex data bus design for aircraft, and the state of the art of microprocessor-controlled microstrip phased arrays Consideration is also given to an airborne thermal infrared position updating system, leadless carrier applications for avionics packaging, design and implementation of mode control logic in digital autopilots, and compiler development methodology for avionics processors B J

A78-12227 * # Future opportunities in digital avionics - NASA's role L W Taylor, Jr (NASA, Electronics Div , Washington, D C) In Digital Avionics Systems Conference, 2nd, Los Angeles, Calif , November 2-4, 1977, Collection of Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 1-4 21 refs (AIAA 77-1468)

The current avionics program of NASA is briefly reviewed with attention given to digital operations (navigation, communication and guidance), integrated controls (dealing with aircraft stability, handling qualities, load alleviation, and propulsion) and cockpit avionics NASA's role is discussed in terms of the present avionics program and the future opportunities that are addressed in long-range plans B J

A78-12228 # **Analog to digital airplanes - One easy step** W T Carnes and D H Featherstone (Aeronautical Radio, Inc, Annapolis, Md) In Digital Avionics Systems Conference, 2nd, Los Angeles, Calif, November 2-4, 1977, Collection of Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc, 1977, p 5-8 (AIAA 77-1469),

The paper analyzes the influence of the air transport industry's traditional attitudes concerning avionics system design on its approach to the digital takeover and reviews some in-service needs of digital systems It is noted that cost-effective use of digital technology in avionics does require a different approach to systems architecture than that employed in the analog era, and that the benefits of form, fit and function standardization will be no less significant in the digital world than they were in the analog world It is concluded that the analog-to-digital changeover, to be economically attractive, must (at least in the autopilot, the sensors and associated cockpit instrumentation) be made in one step B J

A78-12229 # **Digital avionics overview airframe manufacturers' update** G T Gebhardt (Boeing Commercial Airplane Co, Seattle, Wash) In Digital Avionics Systems Conference, 2nd, Los Angeles, Calif, November 2-4, 1977, Collection of Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc, 1977, p 9-12 (AIAA 77-1470)

An update is presented of a paper presented by Dunn in April 1975 at the Boston AIAA Digital Avionics System Conference The present paper updates what has happened in digital avionics since 1975 by reviewing the criteria to which Boeing aircraft are designed and the solutions proposed to meet these criteria, and by forecasting future trends of research and development in digital avionics B J

A78-12230 # **FAA role of certification - Advanced aircraft systems** H E Waterman (FAA, Washington, D C) In Digital Avionics Systems Conference, 2nd, Los Angeles, Calif, November 2 4, 1977, Collection of Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc, 1977, p 13 15 (AIAA 77-1472)

Some of the methods to be used for future evaluation of advanced aircraft systems by the FAA are discussed along with anticipated limitations in FAA resources Actions available to industry to expedite projects are explained in a nontechnical fashion The discussion is carried on with reference to four of the FAA's R & D programs simulation for validating digital avionics, lightning and static discharge upon avionics systems, fault tolerant avionics for flight critical applications in active control technology aircraft, and digital avionics software validation B J

A78-12231 # **A comparative evaluation of modem techniques for simultaneous data and range measurement** H C Salwen (Proteon Associates, Inc, Waltham, Mass) In Digital Avionics Systems Conference, 2nd, Los Angeles, Calif, November 2-4, 1977, Collection of Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc, 1977, p 16-21 9 refs (AIAA 77-1474)

This paper presents a discussion of hybrid modem techniques for aircraft position location and data communication via satellite First, the problem to be solved is defined Then the performances achievable by various techniques are derived and discussed A new technique for ranging/data transmission is presented which offers significant advantages when operating over bandwidth limited and power limited channels (Author)

A78-12232 # **An airplane fiber optic multiplex data bus design and feasibility demonstration system** I R Reese and D R Porter (Boeing Commercial Airplane Co, Seattle, Wash) In Digital Avionics Systems Conference, 2nd, Los Angeles, Calif, November 2-4, 1977, Collection of Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc, 1977, p 22-30 10 refs (AIAA 77-1475)

Multiplex data buses are being implemented in airplanes and space vehicles to reduce wiring and achieve systems flexibility Fiber-optic cables offer several advantages for data communications on airplanes This paper describes a design approach to fiber optic data buses for airplane applications Key design parameters and trades are discussed The architecture and design of a feasibility demonstration system with eight access ports and three active terminals are described The system operates half duplex at a one megabit per second data rate Laboratory test results show that virtually error-free performance is possible with signals as small as 15 nW average power incident on a terminal's detector (Author)

A78-12234 # **The feasibility of an airborne thermal infrared position updating system** E H Conrow, Sr (General Dynamics Corp, Convair Div, San Diego, Calif) In Digital Avionics Systems Conference, 2nd, Los Angeles, Calif, November 2-4, 1977, Collection of Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc, 1977, p 35-39 (AIAA 77-1477)

The feasibility of using a thermal IR radiometer subsystem for providing navigational updates to an inertial guidance system of an airborne vehicle was investigated Temporal thermal IR data was utilized to determine the degree of correlation that could be expected with such an updating system using map-matching techniques In addition, environmental factors that can degrade scene correlation (hence, update performance) were identified and evaluated From this suggestions for implementing and utilizing such an integrated airborne guidance system were determined (Author)

A78-12238 # **Design and implementation of mode control logic in digital autopilots** L R Tomlinson (Boeing Airplane Co, Renton, Wash) In Digital Avionics Systems Conference, 2nd, Los Angeles, Calif, November 2 4, 1977, Collection of Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc, 1977, p 59-67 (AIAA 77-1488)

The problems encountered in designing mode control logic for complex automatic flight control systems are briefly discussed A design work flow chart is suggested which should reduce the probability of overlooking sneak logic A technique is advocated for implementing mode logic in software as follows (1) Rewrite similar logic equations, which share functional commonality, into identical forms (2) Process the resulting logic equations in parallel by using Boolean instructions to operate on packed words This technique is illustrated by a simple example Application of this parallel processing technique will reduce memory requirements, provide good software visibility, allow adequate flexibility for change, be economical with computation time, and provide the mode information in packed words for easy communications with other units This technique does require close design coordination between all the software modules that interface with the mode logic This design idea is offered in hopes of stimulating development of better methods of implementation mode logic in digital control systems (Author)

A78-12243 * # **Advanced Digital Avionics System for general aviation** R K Smyth (Milco International, Inc, Huntington Beach, Calif), R H Hoh, and G L Teper (Systems Technology, Inc, Hawthorne, Calif) In Digital Avionics Systems Conference, 2nd, Los Angeles, Calif, November 2-4, 1977, Collection of Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc, 1977, p 96-102 Contract No NAS2 9311 (AIAA 77-1494)

Objectives and functions of the Advanced Digital Avionics System (ADAS) for general aviation are outlined with particular reference to navigation, flight control, engine management, ATC surveillance, flight management, communications, and the pilot controls and displays The resulting ADAS design comprises the selection of off-the-shelf avionics to be integrated with ADAS-unique elements including new pilot displays and controls along with a microcomputer control complex (MCC) Reasons for which the ADAS achieves increased avionics capability are mentioned, including overall system integration through the MCC and pilot orientation from navigation map display S D

A78-12244 # **Airline viewpoint on systems development and integration** T A Ellison (United Air Lines, Inc, San Francisco, Calif) In Digital Avionics Systems Conference, 2nd, Los Angeles, Calif, November 2-4, 1977, Collection of Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc, 1977, p 103-109 (AIAA 77-1496)

The paper discusses airline views and system integration from functional and structural standpoints A gradual acceptance of functional integration is stressed Avionic development trends are examined along with digital information exchange standard, new sensor specifications, information processors, information flow pattern, and control panels It appears that there is definite transition toward more highly integrated system of avionics information processors for tomorrow's aircraft and that those integration moves which potentially offer improved operation of the aircraft, reduced fuel operating costs, or improvements in traffic capacity in the aircraft ATC system are receiving acceptance One of the major criteria affecting integration and functional partitioning among processors is the optimization of input/output paths and the operational capability remaining in the event of the loss of a processor S D

A78-12245 # **A new concept in integrated reference systems** E V Harrington, Jr, G H Raroha, and J W Bell (USAF, Avionics Laboratory, Wright-Patterson AFB, Ohio) In Digital Avionics Systems Conference, 2nd, Los Angeles, Calif, November 2-4, 1977, Collection of Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc, 1977, p 110-116 8 refs (AIAA 77-1497)

Results of initial feasibility analysis are presented for the Multifunction Inertial Reference Assembly (MIRA) designed to reduce the life cycle costs of mission essential avionics by satisfying the combined kinematic data requirements of flight control, navigation, weapon delivery, and terminal area control Key to practical integration of these sensor functions is the digitalization of avionic and flight control functions Sensor commonality and data utilization are discussed along with the location of inertial sensors and redundancy Modularity is directly applicable to the MIRA concept Other methods for integration of reference sensors are also considered S D

A78-12246 # **TIES - Tactical information exchange system** G J Palatucci and E R Ressler (U S Naval Material Command, Naval Air Development Center, Warminster, Pa) In Digital Avionics Systems Conference, 2nd, Los Angeles, Calif, November 2-4, 1977, Collection of Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc, 1977, p 117-128 (AIAA 77-1498)

Advanced digital and analog RF technology allows the building of a new architecture for satisfying aircraft communication, navigation or identification requirements The hardware found in the TIES system differs from what would be found in the conventional one-function-at-a-time design for CNI systems TIES hardware is usually general purpose, programmable hardware used for multiband applications The heart of the system is a broadband signal distribution subsystem which allows any RF/IF signal path to be connected to any IF baseband signal path The TIES structure has strong potential to pay off in life cycle cost advantage, improved reliability and improved logistics The exploratory development program has included Navy and contractor efforts which have to date defined the basic system architecture to consist of three subsystems - the frequency conversion subsystem (antenna-end), the signal distribution subsystem, and the signal conversion subsystem (baseband I/O-end) Furthermore, the capability of signal processing hardware has been increased significantly by TIES work in the technology areas The TIES system is not without critics (Author)

A78-12247 # **DAIS - Design and performance** J G Weber (USAF, Avionics Laboratory, Wright-Patterson AFB, Ohio), R C Mason, and B A Rich (TRW Defense and Space Systems Group, Dayton, Ohio) In Digital Avionics Systems Conference, 2nd Los Angeles, Calif, November 2-4, 1977, Collection of Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc, 1977, p 129-136 6 refs (AIAA 77 1499)

The Digital Avionics Information System (DAIS) provides a system architecture which can adapt currently available avionics subsystems (radars, inertial platforms, etc) to a common modularly expandable avionics core The architecture of DAIS is not limited to that role, however, and it provides a general system framework in which to design future avionics systems A better characterization of DAIS is a hierarchical system architecture with much more physically distributed computing resources allowed than the casual observer realizes The paper explores that DAIS system design and summarizes its operating features Special attention is given to the adaptability of DAIS architecture to various applications, processes and data control features, redundancy features, and the capability of DAIS to detect and recover from various system error conditions, including failure of the master processor (Author)

A78-12248 # **An approach to system integration /BASIC/** G L Averill (U S Naval Material Command, Naval Air Development Center, Warminster, Pa) In Digital Avionics Systems Conference, 2nd, Los Angeles, Calif, November 2 4, 1977, Collection of Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc, 1977, p 137-145 (AIAA 77-1500)

The paper examines the Basic Avionic Subsystem Integration Concept (BASIC) program designed to resolve system level configuration and integration problems in exploratory and advanced development phases of technology and subsystem developments The corresponding laboratory system consists of core avionic suites that may be applied to any of the advanced Navy aircraft Major issues pertinent to the BASIC program are introduced and briefly discussed These issues include the development process, the avionic needs of future weapon systems, the development opportunity, the BASIC process and the status of the BASIC program S D

A78-12250 # **Digital avionics, active controls, and the FAA - Advanced integrated flight systems /AIFS/** J E Reed and E M Boothe (FAA, Systems Research and Development Service, Atlantic City, N J) In Digital Avionics Systems Conference, 2nd, Los Angeles, Calif, November 2-4, 1977, Collection of Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc, 1977, p 157-161 8 refs (AIAA 77-1503)

The paper examines the FAA AIFS technology program objectives These are (1) to determine the need for any revision of airworthiness standards for advanced systems and aircraft employing such systems, (2) to acquire the necessary data base to support any needed revisions, and (3) to support the development of certification procedures for airworthiness standards Attention is given to program management and implementation, and the following digital flight control and avionics projects are considered the effects of lightning and static discharge on avionics systems, and fault-tolerant avionics for flight critical applications B J

A78-12251 # **Navy advanced sensor programs for fly-by-wire aircraft** C Abrams (U S Naval Material Command, Naval Air Development Center, Warminster, Pa), W Weinstein, and R Solomon (Grumman Aerospace Corp, Bethpage, N Y) In Digital Avionics Systems Conference, 2nd, Los Angeles, Calif, November 2-4, 1977, Collection of Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc, 1977, p 162-173 5 refs (AIAA 77 1504)

Digital fly-by-wire (DFBW) requirements for future Navy air missions present imposing goals for system safety, cost, performance, survivability and operational readiness The Integrated Sensory Subsystem (ISS) and the Integrated Inertial Sensor Assembly (IISA) are examples of advanced concepts which employ redundant sensors as a means of meeting these requirements The ISS program achieves these goals by maximizing modularization, interchangeability, mature sensor technology, and fault indication while avoiding undue hardware proliferation by minimizing the number of sensors The

Advanced Skewed Sensory Electronic Triad (ASSET) system, a unique array of rate sensors and digital redundancy management program, is incorporated within the ISS concept Results of laboratory testing with a simulated A-6A aircraft, utilizing a two-axis fly-by wire (FBW) flight control system, are presented (Author)

A78-12252 * # **Evaluation of the F-8 DFBW analytic redundancy sensor FDI algorithm using telemetry data** J C Deckert, M N Desai, J J Deyst (Charles Stark Draper Laboratory, Inc , Cambridge, Mass) In Digital Avionics Systems Conference, 2nd, Los Angeles, Calif , November 2 4, 1977, Collection of Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 174-185 7 refs Contract No NAS4-2409 (AIAA 77-1506)

In this paper we present a reliable technique for failure detection and identification (FDI) for dual redundant flight control sensors aboard the NASA F-8 digital fly-by-wire (DFBW) aircraft, and we discuss the successful application of the technique to identifying failures injected on test flight telemetry data The technique exploits the analytic redundancy which exists as relationships among variables being measured by dissimilar instruments With straightforward modification the technique may be extended to provide failure monitoring of a single remaining sensor after the identified failure of its companion sensor (Author)

A78-12253 * # **Flight experience with a fail-operational digital fly-by-wire control system** S R Brown and K J Szalai (NASA, Flight Research Center, Edwards, Calif) In Digital Avionics Systems Conference, 2nd, Los Angeles, Calif , November 2-4, 1977, Collection of Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 186-199 9 refs (AIAA 77-1507)

The NASA Dryden Flight Research Center is flight testing a triply redundant digital fly-by-wire (DFBW) control system installed in an F-8 aircraft The full-time, full-authority system performs three-axis flight control computations, including stability and command augmentation, autopilot functions, failure detection and isolation, and self-test functions Advanced control law experiments include an active flap mode for ride smoothing and maneuver drag reduction This paper discusses research being conducted on computer synchronization, fault detection, fault isolation, and recovery from transient faults The F-8 DFBW system has demonstrated immunity from nuisance fault declarations while quickly identifying truly faulty components (Author)

A78-12254 # **Digital multimode fly-by-wire flight control system design and simulation evaluation** G J Vetse , R J Landy, and D B Schaefer (McDonnell Aircraft Co , St Louis, Mo) In Digital Avionics Systems Conference, 2nd, Los Angeles, Calif , November 2-4, 1977, Collection of Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 200-211 7 refs (AIAA 77-1508)

The flexibility and versatility of digital technology facilitates the implementation of multimode control laws to meet specific mission requirements for advanced fighter aircraft Multimode control laws for an advanced fighter aircraft configured with direct force control capability are defined and initially designed in the continuous domain The digitization of one of the multimodes is then illustrated Digital design considerations such as the effects of sample rate, computation delays, aliasing, granularity, prefiltering and postfiltering on system performance are addressed Use of these modes to improve aircraft effectiveness in the various mission segments is illustrated Results from manned simulations conducted to evaluate these modes are presented (Author)

A78-12255 # **An overview of enroute radio navigation services for civil aviation** C Yulo (FAA, Navigation Div , Washington, D C) In Digital Avionics Systems Conference, 2nd, Los Angeles, Calif , November 2 4, 1977, Collection of Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 212-218 (AIAA 77-1509)

A confusing picture appears to have evolved with respect to alternative navigation systems for aviation and non-aviation applications, many of which are in use today or are in various stages of development This has provoked the concern of Congress relative to the proliferation of radio navigation systems The aviation community shares this concern, specifically as it relates to the implied possibility of phasing-out systems that have been an inherent part of the National Airspace System (NAS) The paper summarizes aviation navigation needs and discusses prominent systems available for selection An engineering and development effort that would be responsive to the needs of the aviation community is outlined They are - modernize the VORTAC, clarify the application of LORAN C as an aviation NAVAID, determine the scenario and the technical requirements for post 1985 and, determine the certification requirements for available system (Author)

A78-12256 # **Avionics for the discrete address beacon system /DABS/** W G Shear (Bendix Corp , Avionics Div , Fort Lauderdale, Fla) In Digital Avionics Systems Conference, 2nd, Los Angeles, Calif , November 2-4, 1977, Collection of Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 221-225 (AIAA 77-1511)

A new Air Traffic Control Transponder is required to support the Discrete Address Beacon system proposed by the Federal Aviation Administration This DABS Transponder provides means for responding to both general and discretely addressed interrogation from the Air Traffic Control Radar It includes a significant data transmission capability, permitting a variety of improved ground to air services Important differences in the Avionics requirements are identified, as well as the technical approach selected for implementation The impact of the additional functions on the cost of this next generation equipment is discussed and the projected selling price is presented (Author)

A78-12257 # **The effect of radar disturbances on aircraft runway arrival time in a four-dimensional navigation terminal approach** C L Durocher (USAF, Space and Missiles Systems Organization, Los Angeles, Calif) In Digital Avionics Systems Conference, 2nd, Los Angeles, Calif , November 2-4, 1977, Collection of Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 226-229 (AIAA 77-1512)

This study examines the effect of radar disturbances on time controlled precision landing delivery A simulation has been developed and tested which models an aircraft on a Four-Dimensional Navigation terminal approach Trained pilots flew a nominal approach in a fixed base cockpit simulator following timed delivery commands from an initial fix to a final approach fix During the flight, position information was estimated from noisy radar observations Three phases of testing were conducted to quantify the accuracy of a timed delivery algorithm with modifications in the flight commands In all cases, timed delivery was performed with great accuracy while keeping pilot work-loaded at a low level (Author)

A78-12258 # **Multi-system position determination - An innovative approach to low cost area navigation** L A Hollaar and M J Cannon (Illinois, University, Urbana, Ill) In Digital Avionics Systems Conference, 2nd, Los Angeles, Calif , November 2-4, 1977, Collection of Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 230-237 9 refs (AIAA 77-1513)

A study is being conducted to determine the feasibility of creating a composite system for general aviation navigation, which uses a number of present systems, benefiting from their strengths and ignoring their weaknesses A preliminary configuration based on VOR, Omega and dead reckoning has been proposed and computer simulations of the system are being made with promising results When this concept is combined with inexpensive receivers and low-cost, but logically powerful digital computers, it is possible to offer an RNAV system at an add-on cost comparable to another VOR receiver B J

A78-12259 # **Integration, installation, and flight test of a fail passive digital automatic flight control system in a jet transport aircraft** R H Pursel (FAA, National Aviation Facilities Experimental Center, Atlantic City, N J) In Digital Avionics Systems Conference, 2nd, Los Angeles, Calif , November 2-4, 1977, Collection of Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 238-245 (AIAA 77-1514)

A fail passive digital flight control system which would provide cruise, automatic landing (through rollout) and autothrottle capability to support various project requirements has been developed for the FAA's CV-880 test bed aircraft The system was procured to provide the FAA with a flexible flight control system to be used in a total system evaluation of the Time Reference Scanning Beam MLS A description is given here of system hardware including the digital processor, the aircraft systems coupler, ancillary digital equipment, and servos and servo amplifiers Software is also considered along with system monitoring, installation, and flight testing B J

A78-12260 # **Digital avionics information system control and displays architecture** E F Hitt (Battelle Columbus Laboratories, Columbus, Ohio) and T A Brim (USAF, Avionics Laboratory, Wright-Patterson AFB, Ohio) In Digital Avionics Systems Conference, 2nd, Los Angeles, Calif , November 2-4, 1977, Collection of Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 246-254 5 refs (AIAA 77-1515)

The DAIS C/D provides one-man interaction with, and control of, mission software and aircraft subsystems The architecture provides redundancy for all interfaces with the DAIS multiplex subsystem as well as functional redundancy internal to the C/D subsystem The flexibility provided by the DAIS C/D subsystem will permit investigation and allocation of functions between mission software and C/D software, symbology design and presentation, switching of information between displays, and allocation of functions between the pilot and avionics software The architecture will also permit investigation of the degree of redundancy required and the resultant impact on hardware and software life-cycle cost (Author)

A78-12262 # **JTIDS - An update** E G Smith (U S Naval Material Command, Naval Air Development Center, Warminster, Pa) In Digital Avionics Systems Conference, 2nd, Los Angeles, Calif , November 2-4, 1977, Collection of Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 262-270 (AIAA 77-1521)

The purpose of the Joint Tactical Information Distribution System (JTIDS) is to provide an advanced communication, navigation and identification (CNI) system that will serve a wide variety of users The system uses a low duty cycle, spread-spectrum waveform and advanced coding techniques to provide secure, jam-resistant and low probability of exploitation (LPE) CNI functions The system will implement Multiple Access Techniques to provide various levels of connectivity (access) to user elements for simultaneous distribution and receipt of digital information This presentation will describe the potential of JTIDS, and how it may impact philosophy, concepts and operations for a variety of users Also new generic channel types which have been synthesized with the flexible structure of the JTIDS waveform to provide a variety of access techniques will be described (Author)

A78-12263 # **ARINC communications addressing and reporting system /ACARS/ - The data link that got implemented and why** N D Steele, Jr (Aeronautical Radio, Inc , Annapolis, Md) In Digital Avionics Systems Conference, 2nd, Los Angeles, Calif , November 2-4, 1977, Collection of Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 271-273 (AIAA 77-1522)

A78-12264 # **A computer controlled aircraft collision avoidance system** C A Richardson and M Cohen (FAA, National Aviation Facilities Experimental Center, Atlantic City, N J) In Digital Avionics Systems Conference, 2nd, Los Angeles, Calif , November 2-4, 1977, Collection of Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 274 280 (AIAA 77-1524)

A computer controlled aircraft collision avoidance system capable of operating with or without the assistance of ground-based beacon systems is described The airborne interrogator of the collision avoidance system elicits second-by-second mode C altitude response signals from all beacon-equipped aircraft within a radius of 32 miles The software employed by the collision avoidance system is described, the system has the advantage of requiring only a transponder and an encoding altimeter in the aircraft which it tracks J M B

A78-12265 # ***The communications aspects of the DABS transponder*** P H Robeck and J D Welch (MIT, Lexington, Mass) In Digital Avionics Systems Conference, 2nd, Los Angeles, Calif , November 2 4, 1977, Collection of Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 281-287 FAA-sponsored research (AIAA 77-1525)

The signal and message formats of the Discrete Address Beacon System (DABS), a cooperative surveillance and communications system designed to replace the existing FAA Air Traffic Control Radar Beacon System, are discussed DABS interrogations are transmitted at 4 Mbps and comprise 56 or 112 bits, including 24 bits of address and parity, the replies are transmitted at 1 Mbps Interfacing of the DABS transponder with various message displays and input devices via the Standard Message Interface or the Extended Length Message Interface (capable of transmitting up to 1280 bits of data in a burst) is also considered J M B

A78-12267 # **Digital real time simulation of the F-5E/F flight director computer** R A Weeks (Northrop Corp , Hawthorne, Calif) In Digital Avionics Systems Conference, 2nd, Los Angeles, Calif , November 2-4, 1977, Collection of Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 294-303 (AIAA 77-1528)

A digital real-time flight simulation study was performed to ascertain the modifications required to take an existing analog Flight Director Computing System and adapt it to the F-5E/F Aircraft in the form of digital computations The investigation assumed that all gains would be of constant value and that the input/output of the existing Flight Director Computer would be unaltered Therefore, the problem became one of optimizing the gains without scheduling, and deriving all necessary control laws from the existing computer inputs The simulation program allowed for pilot-in-the-loop evaluations Analog Flight Director Computer aircraft hardware, from which the baseline Digital Flight Director Computer model was derived, was interfaced to the simulation to allow validation with existing analog airborne computing machinery It was found that an effective Digital Flight Director Computer for the F-5E/F Aircraft could execute steering command computations in approximately 1 0 millisecond (Author)

A78-12268 # **Digital avionics system for the Shuttle Training Aircraft** R L Keller, N Lowell, and J F Williams (Sperry Rand Corp , Sperry Flight Systems, Phoenix, Ariz) In Digital Avionics Systems Conference, 2nd, Los Angeles, Calif , November 2-4, 1977, Collection of Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 304-313 6 refs (AIAA 77-1529)

The Shuttle Training Aircraft (STA), used to train astronauts in the terminal descent phase of Orbiter flight, is controlled by a model-following digital avionics system The modeling and model-following processes represent distinct advancements in model-following technology The STA provides complete large motion model-following of the Orbiter, including all speed and position variations from 40,000 feet altitude to touchdown This is in contrast to those systems designed to follow only small perturbed

motions about trimmed flight Achieving the model following capability in addition to various display, monitoring, test and control functions resulted in a 32,000 word airborne program (Author)

A78-12275 # **The flight control computers of the F-18 electronics set - Flight control** D R Katt (McDonnell Douglas Corp , St Louis, Mo) and P A Raymont (General Electric Co , Binghamton, N Y) In Digital Avionics Systems Conference, 2nd, Los Angeles, Calif , November 2 4, 1977, Supplement New York, American Institute of Aeronautics and Astronautics, Inc , 1977 8 p (AIAA 77-1479)

The U S Navy's Hornet is designed to be survivable and fault tolerant It is the first production fighter to utilize a digital processor within its flight control computers An overview of the failure performance of the flight control system is presented This is followed by an explanation of the functional partitioning of the Hornet flight control computers and a description of the mechanization of the hardware and software elements related to the redundancy management of these flight control computers In addition, the divisioning of the software tasks is explained (Author)

A78-12276 # **Application of an airborne digital computer in the F-15 engine air inlet control system** C J Scherz and L E Williams (McDonnell Aircraft Co , St Louis, Mo) In Digital Avionics Systems Conference, 2nd, Los Angeles, Calif , November 2-4, 1977, Supplement New York, American Institute of Aeronautics and Astronautics, Inc , 1977 12 p (AIAA 77-1480)

The F-15 is a high performance air superiority fighter Trade studies showed that an inlet with three variable compression ramps and a variable capture area feature would enhance overall weapon system performance The control mechanism that was chosen for positioning the inlet variable surfaces is presented By means of a digital simulation, it was found that the control system dynamic response requirements were established by the necessity of the system to follow high-rate angle-of-attack transients generated during aircraft maneuvering A study showed that a serial digital computer mechanization for the Air Inlet Controller (AIC) was preferred over an analog or parallel digital computer mechanization The details of the production digital AIC are described Flight test results show that the inlet control system and the AIC have adequate steady state accuracy and dynamic response characteristics for control of the inlet system to provide excellent performance and low inlet distortion during extreme aircraft maneuvers (Author)

A78-12277 # **A high speed fault tolerant multiprocessor for radar data processing** D K Sloper, A R Helland, R J Betz, and T E Underwood (Westinghouse Defense and Electronic Systems Center, Baltimore, Md) In Digital Avionics Systems Conference, 2nd, Los Angeles, Calif , November 2-4, 1977, Supplement New York, American Institute of Aeronautics and Astronautics, Inc , 1977 4 p (AIAA 77 1482)

This paper describes the considerations involved in the design of the radar computer for E-3A High speed parallel processing units and data paths were used to permit the critical requirements of speed, reliability, and maintainability The I/O unit provided the capability to handle a variety of types of interfaces and to provide direct access to the main memory for external interfaces The reliability and maintainability requirements presented unique chal lenges in terms of fault tolerance and automated fault isolation, since the computer must detect and respond to its own faults Such facilities as software control of each CPU by each of the others, software generated interrupts and software control of redundancy in the memory and other important functions were used to make it possible to isolate the great majority of faults within the computer (Author)

A78-12280 # **B-1 Central Integrated Test System /CITS/** K Derbyshire (Rockwell International Corp , Los Angeles, Calif) and D E Pieratt (USAF, Wright-Patterson AFB, Ohio) In Digital Avionics Systems Conference, 2nd, Los Angeles, Calif , November 2-4, 1977, Supplement New York, American Institute of Aeronautics and Astronautics, Inc , 1977 6 p (AIAA 77-1502)

The Central Integrated Test System (CITS), developed for the B-1 aircraft, is the next generation onboard test system It allows the B-1 to meet self-sufficiency and flight hours to maintenance hours requirements of an advanced manned strategic aircraft CITS continuously monitors all aircraft subsystems in flight and on the ground, displays/records failed modes of operation, and fault isolates to the LRU level Maintenance actions will be accomplished using the CITS supplied failure data, and system operation reverified utilizing the CITS active ground tests The need for ground support equipment has been greatly reduced through the use of CITS This paper presents results of the development of the B-1 CITS, the design approach, the implementation of the hardware and software, and the planned use of CITS in an operational environment (Author)

A78-12281 # **Real-time simulation as a tool for F-16 operational flight program development and testing.** R D Teichgraeber and D M DeMoss (General Dynamics Corp , Avionic Systems Dept , Fort Worth, Tex) In Digital Avionics Systems Conference, 2nd, Los Angeles, Calif , November 2-4, 1977, Supplement New York, American Institute of Aeronautics and Astronautics, Inc , 1977 6 p 5 refs (AIAA 77-1527)

A new application of real-time simulation to developmental and qualification testing of an original Operational Flight Program (OFP) is presented Real-time simulation is used as a tool to provide a simulated flight environment for closed-loop dynamic testing of the F-16 Fire Control Computer OFP Components and requirements of the simulation software are described This software is a key component in the overall testing system The Dynamic Test Station (DTS) The role of the DTS in OFP development, OFP formal qualification and DTS capabilities are explained, as well as examples of DTS usage in testing (Author)

A78-12282 # **Manned simulation testing of digital avionic systems** W R Mattingly and D R Rolston (McDonnell Aircraft Co , St Louis, Mo) In Digital Avionics Systems Conference, 2nd, Los Angeles, Calif , November 2-4, 1977, Supplement New York, American Institute of Aeronautics and Astronautics, Inc , 1977 9 p (AIAA 77-1531)

During F-15 development, piloted flight simulation was used to perform weapon system testing as an aid to the design, integration, and evaluation of the new computational subsystem Both individual system and integrated weapon system combat capability testing were performed in three types of test cockpit layout and crew performance evaluation, weapon system effectiveness in close combat, and weapon system compatibility in combat beyond visual range A specialized flight simulation facility was also built for development and testing of the operational flight program and digital flight control computers for the F-18 This development is proceeding in two major phases control law development and flight control hardware integration P T H

A78-12283 # **Distributed processor control of a multiple beam adaptive array for telemetry, command and control of airborne vehicles /RPV's/** R A Bustelo, S S Wilson, and P P Sorrentino (Harris Corp , Electronic Systems Div , Melbourne, Fla) In Digital Avionics Systems Conference, 2nd, Los Angeles, Calif , November 2 4, 1977, Collection of Technical Papers Conference sponsored by the American Institute of Aeronautics and Astronautics New York, American Institute of Aeronautics and Astronautics, Inc , 1977 5 p Contract No F33615-75-C 1216 (AIAA 77-1481)

A multi-level distributed processor developed to control a multiple function phased array antenna is described The antenna system provides multiple target tracking for command and control of RPV's, and adaptive pattern shaping for telemetry A hierarchical architecture is defined which implements system, beam and element control using distributed microprocessors Interprocessor communication is accomplished via a high speed shared memory Device technology in the various microprocessors and peripheral hardware

processors is matched to the computational complexity and execution speed required at each level of control This multi-level, functionally partitioned implementation results in modular, compact, efficient hardware with better system reliability than the traditional mini-computer approach (Author)

A78-12284 # **The role of cockpit simulators in the integration of pilot/controller ATC system related avionics and procedures** D Eldredge (FAA, National Aviation Facilities Experimental Center, Atlantic City, N J) In Digital Avionics Systems Conference, 2nd, Los Angeles, Calif , November 2-4, 1977, Collection of Technical Papers Conference sponsored by the American Institute of Aeronautics and Astronautics New York, American Institute of Aeronautics and Astronautics, Inc , 1977 4 p (AIAA 77-1516)

The paper describes the design features of a cockpit simulation facility used as a substitute for actual aircraft in studies involving piloted aircraft participation The cockpit simulation facility consists of two twin-engine general aviation trainers, two minicomputer systems, a visual system for separation assurance studies, and an interface to the ATC digital simulation facility Emphasis is placed on the role of the cockpit simulation facility, which provides a unique environment for evaluating pilot/equipment and pilot/controller/equipment interfaces associated with the introduction of new concepts prior to their implementation Study projects and modifications undertaken so far are mentioned S D

A78-12285 # **The use of CRT displays in future civil transport aircraft - Some human factor and engineering implications** L F Bateman (British Aircraft Corp , Ltd , Commercial Aircraft Div , Weybridge, Surrey, England) In Digital Avionics Systems Conference, 2nd, Los Angeles, Calif , November 2-4, 1977, Collection of Technical Papers Conference sponsored by the American Institute of Aeronautics and Astronautics New York, American Institute of Aeronautics and Astronautics, Inc , 1977 12 p (AIAA 77-1517)

The Advanced Flight Deck Program considered is concerned with an expansion of the use of cathode ray tubes (CRT) as the primary medium for displaying all relevant data to the crew of civil transport aircraft Theoretical studies related to the program were followed by application studies and an assessment of an electronic attitude display indicator and an electronic horizontal situation indicator on the Concorde flight simulator It was found that from the human point of view, the CRT has the potential to be as good as, and possibly superior to existing electro-mechanical instruments for the presentation of flight information G R

A78-12288 **Three-dimensional inviscid flow through a highly-loaded transonic compressor rotor** J E McCune (MIT, Cambridge, Mass) In Transonic flow problems in turbomachinery, Proceedings of the Workshop, Monterey, Calif , February 11, 12, 1976 Washington, D C , Hemisphere Publishing Corp , 1977, p 20-59, Discussion, p 59 29 refs

A newly-developed approach to the theoretical description of three-dimensional inviscid flow in axial compressor rotors or fans is applied to the case of transonic operation at pressure ratios of practical interest Results are compared with recently acquired data for a transonic ducted fan operating in the M I T Blowdown Facility In the theory, nonlinear inviscid effects are retained to any desired accuracy in the pitch-wise averaged flow (axisymmetric through flow), while blade-to-blade variations are computed by linearizing around this mean flow In this latter step, no quasi-two-dimensional (cascade) assumption is necessary The comparison between experiment and theory is sufficiently encouraging to suggest that the improved theory, appropriately refined, may become of practical use in compressor design Further, the results have interesting implications in the study of compressor noise (Author)

A78-12289 * **Calculation of 3-dimensional choking mass flow in turbomachinery with 2-dimensional flow models** T Katsanis (NASA, Lewis Research Center, Cleveland, Ohio) In Transonic flow problems in turbomachinery, Proceedings of the Workshop, Monterey, Calif , February 11, 12, 1976 Washington, D C , Hemisphere Publishing Corp , 1977, p 60 67, Discussion, p 67-69

An approach is considered for obtaining an approximate flow solution in the case of a cross-sectional flow surface within a guided channel, taking into account a pair of typical turbine blades with three-dimensional orthogonal surfaces across the flow passage, the calculation of the mass flow across the throat in the case of a 2 D passage with curved walls, and the determination of the choking mass flow It is pointed out that the choking solution for a three-dimensional guided passage in a blade row can be obtained in a very similar manner by satisfying momentum equations for the blade-to-blade and the hub-to-tip direction A considered example involves the calculation of the choking mass flow for a centrifugal compressor impeller in an automotive application G R

A78-12290 **Three-dimensional transonic shear flow in a channel** T C Adamson, Jr (Michigan, University, Ann Arbor, Mich) In Transonic flow problems in turbomachinery, Proceedings of the Workshop, Monterey, Calif , February 11, 12, 1976 Washington, D C , Hemisphere Publishing Corp , 1977, p 70-77, Discussion, p 77, 78 Contract No N00014-67-0226-0005 Project SQUID

Steady inviscid transonic shear flow is considered as it passes through a three dimensional channel with a constriction, this flow, in its essential features, is similar to that through a linear rotor cascade, with the blades aligned parallel to the incoming flow The case considered is that where the difference in velocity across the channel due to the velocity gradient in the incoming flow is of the same order as the change in velocity induced by the flow constriction Analytical solutions are given in terms of asymptotic expansions about the incoming flow conditions Results show that choking can occur at a flow constriction even though the flow at the minimum area is mixed, and indicate the range of pressures downstream of the flow constriction for which shock waves appear in the supersonic part of the mixed flow (Author)

A78-12291 **Some formulation considerations in 3D transonic flow computation** D S Paris, A A Ganz, and J F Liutermoza (United Technologies Corp , Pratt and Whitney Aircraft Group, East Hartford, Conn) In Transonic flow problems in turbomachinery, Proceedings of the Workshop, Monterey, Calif , February 11, 12, 1976 Washington, D C , Hemisphere Publishing Corp , 1977, p 79-92, Discussion, p 92-94 17 refs

Some preliminary results for 3D subsonic and transonic shear flows in non-lifting compressor stators are presented Certain non-uniqueness conditions arising from 'thin' blade boundary conditions are described and some of the many problems inherent in a 3D solution are discussed Issues of numerical and physical shock propagation are discussed in terms of weak solutions of first order hyperbolic systems (Author)

A78-12292 **Computation of steady and periodic two-dimensional nonlinear transonic flows in fan and compressor stages** J Erdos, E Alzner, and P Kalben (Advanced Technology Laboratories, Inc , General Applied Science Laboratories, Inc , Westbury, N Y) In Transonic flow problems in turbomachinery, Proceedings of the Workshop, Monterey, Calif , February 11, 12, 1976 Washington, D C , Hemisphere Publishing Corp , 1977, p 95-111 6 refs

Computer programs employing 'time-marching' finite difference methods are being developed to obtain solutions of the compressible Euler equations on two-dimensional surfaces in transonic fan and compressor stages One of the programs is concerned with the solution of the unsteady two-dimensional inviscid equations of motion on a circumferential (blade to-blade) stream surface through a single stage (rotor and stator) machine operating in an undistorted inlet flow An asymptotically periodic solution describing the interaction of rotor and stator at transonic conditions is sought Steady solutions for a single blade row can also be obtained A modification of the program permits the analysis of a transonic rotor

operating under circumferentially distorted inlet (or discharge) conditions The problem of modelling inlet flow distortion produced by screens is discussed and results obtained with the computer programs are considered G R

A78-12293 Computation of transonic potential flows in turbomachinery E M Murman (Flow Research, Inc , Kent, Wash) In Transonic flow problems in turbomachinery, Proceedings of the Workshop, Monterey, Calif , February 11, 12, 1976 Washington, D C , Hemisphere Publishing Corp , 1977, p 115-137, Discussion, p 137, 138 16 refs

A brief review is provided of the computation of transonic potential flows by finite-difference methods The application of the computational procedures to turbomachinery problems is discussed The numerical methods considered are based on mixed finite-difference equations solved by relaxation and semidirect solution techniques Attention is given to a small-disturbance equation, the full-potential equation, and iterative solution procedures G R

A78-12294 Finite difference procedure for unsteady transonic flows A review H Yoshihara (General Dynamics Corp , Convair Aerospace Div , San Diego, Calif) In Transonic flow problems in turbomachinery, Proceedings of the Workshop, Monterey, Calif , February 11, 12, 1976 Washington, D C , Hemisphere Publishing Corp , 1977, p 139-161, Discussion, p 161, 162 5 refs

The finite difference procedure of Magnus et al (1974) will be described in detail This procedure is based upon the Euler equations and utilizes the Lax-Wendroff second order explicit difference scheme The boundary conditions are fulfilled using a localized unsteady plane wave emitted from the surface Shock waves acquire a profile due to the numerical viscosity, and they are captured automatically using a fine mesh about the shock The procedure is illustrated by the example of an airfoil oscillating in pitch at supercritical conditions The rationale and the background for the selection of the mesh configuration, the difference scheme, and the

A78-12295 Comparison of a finite difference method with a time-marching method for blade to blade transonic flow calculations J M Thiaville (SNECMA, Moissy Cramayel, Seine-et-Marne, France) In Transonic flow problems in turbomachinery, Proceedings of the Workshop, Monterey, Calif , February 11, 12, 1976 Washington, D C , Hemisphere Publishing Corp , 1977, p 166-173, Discussion, p 173, 174

A78-12296 * Application of a multi-level grid method to transonic flow calculations J C South, Jr (NASA, Langley Research Center, Theoretical Aerodynamics Branch, Hampton, Va) and A Brandt In Transonic flow problems in turbomachinery, Proceedings of the Workshop, Monterey, Calif , February 11, 12, 1976 Washington, D C , Hemisphere Publishing Corp , 1977, p 180-206, Discussion, p 206, 207 7 refs Grant No NGR-47-102-001

A multi-level grid method has been studied as a possible means of accelerating convergence in relaxation calculations for transonic flows The method employs a hierarchy of grids, ranging from very coarse (e g , 8 x 2 mesh cells) to fine (e g , 128 x 32), the coarser grids are used to diminish the magnitude of the smooth part of the residuals, hopefully with far less total work than would be required with, say, optimal SLOR iterations on the finest grid The method was applied to the solution of the transonic small disturbance equation for the velocity potential in the conservation form Nonlifting transonic flow past a parabolic-arc airfoil is the example studied, with meshes of both constant and variable step size (Author)

A78-12297 Application of time-dependent finite volume method to transonic flow in large turbines C L Farn and D K Whirlow (Westinghouse Research Laboratories, Pittsburgh, Pa) In Transonic flow problems in turbomachinery, Proceedings of the Workshop, Monterey, Calif , February 11, 12, 1976 Washington, D C , Hemisphere Publishing Corp , 1977, p 208-225, Discussion, p 226, 227 20 refs

The investigations reported are related to a search for a method which can be applied both to blade-to-blade and hub-to-shroud problems for large power station turbines It is found that a method, based on time-dependent, integral formulation and finite volume approximation, is best suited for the purpose The governing equations of the considered approach together with the appropriate boundary conditions are applied to three categories of transonic flow problems in turbomachinery Attention is given to the flow field on the blade-to-blade surface, the flow field on the hub to-shroud surface, and the interference between moving blade rows G R

A78-12298 Finite-difference calculations of three-dimensional transonic flow through a compressor blade row, using the small-disturbance nonlinear potential equations W J Rae (Calspan Corp , Buffalo, N Y) In Transonic flow problems in turbomachinery, Proceedings of the Workshop, Monterey, Calif , February 11, 12, 1976 Washington, D C , Hemisphere Publishing Corp , 1977, p 228 250, Discussion, p 250-252 36 refs USAF-supported research

Basic objectives of the considered investigations are related to a study of the interaction between three-dimensionality and transonic nonlinearity in a compressor flow The compressor blades are taken to be thin and lightly loaded, and to be essentially aligned with the helical streamline paths The Mach number of the resultant flow may vary from a subsonic value near the hub to a supersonic value near the tip The finite-difference solutions are discussed, giving attention to the adaptation of isolated-airfoil finite-difference techniques and radial iteration processes G R

A78-12299 Transonic relaxation methods P R Dodge (Garrett-AiResearch Manufacturing Company of Arizona, Phoenix, Ariz) In Transonic flow problems in turbomachinery, Proceedings of the Workshop, Monterey, Calif , February 11, 12, 1976 Washington, D C , Hemisphere Publishing Corp , 1977, p 253-271, Discussion, p 271 273 9 refs

A description is given of a relaxation method which is based on a nonorthogonal grid system The method provides realistic solutions to cascades with either subsonic or supersonic inlet and exit Mach numbers Accurate choked flows are predicted and a distinct shock structure is produced However, for supersonic inlet cascades, viscous effects become extremely important, and affect adversely the correctness of the results The adaptation of an isolated airfoil relaxation method is also discussed G R

A78-12300 * Calculation of transonic potential flowfields about complex, three-dimensional configurations D A Caughey (Cornell University, Ithaca, N Y) and A Jameson (New York University, New York, N Y) In Transonic flow problems in turbomachinery, Proceedings of the Workshop, Monterey, Calif , February 11, 12, 1976 Washington, D C , Hemisphere Publishing Corp , 1977, p 274-291, Discussion, p 292, 293 15 refs Grants No NGR-33-016-167, No NGR-33-016-201, Contract No E(11-1)-3077

Methods for extending iterative, finite-difference calculations of transonic potential flowfields to complex three-dimensional configurations are discussed One particularly attractive approach is to use relatively simple conformal mappings in combination with shearing transformations to generate computational domains that are nearly-conformally mapped from the physical space in one family of coordinate surfaces, and which map the complex boundaries to grid surfaces The application of such a method to a general wing-body combination or to a multi-bladed fan is discussed A transformation to map the wing-fuselage or fan-hub combination to a convenient computational domain is proposed The transformation is useful in its own right for treating the two-dimensional problems of flow past a profile in a wind tunnel or through a cascade Some results of preliminary calculations are presented (Author)

A78-12301 Calculation of supercritical flow past a double wedge by Telenin's method K S Chang and M Holt (California

University, Berkeley, Calif) In Transonic flow problems in turbomachinery, Proceedings of the Workshop, Monterey, Calif , February 11, 12, 1976 Washington, D C , Hemisphere Publishing Corp , 1977, p 294-298, Discussion, p 299, 300

The supercritical flow past a symmetric double wedge with no angle of attack is studied by means of a transform into the hodograph plane The flow is subsonic everywhere except in a small supersonic region attached to the shoulder of the wedge, this region is terminated on the downstream side by a recompression shock The unknown in the hodograph plane is the stream function which satisfies Chaplygin's equation Telenin's method is applied along three directions Sources of possible minor errors arising in this use of the hodograph plane are considered, and reasons for ignoring these factors are explained M L

A78-12302 * Supercritical cascade design D G Korn (New York University, New York, N Y) In Transonic flow problems in turbomachinery, Proceedings of the Workshop, Monterey, Calif , February 11, 12, 1976 Washington, D C , Hemisphere Publishing Corp , 1977, p 301-307, Discussion, p 307, 308 6 refs Grant No NGR-33-016-167, Contract No E(11-1)-3077

The use of the method of complex extension to achieve better aerodynamic designs for supercritical cascades applicable to transonic turbomachinery is discussed The method permits the computation of analytical solutions to elliptic, hyperbolic or mixed second-order partial equations in two dimensions Boundary value problems formulated to develop an airfoil shape having a prescribed speed distribution for subsonic flow and a nearby speed distribution in the transonic case are also considered Computing times necessary to run the blade design program are described as acceptably short J M B

A78-12307 * Perturbation solutions for blade-to-blade surfaces of a transonic compressor S S Stahara, D S Chaussee (Nielsen Engineering and Research, Inc , Mountain View, Calif), and J R Spreiter (Stanford, University, Stanford, Calif) In Transonic flow problems in turbomachinery, Proceedings of the Workshop, Monterey, Calif , February 11, 12, 1976 Washington, D C , Hemisphere Publishing Corp , 1977, p 359-366, Discussion, p 366-368 Contract No NAS3-19738

The paper describes a perturbation method for turbomachinery calculations, particularly where it is necessary to carry out a number of calculations for closely-related flows such as are needed in a parametric study The method is applied for solving a model problem involving blade-to-blade surfaces of a transonic compressor Basically, the method makes use of a previously calculated base solution to determine first-order changes in the flow field due to variations in one or more of a variety of geometrical or flow field parameters The fundamental assumption associated with the perturbation solution is that the magnitude of the deviations from the base solution lies within the range of a linear perturbation analysis Comparisons are made for results obtained, by varying the thickness ratio of an unstaggered nonlifting cascade composed of biconvex profiles in a flow with an oncoming freestream Mach number of 0 60 S D

A78-12308 * On the prediction of viscous phenomena in transonic flows G S Deiwert (NASA, Ames Research Center, Moffett Field, Calif) In Transonic flow problems in turbomachinery, Proceedings of the Workshop, Monterey, Calif , February 11, 12, 1976 Washington, D C , Hemisphere Publishing Corp , 1977, p 371-387, Discussion, p 388-391 10 refs

An algorithm developed by MacCormack (1971) and applied to transonic flows by Deiwert (1974) is used in the reported investigation The investigation is concerned with flows of aerodynamic interest However, many of the concepts apply equally to flows in turbomachinery Turbulent transonic flows are considered, taking into account a biconvex circular arc and a shockless lifting airfoil A simple algebraic eddy viscosity model is used for the description of the turbulent transport process G R

A78-12311 Coupled inviscid/boundary-layer flow field predictions for transonic turbomachinery cascades P R Gliebe (General Electric Co , Fairfield, Conn) In Transonic flow problems in turbomachinery, Proceedings of the Workshop, Monterey, Calif , February 11, 12, 1976 Washington, D C , Hemisphere Publishing Corp , 1977, p 434-452, Discussion, p 452, 453 10 refs

A prediction procedure has been developed for transonic flow through turbomachinery cascades which couples the inviscid flow and the blade surface boundary layers, resulting in a mutually compatible solution This procedure utilizes the Time-Dependent Computation technique for the inviscid flow solution calculation, and the Stratford and Beavers integral method for the blade surface boundary layer calculation The procedure has been applied to predictions for several cascade configurations, and the inviscid-flow/boundary-layer interaction calculation has proved to be stable and convergent, with no evidence of strong-interaction instability for supersonic flows For most cascades, including those typical of high Mach number fan rotor tip sections, the computed results showed little effect of the boundary layers on the flow distribution For one cascade with supersonic inflow and subsonic outflow, the inclusion of the blade boundary layer effects produced a large effect on the cascade passage flow conditions (Author)

A78-12312 * Review of experimental work on transonic flow in turbomachinery W D McNally (NASA, Lewis Research Center, Cleveland, Ohio) In Transonic flow problems in turbomachinery, Proceedings of the Workshop, Monterey, Calif , February 11, 12, 1976 Washington, D C , Hemisphere Publishing Corp , 1977, p 457-484, Discussion, p 484 51 refs

The review is primarily concerned with modern experimental techniques of high response and laser supported instrumentation The considered techniques make it possible to obtain detailed data of steady and unsteady processes occurring inside transonic blade rows and in the vicinity of the rows Such data are needed for the verification of computer codes used for the study of the operational characteristics of turbomachinery Attention is given to high response transducers, hot wire probes, hot film gages, laser Doppler velocimeter systems, laser fluorescence, and laser holography G R

A78-12314 Comparison of prediction of transonic flow in a fan with flow measurements taken using a laser Doppler velocimeter A A Mikolajczak (United Technologies Corp , Pratt and Whitney Aircraft Group, East Hartford, Conn) In Transonic flow problems in turbomachinery, Proceedings of the Workshop, Monterey, Calif , February 11, 12, 1976 Washington, D C , Hemisphere Publishing Corp , 1977, p 514-521, Discussion, p 522, 523

A dual-beam confocal backscatter optical system was used to obtain velocity measurements in a large portion of the intrablade flow field of a transonic fan The location of the passage shock was defined by axial and tangential velocity components A quasi-three-dimensional passage analysis, based on a time-marching finite-difference approach, was found to yield results which were in substantial agreement with the experimental data The development of a fully three-dimensional analysis is discussed, and the possible extension of the passage analyses to include airfoils with blunt leading edges is mentioned J M B

A78-12315 Nonintrusive measurements of the flow vectors within the blade passages of a transonic compressor rotor R Schodl and H Weyer (Deutsche Forschungs- und Versuchsanstalt fur Luft- und Raumfahrt, Institut fur Luftstrahlantriebe, Porz-Wahn, West Germany) In Transonic flow problems in turbomachinery, Proceedings of the Workshop, Monterey, Calif , February 11, 12, 1976 Washington, D C , Hemisphere Publishing Corp , 1977, p 524-537, Discussion, p 537, 538 8 refs

A laser dual focus method of measuring nonintrusive flow velocity is described The procedure differs from the laser Doppler technique in that the fringe pattern in the probe volume is replaced by two discrete light beams The method has been developed to facilitate flow measurements in turbomachines Flow investigations of a transonic axial compressor are reported, perspective plots of

computed and measured relative Mach numbers at various blade regions are presented M L

A78-12320 The effect of leading-edge thickness on the bow shock in transonic rotors F A E Breugelmans (Institut von Karman de Dynamique des Fluides, Rhode-Saint-Genèse, Belgium) In Transonic flow problems in turbomachinery, Proceedings of the Workshop, Monterey, Calif, February 11, 12, 1976 Washington, D C, Hemisphere Publishing Corp, 1977, p 598-607 9 refs

A cascade-configuration model of the bow shocks propagating ahead of a transonic compressor rotor is described The model, which yields a different location for the Mach line on the stagnation streamline than other approaches, is found to provide good agreement with experimental data for blades of several shapes Applications of the method indicate that bow shocks may cause significant loss levels in transonic compressors It is also suggested that the axial extension of the blade, as computed by this method, may serve as a guideline in the blade row interference problem J M B

A78-12357 * NASA's advanced control law program for the F-8 digital fly-by-wire aircraft J R Elliott (NASA, Langley Research Center, Hampton, Va) *IEEE Transactions on Automatic Control,* vol AC-22, Oct 1977, p 753-757 35 refs

This paper briefly describes the NASA F-8 Digital Fly-By-Wire (DFBW) and Langley Research Center's role in investigating and promoting advanced control laws for possible flight experimentation and also provides a brief description of the Phase II DFBW F-8 aircraft and its control system Some of the advanced control law study objectives and guidelines are discussed, and some mathematical models which are useful in the control analysis problem are provided (Author)

A78-12358 * Adaptive control laws for F-8 flight test G Stein, G L Hartmann, and R C Hendrick (Honeywell, Inc, Minneapolis, Minn) *IEEE Transactions on Automatic Control,* vol AC-22, Oct 1977, p 758-767 28 refs Contracts No NAS1-12680, No NAS1-13383

This paper describes an adaptive flight control system design for NASA's F-8 digital fly-by-wire research aircraft This design implements an explicit parallel maximum likelihood identification algorithm to estimate key aircraft parameters The estimates are used to compute gains in simplified quadratic-optimal command augmentation control laws Design details for the control laws and identifier are presented, and performance evaluation results from NASA Langley's F-8 Simulator are summarized (Author)

A78-12359 * The stochastic control of the F-8C aircraft using a multiple model adaptive control /MMAC/ method I - Equilibrium flight M Athans, D Castañon, K-P Dunn, C S Greene, W H Lee, N R Sandell, Jr, and A S Willsky (MIT, Cambridge, Mass) *IEEE Transactions on Automatic Control,* vol AC-22, Oct 1977, p 768-780 28 refs Grant No NsG-1018

The purpose of this paper is to summarize some results obtained for the adaptive control of the F-8C aircraft using the so-called MMAC method The discussion includes the selection of the performance criteria for both the lateral and the longitudinal dynamics, the design of the Kalman filters for different flight conditions, the 'identification' aspects of the design using hypothesis testing ideas, and the performance of the closed-loop adaptive system (Author)

A78-12360 * An implementable digital adaptive flight controller designed using stabilized single-stage algorithms G Alag and H Kaufman (Rensselaer Polytechnic Institute, Troy, N Y) *IEEE Transactions on Automatic Control,* vol AC 22, Oct 1977, p 780-788 21 refs Grant No NGR-33-018-183

An explicit adaptive controller, which makes direct use of on-line parameter identification, has been developed and applied to both the linearized and nonlinear equations of motion for the F-8 aircraft This controller is composed of an on-line weighted least squares parameter identifier, a Kalman state filter, and a real model following control law designed using single-stage performance indices The corresponding control gains are readily adjustable in accordance with parameter changes to ensure asymptotic stability if the conditions of perfect model following are satisfied, and stability in the sense of boundedness otherwise Simulation experiments with realistic measurement noise indicate that the controller was effective in compensating for parameter variations and capable of rapid recovery from a set of erroneous initial parameter estimates which defined a set of destabilizing gains (Author)

A78-12361 * A moving window parameter adaptive control system for the F8-DFBW aircraft H J Dunn and R C Montgomery (NASA, Langley Research Center, Hampton, Va) *IEEE Transactions on Automatic Control,* vol AC-22, Oct 1977, p 788-795 8 refs

This paper describes the moving window parameter adaptive control system developed for the NASA F8-DFBW aircraft The control system employs a parameter identification process that, iteratively, adjusts parameters of a model of the aircraft motions in a batch-processing manner so that responses generated from the model fit the outputs of sensors stored in a finite record referred to as the moving window Tests are made on the validity of the parameter estimates before using the parameters in an on-line design process The on-line design process is an algebraic mapping of the parameters of the model into primary control system feedback and feedforward gains The mapping was selected to satisfy specific flying quality characteristics over the range of parameter variations expected Results are presented from simulation studies on the identification algorithm made during the development of the system (Author)

A78-12362 * F-8 DFBW sensor failure identification using analytic redundancy J C Deckert, M N Desai, J J Deyst (Charles Stark Draper Laboratory, Inc, Cambridge, Mass), and A S Willsky (MIT, Cambridge, Mass) *IEEE Transactions on Automatic Control,* vol AC-22, Oct 1977, p 795-803 23 refs Contract No NAS1-13914

The structure of a sensor failure detection and identification system designed for the NASA F-8 DFBW aircraft is outlined The system is for use in a dual-redundant environment, and it takes maximal advantage of all functional relationships among the sensed variables The identification logic uses the quality sequential probability ratio, which provides a useful on-line measure of confidence in the various forms of analytic redundancy Preliminary simulation results indicate good behavior of the analytic decision statistic, based on the sequential probability ratio test (Author)

A78-12456 Manufacture of titanium components by hot isostatic pressing W T Highberger (U S Navy, Naval Air Systems Command, Washington, D C) In Powder metallurgy in defense technology, Proceedings of the P/M in Ordnance Seminars, Frankford Arsenal, Philadelphia, Pa, October 8, 9, 1975 and Picatinny Arsenal, Dover, N J, April 19, 20, 1976 Volume 3 Princeton, N J, Metal Powder Industries Federation, 1977, p 145-150

The paper discusses program objectives and manufacturing procedure for hot isostatic pressing (HIP) of structural titanium-alloy parts for military aircraft Cost savings and nondestructive testing are examined, showing that titanium parts can be produced to near net shape by HIP Preliminary mechanical values are found to be in the range of annealed plate minima for both Ti-6Al-6V-2Sn and Ti-6Al-4V Current work includes qualification and flight testing of the fuselage brace along with up-scaling to larger parts (Author)

A78-12557 * # The effect of ambient temperature and humidity on the carbon monoxide emissions of an idling gas turbine C W Kauffman and A K Subramaniam (Cincinnati, University, Cincinnati, Ohio) *Combustion Institute, Spring Technical Meeting, Cleveland, Ohio, Mar 28-30, 1977, Paper* 33 p 17 refs Grant No NsG-3045

Changes in ambient temperature and humidity affect the exhaust emissions of a gas turbine engine The results of a test program employing a JT8D combustor are presented which quantize the effect of these changes on carbon monoxide emissions at simulated idle operating conditions Analytical results generated by a kinetic model of the combustion process and reflecting changing ambient conditions are given It is shown that for a complete range of possible ambient variations, significant changes do occur in the amount of carbon monoxide emitted by a gas turbine engine (Author)

A78-12566 # **Analysis of spray combustion in a research gas turbine combustor** P B Patil, M Sichel, and J A Nicholls (Michigan, University, Ann Arbor, Mich) *Combustion Institute, Spring Technical Meeting, Cleveland, Ohio, Mar 28-30, 1977, Paper* 16 p 7 refs US Environmental Protection Agency Grant No R-802925-02-2

This paper deals with analysis of liquid fuel spray combustion in an idealized gas turbine combustor The flow, which is assumed to be one dimensional, is divided into two regions (1) the heat up region, and (2) the combustion region Appropriate nondimensional equations have been solved for each region and the solutions are matched at the common boundary Analytical expressions have been developed for the burning velocity eigenvalue as well as for the solution in the combustion region The effects of the properties of the fuel and air as well as the effects of the conditions prevalent within the combustor on the solution are discussed Typical results for JP-4 fuel are presented The research gas turbine combustor designed and built at The University of Michigan comes very close to satisfying the assumptions made in this analysis (Author)

A78-12600 **The geriatric jet problem** J M Ramsden *Flight International,* vol 112, Oct 22, 1977, p 1201-1204, 1207

The article discusses the Lusaka (Zambia) aircraft accident (1977) in terms of procedures for determining when a jet is too old to be considered safe In particular this involves a consideration of fatigue policy and testing as developed by the Civil Aviation Authority and the Federal Aviation Administration Attention is given to fatigue testing procedures applicable to different aircraft models, and proposed procedures for future designs and requirements Means for the evaluation of fatigue are reviewed, along with the occurrence of debris falling from in-flight aircraft The development of the Maintenance Steering Group is reviewed along with their recommendations for safety control Techniques for aircraft inspection and structural testing are outlined, noting the necessity to finance future research S C S

A78-12606 # **Technical exploitation of aircraft /2nd revised and enlarged edition/ (Tekhnicheskaia ekspluatatsiia letatel'nykh apparatov /2nd revised and enlarged edition/)** A I Pugachev, A A Komarov, N N Smirnov, N I Vladimirov, A S Kravets, V K Andreev, M V Davidenko, V F Skripka, I T Chekharovskii, and F K Germanchuk Moscow, Izdatel'stvo Transport, 1977 440 p 31 refs In Russian

The handbook discusses the optimization of effectiveness in aircraft flight operations, means to determine the reliability of aviation technology, and various processes which cause mechanical failure The organization of an aircraft technical maintenance system is outlined noting servicing, repair procedures, monitoring procedures, and documentation requirements Attention is given to servicing propulsion systems (with reference to typical factors in engine failure), problems associated with aircraft servicing under various climatic conditions, special procedures in the servicing of helicopters, and aircraft servicing and repair in foreign countries Optimal flight operations are described for various stages of the flight both in terms of theoretical notions (a review of the factors which may cause hazardous situations) and actual analyses of accidents with reference to the role of flight safety personnel (Author)

A78-12610 **Helicopter manufacturing technology II - Drive system and turbine engine technology** R L Spangenberg (U S Army, Tank-Automotive Command, Warren, Mich) *ManTech Journal,* vol 2, no 2, 1977, p 33-38

Attention is given to potential improvements in helicopter drive systems for the reduction of manufacturing time and costs The methods include (1) precision forging of transmission gears, (2) a titanium casting technique for compressor wheels, (3) improved materials for gears, and (4) new compounds for seals Revisions in turbine engine manufacture are also proposed, such as (1) improved hot isostatic pressing for disks, (2) a new method of compressor case casting, (3) a technique for casting turbine blades via integral cooling passages, and (4) automated blisk machining for rotor assemblies S C S

A78-12616 **Tandem-wing aircraft** J Bottomley *Aerospace (UK),* vol 4, Oct 1977, p 12-20

The tandem-wing aircraft is described with regard to the system's advantages (including lift in a positive sense and structural features producing a lighter aircraft) and disadvantages (such as that the rear wing cannot work at high coefficients and the possibility of different handling characteristics) The history of tandem-wing development is outlined from 1615 to the present, noting the Flying Flea, the Miles Libellula series, and the Lockspeiser LDA-01 Current research in the design of tandem-wing aircraft is discussed including (1) a tandem-wing monoplane with the foreplane higher and slightly larger than the mainplane, (2) an aircraft where the engines are relocated on pylons on the upper surface of the rear mainplane, and (3) a layout with a reversal of wing positions, having the front wing lower than the rear one S C S

A78-12661 # **Future aerospace digital signal processing concepts** S F Hsueh, W Vojir, and P Burkhardt (Grumman Aerospace Corp , Bethpage, N Y) In Computers in Aerospace Conference, Los Angeles, Calif , October 31-November 2, 1977, Collection of Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 75 81 14 refs (AIAA 77-1389)

The paper attempts to outline likely requirements for signal processing in avionics in the future (up to 1985 and beyond) and to indicate some of the considerations that will influence the design and performance of future signal processing machines Emphasis is placed on currently successful techniques which should be exploited for multipurpose applications, and on the fact that a multipurpose programmable signal processor is needed which meets the full diversity of major avionics applications Functional modularity and software commonality are recommended as areas of standardization which will allow for growth in device technology and theoretical developments B J

A78-12677 # **Acceptance testing of the JTIDS Class II terminal by augmented minicomputer** M H Wallenstein (Singer Co , Kearfott Div , Wayne, N J) In Computers in Aerospace Conference, Los Angeles, Calif , October 31-November 2, 1977, Collection of Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 205 211 (AIAA 77-1415)

The paper describes the minicomputer-assisted testing of the Class II terminal for the Joint Tactical Information Distribution System (JTIDS) The terminal provides time division multiple access communication and navigation capabilities for aircraft, ships, and mobile ground facilities, and consists of a digital microprocessor, a receiver-transmitter, a TDMA signal processor, and a TACAN signal processor Acceptance tests were made under simulated real world conditions The test procedures and sequences are described P T H

A78-12694 # **Computer redundancy for aircraft flight control** M F Marx (General Electric Co , Binghamton, N Y) In Computers in Aerospace Conference, Los Angeles, Calif , October 31-November 2, 1977, Collection of Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 329-337 6 refs (AIAA 77-1440)

The growing availability of large-scale integrated electronic devices, suitable for aircraft environments, has stimulated application

of digital computation to flight control Easy changes of system characteristics via software is one of the attractive feature of digital computation The present paper deals with the use of redundancy as a means of meeting the reliability requirements for digital flight control It is shown that with the presently available computational power, it has become possible to implement control laws for highly coupled airplanes with performance envelopes ranging from hover to supersonic speeds In addition, the self-test capability offered by the digital system makes practical all electrical or fly by-wire techniques that are reliable enough to operate without mechanical backup V P

A78-12695 # **Dual device redundancy management** L A Smith and P G Williams (Boeing Aerospace Co , Seattle, Wash) In Computers in Aerospace Conference, Los Angeles, Calif , October 31-November 2, 1977, Collection of Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1977, p 338-343 Contract No F33657-76-C-0792 (AIAA 77-1441)

Dual control systems which can detect and isolate a faulty component are an attractive solution to automatic control systems that require a high degree of reliability with minimum cost, weight, and volume The analysis described in this paper is based on a RPV flight control system for which a failure would mean an air vehicle loss Each of the flight control system's dual components is monitored as a pair and can be individually isolated from the system by the onboard automatic redundancy management function or by the ground operator A performance exceedance monitor provides a complete swap of all online/offline components should the air vehicle exceed its performance boundaries for an unknown cause, and a minimum operational software subset is defined as the operational recovery configuration (Author)

A78-12814 **Aircraft noise control** K M Eldred (Bolt Beranek and Newman, Inc , Cambridge, Mass) In Inter noise 77 Noise control - The engineers responsibility, Proceedings of the Sixth International Conference, Zurich, Switzerland, March 1-3, 1977 Zurich, International Institute of Noise Control Engineering, 1977, p A 123-A 135 17 refs

This paper summarizes the impact of airport noise on people residing in the vicinity of airports and estimates the noise control requirement to reduce the severity of the existing impact Several of the significant options of comprehensive noise control program are reviewed relative to this requirement, with emphasis being given to source control It is concluded that all available and practicable noise control methods must be fully exercised to begin a reduction of noise for airport neighbors with the promise of increasing relief over the next twenty years (Author)

A78-12821 **Noise abatement at general aviation airports - A regulator's dilemma** A S Harris (Bolt Beranek and Newman, Inc , Cambridge, Mass) In Inter-noise 77 Noise control - The engineers responsibility, Proceedings of the Sixth International Conference, Zurich, Switzerland, March 1-3, 1977 Zurich, International Institute of Noise Control Engineering, 1977, p B 621-B 626

Conflicts between land use policy and noise abatement procedures instituted at general aviation airports in Massachusetts are discussed The noise levels at which complaints from residents of the airport vicinity occur are given for both touch-and-go training operations and normal arrivals and departures In addition, the effect of reducing noise exposure levels by five to nine decibels, the reduction required to eliminate residents' complaints, is assessed Modified definitions of unacceptable noise levels and the development of mechanisms to control land use around airports are also considered J M B

A78-12822 **New airport in Gothenburg - How the noise problems have been handled** T Hall (Goteborgs Fororter, Arkitektkontoret, Goteborg, Sweden) and S-O Benjegard (Ingemansson Acoustics, Goteborg, Sweden) In Inter-noise 77 Noise control - The engineers responsibility, Proceedings of the Sixth International Conference, Zurich, Switzerland, March 1-3, 1977 Zurich, International Institute of Noise Control Engineering, 1977, p B 627 B 633

Noise monitoring and abatement procedures instituted at a commercial airport capable of handling about 60,000 movements per year are described The selection of a parallel runway instead of a crossed runway layout is discussed, and the stipulated entry heights of landing aircraft are considered A noise monitoring system designed to provide noise level and flight path assessments for all aircraft using the airport is also mentioned Maintenance of a 55-decibel flight noise limit is required at the airport J M B

A78 12823 **Status of aircraft noise control in Israel** N Moses and O Zeitlin (Ministry of the Interior, Environmental Protection Service, Jerusalem, Israel) In Inter-noise 77 Noise control - The engineers responsibility, Proceedings of the Sixth International Conference, Zurich, Switzerland, March 1-3, 1977 Zurich, International Institute of Noise Control Engineering, 1977, p B 634-B 639 5 refs

A master plan for the equitable sharing of airspace, land and rights in the vicinity of Ben Gurion International Airport, Israel, is described Noise abatement procedures for aircraft, the introduction of zoning restrictions, the enactment of noise abatement flight regulations, urban planning and the acoustic treatment of residential buildings, and the monitoring and control of aircraft noise levels in communities surrounding the airport are discussed J M B

A78-12824 **Problems of noise certifying business aircraft** N Moses and I Even Zur (Ministry of the Interior, Environmental Protection Service, Jerusalem, Israel) In Inter-noise 77 Noise control - The engineers responsibility, Proceedings of the Sixth International Conference, Zurich, Switzerland, March 1-3, 1977 Zurich, International Institute of Noise Control Engineering, 1977, p B 640-B 645

Problems in the noise certification of business executive aircraft are discussed, the effect of background noise levels on takeoff noise measurement, the use of flight path and atmospheric correction procedures, and the generation of airplane and engine parameter variation correction curves are considered In addition, the location of takeoff measurement microphones and the correlation between noise certification assessments and effective perceived noise levels are mentioned J M B

A78-12849 # **Automatic control of airplanes and helicopters (Avtomatizirovannoe upravlenie samoletami i vertoletami)** S M Fedorov, V V Drabkin, V M Kein, and O I Mikhailov Moscow, Izdatel'stvo Transport, 1977 248 p 42 refs In Russian

The principles of designing aircraft and helicopter autopilots and the principles of action of these systems are outlined Attention is given to the analysis of systems controlling the approach to landing, circling, landing, and takeoff, and to the principles of designing systems for checking the working order of onboard control, signaling, and display systems The general principles of designing modern control systems are demonstrated by a discussion of the ABSU-154 system installed on board the Tu-154 aircraft The dynamic characteristics of helicopters are examined, along with the basic control and stabilization modes A special chapter is devoted to the application of automatic and semiautomatic control systems during various flight phases The developmental trends of automatic control are discussed, placing emphasis on the development of digital control V P

A78-13000 # **Mathematical planning and bulk service methods of civil aviation (Matematicheskie metody planirovaniia i upravleniia proizvodstvenno-khoziaistvennoi deiatel'nost'iu predpriiatii grazhdanskoi aviatsii)** A M Andronov and A N Khizhniak Moscow, Izdatel'stvo Transport, 1977 216 p 36 refs In Russian

The book deals with mathematical methods developed for deriving models that may be used to predict the course of a production or economic process and also to determine the best combination of factors to obtain optimum process efficiency The models consist of mathematical formulas and algorithms which describe a given process and permit evaluation of the relevant characteristics of the process A brief historical review of the development of such mathematical methods is followed by discussions of the principal theories involved in the development and application of the mathematical models Particular attention is given to queueing theory, regression theory, and mathematical programming Applications of the theories to civil aviation are examined V P

A78-13049 **A photographic study of the interaction of two high-velocity gas jets** J E Field, Jr , L J Poldervaart, and A P J Wijnands (Eindhoven, Technische Hogeschool, Eindhoven, Netherlands) In International Congress on High Speed Photography (Photonics), 12th, Toronto, Canada, August 1-7, 1976, Proceedings Bellingham, Wash , Society of Photo-Optical Instrumentation Engineers, 1977, p 452-459 9 refs

Two supersonic gas jets were operated and allowed to interact in order to study aerodynamic/acoustic features Two D nozzles were mounted side by side and operated separately via a vernier control from a separation of several centimeters till they were adjacent Vertical motion of one jet and limited rotational motion were also possible A stroboscopic/TV method was used for photography, and video recordings and a film were made using single-flash, high-resolution techniques Cell structure, oscillation phenomena, and the manner in which the two jets interacted acoustically and aerodynamically were evaluated S C S

A78-13070 # **Facing up to the military V/STOL challenge** F S Petersen (U S Naval Air Systems Command, Washington, D C) *Astronautics and Aeronautics,* vol 15, Nov 1977, p 16-21

The recognition of the critical importance of V/STOL not only to naval aviation but to the entire spectrum of military aviation has prompted an all-out research and development effort in this field Successful V/STOL development, eliminating present insufficiencies in terms of range, payload, and reliability may reshape military and naval operations, tactics, deployment concepts, and support plans and may change the entire course of national defense The great potential benefits of V/STOL and the need for serious methodical assessment of the art to arrive confidently at the conclusion that these benefits can be realized are emphasized The Navy strategy is to pursue a phased balanced program of analysis and research for V/STOL, while keeping contingency plans in the event of disappointing progress V P

A78-13071 * # **Toward a new V/STOL generation** L Roberts and S B Anderson (NASA, Ames Research Center, Moffett Field, Calif) *Astronautics and Aeronautics,* vol 15, Nov 1977, p 22-27

While many V/STOL problems are now better understood and technology has progressed to the point where higher thrust/weight ratios and greater stability augmentation are achievable, a number of still existing insufficiencies provide a sobering reminder that learning in ground testing and simulation, and careful methodical planning, are a prerequisite for any research and development program The present paper is centered on the major technical problems for the Navy Type multimission V/STOL aircraft The aircraft's configurations with and without forward lift fan are discussed, along with the propulsion systems, testing techniques, controls, displays, flight dynamics, and ground/flow field interactions V P

STAR ENTRIES

N78-10002*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif

CALCULATED HOVERING HELICOPTER FLIGHT DYNAMICS WITH A CIRCULATION CONTROLLED ROTOR

Wayne Johnson and Inderjit Chopra Sep 1977 40 p refs Prepared in cooperation with Army Aviat Res and Develop Command, Moffett Field Calif

(NASA-TM-78443 A-7227) Avail NTIS HC A03/MF A01 CSCL 01A

The influence of the rotor blowing coefficient on the calculated roots of the longitudinal and lateral motion was examined for a range of values of the rotor lift and the blade flap frequency The control characteristics of a helicopter with a circulation controlled rotor are discussed The principal effect of the blowing is a reduction in the rotor speed stability derivative Above a critical level of blowing coefficient, which depends on the flap frequency and rotor lift negative speed stability is produced and the dynamic characteristics of the helicopter are radically altered Author

N78-10003# Air Force Avionics Lab, Wright-Patterson AFB Ohio

AVIONICS MAINTENANCE STUDY Final Report, Jan - 31 Jun 1976

P R Owens M R StJohn, and F D Lamb Jun 1977 107 p

(AF Proj 6096)

(AD-A042568, AFAL-TR-77-90) Avail NTIS HC A06/MF A01 CSCL 09/3

Avionics maintenance has become a major contributor to the life cycle cost of weapons systems and this study was undertaken to gain insight into factors contributing to the cost of avionics maintenance To become familiar with the procedures employed and operating conditions encountered in the operational Air Force a team from the Air Force Avionics Laboratory visited several avionics maintenance squadrons along with depot organizations at Air Logistics Centers Through interviews with both supervisors and maintenance technicians at these organizations a familiarization with the working level procedures was acquired Similarities and differences in procedures, personnel test equipment complaints and equipment supported at installations under different major commands were noted A wide range of avionics from old tube type equipment through the latest solid-state equipment just being introduced into the inventory was considered in the selection of organizations to be visited Difficulties in obtaining replacement parts and dissatisfaction with test equipment were found to be the problems most often voiced by maintenance personnel To persons from a laboratory environment, the age of some equipment still in use was shocking and the necessity for designing avionics to provide reliable service for 15 to 20 years was strongly realized The need for early consideration of ATE requirements to insure rapid, cost-effective fault isolation in new avionics design is emphasized as one conclusion to the study Author (GRA)

N78-10004# Air Force Human Resources Lab Brooks AFB, Tex

USER ACCEPTANCE AND USABILITY OF THE C-141 JOB GUIDE TECHNICAL ORDER SYSTEM Final Report, Jun 1975 - Feb 1977

Robert C Johnson Donald L Thomas and Deborah J Martin Jun 1977 77 p

(AF Proj 1710)

(AD-A044001, AFHRL-TR-77-31) Avail NTIS HC A05/MF A01 CSCL 01/3

This report documents a study of the user acceptance and usability of the technical data developed under the C-141 Job Guide Technical Order (TO) Program Step-by-step, illustrated technical orders called job guides, were developed to replace the original TOs on the C-141 aircraft Job guides are characterized by detailed fully proceduralized task instruction which are keyed to illustrations which identify each component and its location Other features include a small handbook size, standardized verb usage simplified writing style, job preparation instructions, identification of tools and parts required, and little or no referencing to other TOs In this first large-scale application of the job guide concept, the following positive and negative factors affecting usability and user acceptance were identified using questionnaires, interviews and observation Positive Factors included small size, ease of reading and understanding good illustrations keyed to procedures job preparation information, and information acceptable to both experienced and inexperienced technicians Negative Factors included too many volumes required for some task sequences errors in the data inability to locate information quickly storage problems, and torn and lost pages Although problems existed the C-141 job guides are considered to be very usable and well-accepted It is obvious that the development of the data and the implementation of the data are two very critical factors in the success of the job guide concept Author (GRA)

N78-10005# Advisory Group for Aerospace Research and Development, Paris (France)

SELECTED PAPERS ON ADVANCED DESIGN OF AIR VEHICLES

Antonio Ferri Aug 1977 133 p refs

(AGARD-AG-226 ISBN-92-835-1253-7) Avail NTIS HC A07/MF A01

Research and Development on SST project in the U S A are presented Engine design, air pollution and aerodynamic drag are emphasized

N78-10006*# Advisory Group for Aerospace Research and Development, Paris (France)

POSSIBILITIES AND GOALS FOR THE FUTURE SST

Antonio Ferri *In its* Selected Papers on Advanced Design of Air Vehicles Aug 1977 p 3-12 refs Repr from J Aircraft, v 12 no 12, Dec 1975 p 919-929 Presented at 13th AIAA Aerospace Sci Meeting Pasadena Calif 20-22 Jan 1975

(Grants NGL-33-016-119, NGR-33-016-131)

(AIAA-Paper-75-254) Avail NTIS HC A07/MF A01 CSCL 01C

An analysis and evaluation of the social value of the SST project are presented It is emphasized that the means of civil mass transportation reaching the same range available to military decrease the tension among neighboring nations and reduce human fatigue The present status of the SST in the United States, together with the future goals are described I M

N78-10007*# Advisory Group for Aerospace Research and Development Paris (France)

REVIEW OF PROBLEMS IN APPLICATION OF SUPERSONIC COMBUSTION

Antonio Ferri *In its* Selected Papers on Advanced Design of Air Vehicles Aug 1977 p 13-30 refs Repr from J Roy Aeronaut Soc (Engl) v 68, no 645 Sep 1964 p 575-595

(Contracts NAS8-2686 AF 49(638)-991 AF 33(657)-10463) Avail NTIS HC A07/MF A01 CSCL 21B

The problem of air-breathing engines capable of flying at very high Mach numbers is described briefly Possible performance of supersonic combustion ramjets is outlined briefly and the supersonic combustion process is described Two mechanisms of combustion are outlined one is supersonic combustion controlled by convection process, and the second is controlled by diffusion The parameters related to the combustion process are discussed in detail Data and analyses of reaction rates and

mixing phenomena are represented the flame mechanism is discussed, and experimental results are presented Author

N78-10009# Advisory Group for Aerospace Research and Development, Paris (France)
ANALYSIS OF FLUID DYNAMICS OF SUPERSONIC COMBUSTION PROCESS CONTROLLED BY MIXING
Antonio Ferri and Herbert Fox *In its* Selected Papers on Advanced Design of Air Vehicles Aug 1977 p 43-49 refs Presented at 12th Intern Symp on Combust p 1105-1112

(Contract F33615-68-C-1114)
Avail NTIS HC A07/MF A01

The fluid dynamics of supersonic combustion is discussed The interference between the combustion process and the supersonic flow secondary to the combustion region is described Multiple injector flow fields are described from the point of view of mixing and of interaction with the external flow It is shown that the selection of injector location and combustion process can be utilized to produce compression waves of controlled strength Such waves can be utilized to reduce the flow Mach number in front of subsequent injectors This effect is called thermal compression Engineering criteria for utilization of thermal compression are presented An example of such utilization is described The example indicates that the interaction between combustion and geometry is of primary importance for the fluid-dynamic process The effect of this interaction cannot be accounted for by a simple one-dimensional analysis Only a judicious combination of mixing analyses and more complex analyses that takes into account the formation and propagation of the waves due to combustion can give detailed qualitative information on the fluid dynamics of supersonic combustion Author

N78-10010*# Advisory Group for Aerospace Research and Development, Paris (France)
EFFECTS OF LENGTHWISE LIFT DISTRIBUTION ON SONIC BOOM OF SST CONFIGURATIONS
Antonio Ferri and Ahmed Ismail *In its* Selected Papers on Advanced Design of Air Vehicles Aug 1977 p 51-54 refs Repr from J Aircraft v 12 no 12 Dec 1975 p 919-929

(Grant NGR-33-016-119)
Avail NTIS HC A07/MF A01 CSCL 20A

Sonic Boom signatures produced by possible SST configurations during cruise were investigated It is shown that optimization based on a far field analysis is not necessarily the optimum for these conditions For an airplane length of 300 ft near-field effects can be obtained when sufficient lift is generated near the nose of the airplane Because of the near-field effects, sonic booms with maximum overpressures of the order of 1 lb/square foot can be obtained with possible airplane configurations having the same flight conditions at cruise Author

N78-10011*# Advisory Group for Aerospace Research and Development Paris (France)
PRACTICAL ASPECTS OF SONIC BOOM PROBLEMS
Antonio Ferri *In its* Selected Papers on Advanced Design of Air Vehicles Aug 1977 p 55-63 refs Presented at 7th Congr of the Intern Council of the Aeronautical Sci , Consiglio Nazl delle Ricerche, Rome, 14-18 Sep 1970

(Grant NGL-33-016-119)
(ICAS-Paper-70-23) Avail NTIS HC A07/MF A01 CSCL 20A

SST configurations selected from the point of minimizing sonic booms are investigated It is indicated that for a total length of 300 ft and total initial weight of the same order as the present U S SST designs sonic booms having shock pressure rise of the order of 0 6 lb/square foot can be obtained Values as low as 0 3 are possible for airplanes designed for cross-country flights Author

N78-10012*# Advisory Group for Aerospace Research and Development Paris (France)
SONIC BOOM ANALYSIS FOR HIGH-ALTITUDE FLIGHT AT HIGH MACH NUMBER
Antonio Ferri, Michael Siclari and Lu Ting *In its* Selected Papers on Advanced Design of Air Vehicles Aug 1977 p 65-74 refs Repr from Progr Astronaut Aeronaut , v 38, 1975 p 301-320 Presented at AIAA Aero-Acoustics Conf , Seattle, 15-17 Oct 1973
(Grant NGL-33-016-119)
(AIAA-Paper-73-1034) Avail NTIS HC A02/MF A01 CSCL 20A

Numerical programs for the computation of the flow field from the airplane at the flight altitude to the ground are presented They take into account the nonlinear effects of high Mach number the entropy change across the shock the entropy and enthalpy variations in the atmospheric layer and the gravitational effect Extension of the programs for the axisymmetric problems to handle nonaxisymmetric terms is described The asymmetry can be caused by the geometry of the body and the lift and also by *the fact that the variations in the atmospheric layer are* two-dimensional Numerical results for ground level signatures of several configurations at various flight conditions are presented and compared with existing approximate theories to demonstrate the influences of these nonlinear effects Author

N78-10013# Advisory Group for Aerospace Research and Development, Paris (France)
BETTER MARKS ON POLLUTION FOR THE SST
Antonio Ferri *In its* Selected Papers on Advanced Design of Air Vehicles Aug 1977 p 75-78 Repr from J Aircraft v 12 no 12, Dec 1975 p 919-929

Avail NTIS HC A02/MF A01

The SST engine was investigated in terms of acceptable levels of nitrogen oxides and appropriate specifications for engine design as in other pollution problems It was found that neither the SST nor other aircraft using conventional chemical fuel will harm the upper atmosphere by water injection, and propulsion stratagems can reduce the figure of oxides of nitrogen from the 400 parts per million in exhaust used two years ago to 1 or 2 parts through the technology possible now Author

N78-10014*# Advisory Group for Aerospace Research and Development Paris (France)
THE JET ENGINE DESIGN THAT CAN DRASTICALLY REDUCE OXIDES OF NITROGEN
Antonio Ferri and Anthony Agnone *In its* Selected Papers on Advanced Design of Air Vehicles Aug 1977 p 79-88 refs Presented at 12th AIAA Aerospace Sci Meeting Wash D C 30 Jan - 1 Feb 1974
(Grant NGR-33-016-131)
(AIAA-Paper-74-160) Avail NTIS HC A07/MF A01 CSCL 21E

The NOx pollution problem of hydrogen fueled turbojets and supersonic combustion ramjets (scramjets) was investigated to determine means of substantially alleviating the problem Since the NOx reaction rates are much slower than the energy producing reactions the NOx production depends mainly on the maximum local temperatures in the combustor and the NOx concentration is far from equilibrium at the end of a typical combustor (L approximately 1 ft) In diffusion flames as used in present turbojets and scramjets combustor designs the maximum local temperature occurs at the flame and is equal to the stoichiometric value Whereas in the heat conduction flames wherein the flame propagates due to a heat conduction process away from the flame to the cooler oncoming premixed unburnt gases the maximum temperature is lower than in the diffusion flame Hence the corresponding pollution index is also lower Author

N78-10015*# Advisory Group for Aerospace Research and Development Paris (France)
THE PROBLEM OF POLLUTION FOR THE SST
Antonio Ferri *In its* Selected Papers on Advanced Design of Air Vehicles Aug 1977 p 89-96 refs Presented at the 9th Congr of the Intern Council of the Aeron Sci Haifa Israel 25-30 Aug 1974
(Grant NGR-33-016-131)

(ICAS-Paper-74-29) Avail NTIS HC A07/MF A01 CSCL 21E

A qualitative review of the possible effects of the exhaust gases discharged by a large fleet of SST s in the upper atmosphere is given The review indicates the importance of the NO production in the exhaust gases The mechanism of NO formation by the combustion process is described A method for reduction of the NO formation is presented Author

N78-10016 Polish Academy of Sciences Warsaw
AERODYNAMIC INTERFERENCE IN A SYSTEM OF TWO HARMONICALLY OSCILLATING AIRFOILS AND ITS INFLUENCE ON FLUTTER [INTERFERENCJA AERODYNAMICZNA W UKLADZIE DWOCH HARMONICZNIE OSCYLUJACYCH PROFILI I JEJ WPLYW NA FLATTER]
Janusz Grzedzinski 21 Jan 1977 113 p refs In POLISH
Avail Issuing Activity

A two-dimensional model which can provide a determination of the critical flutter speed in a system of two mutually interracting airfoils was employed The basic characteristic of interference was taken into account namely, the effect of whirling wakes arising behind the airfoils Results of various experiments are presented namely (1) the occurrence of flutter caused only by aerodynamic interference between the wing and the vertical stabilizer was observed (2) the flutter disappears when the stabilizer is placed near the plane of the wing and (3) a monotonic fall in the speed of flutter was observed when the wings in a biplane system were brought close together A verification of these observations is provided within the framework of the two-dimensional model described above Author

N78-10017*# Stanford Univ Calif Dept of Aeronautics and Astronautics
UNSTEADY AERODYNAMIC MODELING AND ACTIVE AEROELASTIC CONTROL
John William Edwards Feb 1977 207 p refs
(Grant NGL-05-020-007)
(NASA-CR-148019 SUDAAR-504) Avail NTIS HC A10/MF A01 CSCL 01A

Unsteady aerodynamic modeling techniques are developed and applied to the study of active control of elastic vehicles The problem of active control of a supercritical flutter mode poses a definite design goal stability and is treated in detail The transfer functions relating the arbitrary airfoil motions to the airloads are derived from the Laplace transforms of the linearized airload expressions for incompressible two dimensional flow The transfer function relating the motions to the circulatory part of these loads is recognized as the Theodorsen function extended to complex values of reduced frequency, and is termed the generalized Theodorsen function Inversion of the Laplace transforms yields exact transient airloads and airfoil motions Exact root loci of aeroelastic modes are calculated providing quantitative information regarding subcritical and supercritical flutter conditions Author

N78-10019*# National Aeronautics and Space Administration Ames Research Center Moffett Field, Calif
LOW SPEED AERODYNAMIC CHARACTERISTICS OF AN 0 075-SCALE F-15 AIRPLANE MODEL AT HIGH ANGLES OF ATTACK AND SIDESLIP
Daniel N Petroff Stanley H Scher and Lee E Cohen (ARO Inc Moffett Field Calif) Jul 1974 118 p refs
(NASA-TM-X-62360) Avail NTIS HC A06/MF A01 CSCL 01A

An 0 075 scale model representative of the F-15 airplane was tested in the Ames 12 foot pressure wind tunnel at a Mach number of 0 16 to determine static longitudinal and lateral directional characteristics at spin attitudes for Reynolds numbers from 1 48 to 16 4 million per meter (0 45 to 5 0 million per foot) Angles of attack ranged from 0 to +90 deg and from -40 deg to -80 deg while angles of sideslip were varied from -20 deg to +30 deg Data were obtained for nacelle inlet ramp angles of 0 to 11 deg with the left and right stabilators deflected 0 -25 deg, and differentially 5 deg and -5 deg The normal pointed nose and two alternate nose shapes were also tested along with several configurations of external stores Analysis of the results indicate that at higher Reynolds numbers there is a slightly greater tendency to spin inverted than at lower Reynolds numbers Use of a hemispherical nose in place of the normal pointed nose provided an over correction in simulating yawing moment effects at high Reynolds numbers Author

N78-10020*# Boeing Vertol Co Philadelphia Pa
WIND TUNNEL INVESTIGATION OF ROTOR LIFT AND PROPULSIVE FORCE AT HIGH SPEED DATA ANALYSIS
Frank McHugh Ross Clark and Mary Soloman Oct 1977 211 p 3 Vol
(Contract NAS1-14317)
(NASA-CR-145217-App-1 D210-11135-1) Avail NTIS HC A10/MF A01 CSCL 01A

The basic test data obtained during the lift-propulsive force limit wind tunnel test conducted on a scale model CH-47b rotor are analyzed Included are the rotor control positions blade loads and six components of rotor force and moment corrected for hub tares Performance and blade loads are presented as the rotor lift limit is approached at fixed levels of rotor propulsive force coefficients and rotor tip speeds Performance and blade load trends are documented for fixed levels of rotor lift coefficient as propulsive force is increased to the maximum obtainable by the model rotor Test data is also included that defines the effect of stall proximity on rotor control power The basic test data plots are presented in volumes 2 and 3 Author

N78-10021*# Boeing Vertol Co Philadelphia Pa
WIND TUNNEL INVESTIGATION OF ROTOR LIFT AND PROPULSIVE FORCE AT HIGH SPEED TEST DATA APPENDIX
Frank McHugh Ross Clark and Mary Soloman Oct 1977 607 p 3 Vol
(Contract NAS1-14317)
(NASA-CR-145217-App-2 D210-11135-2) Avail NTIS HC A99/MF A01 CSCL 01A
For abstract see N78-10020

N78-10022*# Boeing Vertol Co Philadelphia Pa
WIND TUNNEL INVESTIGATION OF ROTOR LIFT AND PROPULSIVE FORCE AT HIGH SPEED TEST DATA APPENDIX
Frank McHugh Ross Clark and Mary Soloman Oct 1977 360 p 3 Vol
(Contract NAS1-14317)
(NASA-CR-145217-App-3 D210-11135-3-App) Avail NTIS HC A16/MF A01 CSCL 01A
For abstract see N78-10020

N78-10023*# National Aeronautics and Space Administration Langley Research Center Langley Station, Va
AN EXPLORATORY INVESTIGATION OF THE EFFECTS OF A THIN PLASTIC FILM COVER ON THE PROFILE DRAG OF AN AIRCRAFT WING PANEL
William D Beasley and Robert J McGhee Oct 1977 17 p refs
(NASA-TM-74073) Avail NTIS HC A02/MF A01 CSCL 01A

Exploratory wind tunnel tests were conducted on a large chord aircraft wing panel to evaluate the potential for drag reduction resulting from the application of a thin plastic film cover The tests were conducted at a Mach number of 0 15 over a Reynolds number range from about 7 x 10 to the 6th power to 63 x 10 to the 6th power Author

N78-10024# AeroVironment Inc Pasadena Calif
AIRCRAFT VORTEX WAKE DECAY NEAR THE GROUND Final Report, Jun 1975 - Sep 1976
I Tombach P B S Lissaman J B Mullen and S J Barker (Poseidon Res) May 1977 162 p refs
(Contract DOT-TSC-1008)
(AD-A042478/8 DOT-TSC-FAA-77-8 FAA-RD-77-46, AV-FR-668) Avail NTIS HC A08/MF A01 CSCL 20D

A multifaceted experimental and analytical research program was carried out to explore the details of aircraft wake vortex breakdown under conditions representative to those which would

prevail at low altitudes in the vicinity of airports Numerous separate approaches were taken simultaneously Flight tests with Lockheed L-18 Lodestar and Boeing 747 aircraft flying over ground based instrumentation provided data on overall vortex behavior on the vortex ages at the time of onset of instabilities and on the changes in the vortex velocity fields which resulted from vortex breakdowns Analytical work on stability theories identified conditions under which vortices could undergo unstable decay Experimental tests in a water tank looked at the internal instability of vortices, and also shed light on vortex motion near the ground Finally a heuristic modeling approach resulted in a simple representation of the relationship between the times of vortex breakdowns and the ambient turbulence levels Although a detailed mechanism for vortex breakdowns was not found, a universal function usable for all aircraft was developed for *predicting vortex breakdown times within a factor of two error*
Author

N78-10026*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
ATMOSPHERIC EFFECTS ON INLETS FOR SUPERSONIC CRUISE AIRCRAFT
Gary L Cole 1977 14 p refs Presented at 13th Prop Conf Orlando Fla 11-13 Jul 1977, sponsored by AIAA and Soc of Automotive Engr
(NASA-TM-X-73647 E-9154) Avail NTIS HC A02/MF A01 CSCL 01A

Mixed-compression inlet dynamic behavior in the vicinity of unstart, was simulated and analyzed to investigate time response of an inlet s normal shock to independent disturbances in ambient temperature and pressure and relative velocity (longitudinal gust) with and without inlet controls active The results indicate that atmospheric disturbances may be more important than internal disturbances in setting inlet controls requirements because they are usually not anticipated and because normal shock response *to rapid atmospheric disturbances is not attenuated by the inlet* as it is for engine induced disturbances However before inlet control requirements can be fully assessed more statistics on *extreme atmospheric disturbances are needed*
Author

N78-10027*# Boeing Commercial Airplane Co Seattle Wash
SPLINED VERSION OF FLEXSTAB A CRITICAL ANALYSIS OF ALTERNATE SCHEMES Final Report
J A Weber Aug 1977 47 p refs
(Contract NAS2-7729)
(NASA-CR-152030) Avail NTIS HC A03/MF A01 CSCL 01A

Recommendations are made for improved aerodynamic models and numerical schemes to be considered for inclusion into the FLEXSTAB computer program system These recommendations are based on a critical analysis of numerical technology
Author

N78-10030*# National Aeronautics and Space Administration Langley Research Center, Langley Station Va
EFFECT OF A SIMULATED ENGINE JET BLOWING ABOVE AN ARROW WING AT MACH 2 0
Barrett L Shrout and Clyde Hayes 1977 56 p refs
(NASA-TP-1050 L-11751) Avail NTIS HC A04/MF A01 CSCL 01A

The effects of a gas jet simulating a turbojet engine exhaust blowing above a cambered and twisted arrow wing were investigated Tests were conducted in the Langley 4-foot supersonic pressure tunnel at a Mach number of 2 0 Nozzle pressure ratios from 1 to 64 were tested with both helium and air used as jet gases The tests were conducted at angles of attack from -2 deg to 8 deg at a Reynolds number of 9,840,000 per meter Only the forces and moments on the *wing were measured Results of the investigation indicated that* the jet blowing over the wing caused reductions in maximum lift-drag ratio of about 4 percent for helium and 6 percent for *air at their respective design nozzle pressure ratios relative to* jet-off data Moderate changes in the longitudinal vertical or angular positions of the jet relative to the wing had little effect on the wing aerodynamic characteristics
Author

N78-10033# ARO, Inc Arnold Air Force Station Tenn
CRITICAL STING LENGTH AS DETERMINED BY THE MEASUREMENT OF PITCH-DAMPING DERIVATIVES FOR LAMINAR, TRANSITIONAL, AND TURBULENT BOUNDARY LAYERS AT MACH NO 3 FOR REDUCED FREQUENCIES OF 0 0033 AND 0 0056 Final Report, 1 Jul 1975 - 17 Apr 1977
Bob L Uselton and Fred B Cyran AEDC Jul 1977 67 p refs
(ARO Proj V32A04A ARO Proj V41A-J0A, ARO Proj V32A-A1A ARO Proj V41A-N9A)
(AD-A042747 ARO-VKF-TR-77-35 AEDC-TR-77-66) Avail NTIS HC A04/MF A01 CSCL 20/4

Support interference in supersonic wind tunnels is studied The critical sting length at alpha = 0 was determined by the *measurement of pitch-damping derivatives for laminar transitional* and turbulent boundary layers at the model base The effect of wedge splitter plates on sting interference was also investigated By utilizing the small amplitude forced oscillation technique data were obtained at Mach number 3 on a blunt 7 deg cone for reduced frequencies of 0 0033 and 0 0056 Model base pressure and a model surface pressure near the base were measured tin addition to the pitch damping derivatives The results showed that the critical sting length with respect to sting interference on pitch-damping data was two model diameters for the two reduced frequencies investigated and was independent of the type of boundary layer at the model base The critical sting length for minimal base pressure interference is 2 5 model diameters for this model and these test conditions
GRA

N78-10034*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
LIGHT AIRPLANE CRASH TESTS AT IMPACT VELOCITIES OF 13 AND 27 m/sec
Emilio Alfaro-Bou and Victor L Vaughan Jr Nov 1977 52 p refs
(NASA-TP-1042 L-11426) Avail NTIS HC A04/MF A01 CSCL 01C

Two similar general aviation airplanes were crash tested at the Langley impact dynamics research facility at velocities of 13 and 27 m/sec Other flight parameters were held constant The facility, instrumentation test specimens and test method are briefly described Structural damage and accelerometer data *are discussed*
Author

N78-10035*# Douglas Aircraft Co, Inc Long Beach, Calif
COST/BENEFIT TRADEOFFS FOR REDUCING THE ENERGY CONSUMPTION OF THE COMMERCIAL AIR TRANSPORTATION SYSTEM Summary Report, 5 Nov 1974 - 30 Jun 1976
E F Kraus and J C VanAbkoude Jun 1976 77 p
(Contract NAS2-8618)
(NASA-CR-137925 MDC-J7340) Avail NTIS HC A05/MF A01 CSCL 05C

*The fuel saving potential and cost effectiveness of numer*ous operational and technical options proposed for reducing the fuel consumption of the U S commercial airline fleet was examined and compared The impact of the most promising fuel conserving options on fuel consumption passenger demand operating costs and airline profits when implemented in the U S domestic and international airline fleets was determined A forecast estimate was made of the potential fuel savings achievable in the U S scheduled air transportation system Specifically the means for reducing the jet fuel consumption of the U S scheduled airlines in domestic and international passenger operations were investigated A design analysis was made of two turboprop aircraft as possible fuel conserving derivatives of the DC-9-30
Author

N78-10036# *Civil Aeromedical Inst Oklahoma City Okla*
EMERGENCY ESCAPE OF HANDICAPPED AIR TRAVELERS
J G Blethrow J D Garner D L Lowrey D E Busby and R F Chandler Jul 1977 72 p refs
(AD-A043269/0 FAA-AM-77-11) Avail NTIS HC A04/MF A01 CSCL 06/7

A study is conducted to investigate potential problems related to the emergency evacuation of civil aircraft carrying handicapped passengers An analysis of the movement of individual handicapped subjects in an aircraft cabin is included along with the results of evacuation tests in which a portion of the test subjects either were handicapped or simulated handicaps Data are given relative to assistance to handicapped passengers, the effects of groups of handicapped passengers seating location floor slope and exit type on the evacuation time Suggestions by handicapped subjects and a summary of recent aircraft accidents involving evacuation of handicapped passengers are included as appendices to the report Author

N78-10037# Boeing Commercial Airplane Co Seattle Wash
AIRCRAFT ALERTING SYSTEMS CRITERIA STUDY VOLUME 1 COLLATION AND ANALYSIS OF AIRCRAFT ALERTING SYSTEM DATA Final Report, Jan - Nov 1976
J E Veitengruber G P Boucek Jr , and W D Smith May 1977 288 p refs
(Contract DOT-FA73WA-3233)
(AD-A042328/5 FAA-RD-76-222-Vol-1) Avail NTIS HC A13/MF A01 CSCL 01/4

Studies performed to develop optimum alerting methods for new alerts that had to be retrofitted to existing aircraft identified as major alerting system problems the proliferation of aleting systems and the inconsistent application of alerting concepts in current commercial transport aircraft These problem areas were addressed in the following manner (1) refine and augment the stimuli response data collected (2) provide test plans for additional stimuli response tests (3) provide tabulations of the alerting methods and alerting requirements used on current commercial transport aircraft (4) develop a method for prioritizing alerting functions and the alerting functions accordingly, (5) note conflicts between current alerting requirements and the prioritized list of alerts and (6) provide recommendations for standardization of alerting functions/methods A collation of human factors data pertinent to alerting systems is included plus cursory test plans for obtaining missing human factors data required to complete definition of and validate the standards recommended for alerting systems criteria for alert priority levels an example tabulation of alerts that might fall within each priority level and recommended methods of annunciating the alerts within each priority level Author

N78-10038# Air Force Flight Dynamics Lab Wright-Patterson AFB Ohio
CREW ESCAPE CAPSULE RETROROCKET CONCEPT VOLUME 1 DEMONSTRATION PROGRAM Final Technical Report, May 1972 - Oct 1975
Marvin C Whitney May 1977 78 p refs 2 Vol
(AF Proj 6065)
(AD-A042337 AFFDL-TR-76-107-Vol-1) Avail NTIS HC A05/MF A01 CSCL 01/2

The retrorocket demonstration program was conducted to evaluate an alternative to the inflatable airbags that are currently used with crew escape capsules to attenuate the landing impact forces In-house tests indicated that if the vertical impact velocity was ten feet per second or less the impact forces would be within human tolerances Analyses revealed that the retrorocket concept could meet this criteria therefore a demonstration test program was established A structural steel test vehicle that was configured to simulate the B-1 capsule (weight center of gravity location footprint size and parachute bridle system) was used for the test program A cluster of four rocket motors with a high level primary thrust and a low level sustainer that had been developed for the NASA Gemini Program was installed at the confluence of the three 69 8 foot diameter slotted ring sail recovery chutes and the vehicle bridle system A mechanical altimeter or telescoping probe was developed to extend down below the vehicle to trigger the rocket ignition at the correct time so as to decelerate the vehicle from 30 ft/sec down to 10 ft/sec or less before ground impact Eight tests were conducted in developing the demonstration system with the last test a complete retrorocket system test Test results and the rocket performance computer program indicated the demonstration program met design requirements Author (GRA)

N78-10039# Air Force Flight Dynamics Lab Wright-Patterson AFB Ohio
CREW ESCAPE CAPSULE RETROROCKET CONCEPT VOLUME 2 SELECTION OF A RETROROCKET SYSTEM Final Technical Report, May 1972 - Oct 1975
James M Peters May 1977 76 p refs 2 Vol
(AF Proj 6065)
(AD-A042218, AFFDL-TR-76-107-Vol-2) Avail NTIS HC A05/MF A01 CSCL 21/8

The objective of this analysis was to select a rocket design which would decelerate a B-1 escape capsule drop test vehicle to a vertical velocity of 10 ft/sec or less at capsule impact with the terrain The concept is based on the prediction that if the capsule is decelerated to a vertical velocity of 10 ft/sec or less at impact, the capsule occupants would not be subjected to accelerations which exceed the requirements of MIL-C-25969B The results of a parametric study which considered thrust to weight ratios of 2 through 10, in combination with recovery system descent rates of 30 through 60 ft/sec, are presented The test envelopes which could be accommodated with two different off-the-shelf rocket systems are presented The analytical method employed in determining the test envelopes is discussed Performance summaries for the selected rocket system are given Author (GRA)

N78-10040# Systems Control Inc , Palo Alto Calif
AN OPERATIONAL EVALUATION OF FLIGHT TECHNICAL ERROR Final Report
R J Adams Jul 1975 358 p refs
(Contract DOT-FA72WA-3098)
(AD-A042796/3 FAA-RD-76-33) Avail NTIS HC A16/MF A01 CSCL 17/7

Controlled cockpit simulator and flight test experiments were conducted to determine whether a one mile flight technical error (FTE) is achievable in enroute and terminal area operations using various types of RNAV equipment The magnitude of FTE and its impact on airspace planning RNAV system manufacturers RNAV users and air traffic controllers is analyzed taking into account the following RNAV equipment and display factors, FTE performance in turns performance in parallel offset, delay fan and direct to maneuvers effects of workload and airspace utilization RNAV error budget element combination is also analyzed The currently used RSS technique is compared to a modified version of this computation which is more accurate in predicting the total system cross track error Data from the controlled cockpit simulator tests, airline type RNAV system tests and operational flight tests using general aviation quality RNAV systems are discussed Author

N78-10041# National Aviation Facilities Experimental Center, Atlantic City N J
A FLIGHT INVESTIGATION OF SYSTEM ACCURACIES AND OPERATIONAL CAPABILITIES OF A GENERAL AVIATION AREA NAVIGATION SYSTEM Final Report
Jack D Edmonds Robert H Pursel and John Gallagher Jun 1977 100 p
(AD-A042846/6 FAA-NA-77-1 FAA-RD-77-43) Avail NTIS HC A05/MF A01 CSCL 17/7

Flight tests were conducted using a general aviation area navigation (RNAV) system to investigate system accuracies and resultant airspace requirements in the terminal area Issues investigated were total system error and error budget, flight technical error, turn anticipation waypoint storage capacity and results of typical operational maneuvers Subject pilots for the test represented two distinct levels of experience Subjects were also restricted to a one- two- or three-waypoint storage capacity for various flights Statistical data are presented for the various error components making up the RNAV total system error Various operational capabilities were also investigated and graphical data are presented for parallel offsets and turn anticipation A two standard deviation of + or - 1 5 n mi was measured for total system crosstrack error in the terminal area Author

N78-10042*# Analytical Mechanics Associates Inc Jericho N Y

AUTOMATED LANDING, ROLLOUT, AND TURNOFF USING MLS AND MAGNETIC CABLE SENSORS Final Report
S Pines, S F Schmidt, and F Mann Washington NASA Oct 1977 152 p refs
(Contract NAS1-14311)
(NASA-CR-2907, AMA-77-3) Avail NTIS HC A08/MF A01 CSCL 17G

A description of the simulation program used to study the landing approach rollout and turnoff of the B737-100 aircraft utilizing MLS and a buried magnetic leader cable as navigation aids is presented Simulation results are given and show the concept to be both feasible and practical for commercial type aircraft terminal area control Author

N78-10043# Army Electronics Command Fort Huachuca, Ariz
AN APPROACH GUIDANCE SYSTEM FOR REMOTELY-PILOTED VEHICLES
Norman K Shupe Jul 1977 71 p
(AD-A041561 ECOM-4503) Avail NTIS HC A04/MF A01 CSCL 17/7

This report develops a guidance formulation with general applicability to the problem of the IFR landing of aircraft of any type however the formulation is specialized in this document to the case of a non-decelerating approach to the landing point The control problem considered is the computer simulation of the automatic landing of a mini-RPV of the delta wing variety Author (GRA)

N78-10045*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
EFFECT OF DIGITALLY COMPUTED DRIVES ON PERFORMANCE OF CONTINUOUS LINEAR SYSTEMS
Russell V Parrish Sep 1977 47 p refs
(NASA-TN-D-8518 L-11491) Avail NTIS HC A03/MF A01 CSCL 01C

The dependence of the Bode response upon digital sample rate for first and second order linear continuous systems driven by a digital computer is derived Open loop lead compensation introduced within the digital computer in order to increase the system bandwidth is also examined in terms of derived Bode responses This introduction of lead terms within the digital computer is shown to be effective at operating frequencies below the Nyquist frequency In most practical applications empirical determination of these lead coefficients appears to be a sufficient compensation method Author

N78-10046*# Boeing Vertol Co, Philadelphia Pa
PILOT EVALUATION OF AN ADVANCED HINGELESS ROTOR XY-15 SIMULATION
M A McVeigh Jun 1977 43 p refs
(Contract NAS2-8048)
(NASA-CR-152034 D210-11255-1) Avail NTIS HC A03/MF A01 CSCL 01C

A piloted simulation of an advanced hingeless rotor XV-15 tilt-rotor aircraft was carried out The evaluation was made by a pilot from NASA-Ames who had previous experience flying a simulation of the current gimballed rotor NASA/Army XV-15 It was pointed out that some modifications to the force feel system were needed in order to provide rapid force trimming during rapid maneuvers Some additional tailoring of the SCAS system was required to achieve good nap-of-the-earth performance Overall pilot opinion on the hingeless rotor XV-15 tilt rotor was favorable Brief discussion on the mathematical models and the simulator configuration are presented The maneuvers and pilot comments are given along with some engineering comments Author

N78-10047*# Boeing Commercial Airplane Co, Seattle Wash
THE 737 GRAPHITE COMPOSITE FLIGHT SPOILER FLIGHT SERVICE EVALUATION Annual Report, Apr 1976 - Apr 1977
Robert L Stoecklin Aug 1977 33 p refs
(Contract NAS1-11668)
(NASA-CR-145207 AR-3) Avail NTIS HC A03/MF A01 CSCL 01C

The flight service experience of 110 graphite epoxy spoilers on 737 transport aircraft was reviewed as well as ground based environmental exposure of graphite epoxy material specimens for the period from April 1976 through April 1977 Several spoilers were installed on each of 27 aircraft representing seven major airlines operating throughout the world A flight service evaluation program of at least 5 years is under way As of April 30 1977, a total of 766 938 spoiler flight hours and 1 168,090 spoiler landings were accumulated by the fleet Based on visual ultrasonic and destructive testing there was no evidence of moisture migration into the honeycomb core and no core corrosion Tests of removed spoilers and of ground based exposure specimens after the third year of service continue to indicate modest changes in composite strength properties Author

N78-10049*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
VALIDATION OF A FLEXIBLE AIRCRAFT TAKE-OFF AND LANDING ANALYSIS (FATOLA)
Huey D Carden and John R McGehee 1977 68 p refs
(NASA-TP-1025, L-11704) Avail NTIS HC A04/MF A01 CSCL 01C

Modifications to improve the analytical simulation capabilities of a multi-degree-of-freedom flexible aircraft take-off and landing analysis (FATOLA) computer program are discussed The FATOLA program was used to simulate the landing behavior of a stiff body X-24B reentry research vehicle and of a flexible body supersonic cruise YF-12A research airplane The analytical results were compared with flight test data and correlations of vehicle motions attitudes forces and accelerations during the landing impact and rollout were good For the YF-12A airplane airframe flexibility was found to be important for nose gear loading Based upon the correlation study presented the versatility and validity of the FATOLA program for the study of landing dynamics of aircraft are confirmed Author

N78-10051# United Technologies Corp Stratford Conn Sikorsky Aircraft Div
INVESTIGATION OF THE COMPLIANT ROTOR CONCEPT
Robert H Blackwell Jun 1977 116 p refs
(Contract DAAJ02-76-C-0003 DA Proj 1F2-62209-AH-76)
(AD-A042338 SER-50985 USAAMRDL-TR-77-7) Avail NTIS HC A06/MF A01 CSCL 01/3

An analytic investigation was conducted to determine the feasibility of improving helicopter performance and reducing flight loads by passive control of blade torsional response Distributions of time-varying blade elastic twist that improve performance and decrease blade stress are identified Blade design features producing the desired twisting are then sought through examination of model and full-scale torsional response data and through an analytic evaluation of significant parameters Results indicate a significant potential for inducing 1P and 2P elastic twisting Tip sweep on a blade of reduced torsional stiffness improves performance and reduces control loads and blade stress by inducing a 1P torsional response which decreases advancing-blade twist and increases retreating-blade twist Negative airfoil camber is shown to reduce blade stress but generally degrade performance Control of the spanwise distribution of aerodynamic center--elastic axis offset is shown to be effective in producing 2P elastic twist which improves forward-flight performance The potential for improving hover performance by inducing large negative elastic twist is demonstrated Preliminary design of two compliant rotors is accomplished Relative to a conventional baseline rotor both designs employ four-to-one torsional stiffness reductions outboard of the 50-percent radius The first design uses a 20-degree swept tip at the 90-percent radius to induce 1P elastic twist which improves rotor L/D by an average of 4 percent for the conditions analyzed Vibratory pushrod loads are reduced by up to 50 percent and blade flatwise stress is reduced by approximately 10 percent GRA

N78-10052# Mechanics Research Inc McLean Va Electronics Systems Div
FEASIBILITY ANALYSIS FOR A MICROWAVE DEICER FOR HELICOPTER ROTOR BLADES Final Report

Bertram Magenheim and Frank Hains May 1977 280 p refs (Contract DAAJ02-75-C-0042 DA Proj 1F2-63209-DB-38) (AD-A042581 USAAMRDL-TR-76-18) Avail NTIS HC A13/MF A01 CSCL 01/3

An analysis of the feasibility of utilizing microwave energy to deice helicopter rotor blades is presented The analysis is based upon the coupling of microwave energy to the ice layers by means of dielectric surface waveguides coating the leading edge of the rotor blades where the ice accumulates The thickness of the dielectric coating is adjusted by design so that in the ice-free condition a loosely bound surface wave may propagate along the coating with only minor losses As the ice accumulates tending to thicken the surface waveguides the surface wave becoming more tightly bound undergoes higher losses dissipating much of its energy in the glossy ice layer The dissipation of energy in the ice raises its temperature above the level required for breaking its bond to the blade which occurs before any melting takes place The analysis considers four major topics (1) the properties of surface waveguides including dielectrics suitable electrically and mechanically for rotor blades and the dielectric properties of rotor ice (2) dissipation and heat distribution theory (3) the problems associated with coupling microwave energy to the surface waveguides and (4) the typical and preliminary configuration and the cost of installing microwave deicers in UH-1 helicopters in production quantities

Author (GRA)

N78-10053# Naval Air Test Center Patuxent River Md

THE NUMERICAL ANALYSIS OF AIR COMBAT ENGAGEMENTS DOMINATED BY MANEUVERING PERFORMANCE

W R Simpson and R A Oberle 20 Jun 1977 85 p refs (AD-A042483, NATC-TM-77-2-SA) Avail NTIS MF A01 CSCL 15/7

An analysis capability has been developed for use by the training and test and evaluation communities to quantify air combat maneuvering engagement outcomes Details of this analysis capability in the form of computer programs for producing analytic engagement data are presented Results from a sample test data base are presented to illustrate analysis and conclusion forming methods The conclusions from the sample data set are not intended to represent actual strategic decisions but are exemplary only GRA

N78-10054# Boeing Aerospace Co Seattle Wash Military Airplane Development

INNOVATIVE AIRCRAFT DESIGN STUDY TASK 2 DESIGN SUBTASK 1 CHEMICALLY FUELED AIRCRAFT VOLUME 2 APPENDICES

Jun 1977 175 p refs

(Contract F33615-76-C-0122)

(AD-A044319) Avail NTIS HC A08/MF A01 CSCL 01/3

The following topics are discussed (1) Analysis of innovative configurations (2) parametric configuration characteristics (3) Stedlec engine characteristics (4) circular body cross section configuration characteristics (5) technology assessment (6) mission sensitivity (7) weights methodology, and (8) advanced technology cost factor methodology Author

N78-10055# Naval Intelligence Support Center Washington D C Translation Div

THE INVESTIGATION OF TAKE-OFF AND LANDING CHARACTERISTICS OF JET SHORTENED TAKE-OFF AND LANDING AIRCRAFT (STOL)

V I Surus 25 Jul 1977 8 p refs Transl into ENGLISH from Samoletostr Tekh Vozdush Flota (USSR) no 20 1970 p 40-44

(AD-A044292 NISC-Trans-3947) Avail NTIS HC A02/MF A01 CSCL 01/3

The negative effect of secondary forces induced by the jet flow of the engine because of its ejection properties is not taken into account during the examination of aerodynamic and take-off and landing characteristics of jet STOL and VTOL aircraft (vertical take-off and landing aircraft) It can be so significant for certain STOL configurations (Figure 1) that aircraft equipped with a BLC system (boundary layer control) could be more preferable GRA

N78-10056# Aeronautical Systems Div Wright-Patterson AFB Ohio

A STUDY OF TASK LOADING USING A THREE MAN CREW ON A KC-135 AIRCRAFT Final Report, Nov 1975 - Mar 1976

Richard Geiselhart Richard J Schiffler and Larry J Ivey Jan 1976 47 p refs

(AD-A044257 ASD-TR-76-19) Avail NTIS HC A03/MF A01 CSCL 01/3

A series of flight tests were conducted to assess the feasibility of reducing crew size on KC-135 from 4 to 3 A dual INS was installed in the test aircraft and refueling missions flown task times of crew performing duties were recorded Subjects also completed questionnaires It was concluded that on several types of missions a three man crew leads to extremely high workloads Author (GRA)

N78-10057# Air Force Inst of Tech Wright-Patterson AFB Ohio School of Systems and Logistics

A FEASIBILITY STUDY TO DEVELOP OPTIMIZATION ALGORITHMS FOR AIRCRAFT STRUCTURES M S Thesis

Ronald L Evans and Bruce P Christensen Jun 1977 130 p refs

(AD-A044190 AFIT-LSSR-30-77A) Avail NTIS HC A07/MF A01 CSCL 01/3

The concept of design to cost requires accurate cost estimation throughout the acquisition process of a major weapon system Cost estimation is particularly important during the conceptual and validation phases This research effort was directed toward improving cost estimation techniques for aircraft structures Previous cost estimates had been derived through the use of a Vehicle Design and Evaluation Program (VDEP) which designed an aircraft structure to a minimum weight for a given set of structural parameters However a vehicle designed for minimum weight did not necessarily result in a structure with the lowest cost This study examined the feasibility of developing algorithms which would together with VDEP design a cost optimized airframe structure Cost as the dependent variable was regressed with load factor rib spacing structural types skin thickness and weight as the independent variables The results of the research showed that it is feasible to develop cost optimization algorithms by using the highly significant relationship between skin thickness and rib spacing The analysis further indicated that when weight was removed from the regression models skin thickness became the key design parameter Author (GRA)

N78-10058# Boeing Aerospace Co Seattle Wash Logistics Support and Services

LIFE CYCLE COST OF C-130E WEAPON SYSTEM Interim Report, 29 Jun 1976 - 3 Jun 1977

Frank D Brown Gary A Walker, David H Wilson and Duncan L Dieterly (AF Human Resources Lab) Jul 1977 71 p refs (Contract F33615-76-C-0062 AF Proj 1959)

(AD-A044046 AFHRL-TR-77-46) Avail NTIS HC A04/MF A01 CSCL 01/3

Human and material resource data accumulated from all available Air Force sources is used to calculate the approximate life cycle cost (LCC) of the C-130E Hercules aircraft The data was located collected and reduced to computer files under another phase of the study The Air Force Cost Analysis and Cost Estimating (CACE) model was modified and used to calculate the C-130E LCC Based on fifteen years of Air Force data (1962-1976) a LCC estimate was calculated The methodology for determining the historical LCC may be applied to other systems The primary difficulty in computing historical LCC estimates is the lack of required data files and the low quality control on many data variables This research provides a methodology and a guide for accomplishing historical LCC on other weapon systems The reason for determining historical LCC is to establish a baseline that can be applied to new weapon system development programs to identify possible areas for redesign to reduce future weapon system LCC This document is the third of a series of five Technical Reports emanating from this Project 1959 Phase 1 study namely AFHRL-TR-77-40 C-130E Hercules Aircraft Review of Published Literature and Structured Interviews (Available to U S Government Agencies Only) AFHRL-TR-77-48 Historical Analysis of C-130E

Resources AFHRL-TR-77-46 Life Cycle Cost of C-130E Weapon System AFHRL-TR-77-64(I) Historical Resource Utilization Methodology and AFHRL-TR-77-64(I) Historical Task Analysis of C-130E Personnel Author (GRA)

N78-10059# General Dynamics/Convair, San Diego Calif
WEAPON SYSTEM COSTING METHODOLOGY IMPROVED STRUCTURAL COST ANALYSIS Final Report, Jul 1975 - Feb 1977
R E Kenyon May 1977 281 p refs
(Contract F33615-75-C-3148 AF Proj 1368)
(AD-A044037 AFFDL-TR-77-24) Avail NTIS HC A13/MF A01 CSCL 01/3

This report describes a study to improve a previously developed weapon system costing methodology for aircraft airframes and basic structures under Contract F33615-72-C-2083 The methodology is part of a preliminary design level technique for the cost estimation flight vehicle structures Applications of the *method have indicated a number of areas where further* study and development could be expected to provide an advanced state-of-the-art capability This study was directed towards that end The study was limited to the specific changes consisting of (1) development of complexity factors for technologies and materials represented by the advanced strategic bomber wing carry-through box, (2) modification of raw material cost estimating relationships (CERs) to increase sensitivity to material product form and type of scrappage, (3) investigation of additional assembly techniques and adding or modifying corresponding cost estimating factors (4) modification of existing CERs to include evaluation of variations in the degree of commonality involved, (5) determination of the effect of production rate on recurring production costs, and (6) determination of the variation in learning curve factors due to variation in the type of material or type of construction Detailed results are described Author (GRA)

N78-10060*# Southern Illinois Univ , Carbondale
PRELIMINARY CANDIDATE ADVANCED AVIONICS SYSTEM FOR GENERAL AVIATION Final Report
T M McCalla F L Grismore, S E Greatline, and L M Birkhead Jul 1977 248 p refs
(Contract NAS2-9310)
(NASA-CR-152025) Avail NTIS HC A11/MF A01 CSCL 01D

An integrated avionics system design was carried out to the level which indicates subsystem function and the methods of overall system integration Sufficient detail was included to allow identification of possible system component technologies, and to perform reliability modularity, maintainability cost, and risk analysis upon the system design Retrofit to older aircraft, availability of this system to the single engine two place aircraft, was considered Author

N78-10061*# Systems Technology, Inc , Hawthorne Calif
PRELIMINARY CANDIDATE ADVANCED AVIONICS SYSTEM (PCAAS) Final Report
Gary L Teper, Roger H Hon and Richard K Smyth Sep 1977 189 p refs
(Contract NAS2-9311)
(NASA-CR-152026 TR-1084-1) Avail NTIS HC A09/MF A01 CSCL 01D

Specifications which define the system functional requirements, the subsystem and interface needs, and other requirements such as maintainability, modularity, and reliability are summarized A design definition of all required avionics functions and a system risk analysis are presented Author

N78-10062*# National Aeronautics and Space Administration Langley Research Center Langley Station, Va
DESCRIPTION OF PATH-IN-THE-SKY CONTACT ANALOG PILOTING DISPLAY
Charles E Knox and John Leavitt (Sperry Rand Corp , Hampton, Va) Oct 1977 23 p refs
(NASA-TM-74057 L-11812) Avail NTIS HC A02/MF A01 CSCL 01D

A contact analog display called Path-In-The-Sky (PITS) integrates information on airplane attitude airplane kinematic performance navigation situation and path prediction into one instrument The pictorial format utilized in the PITS display concept was designed to reduce the required instrument scan and to simplify interpretation of information with the objective of reducing pilot work load Described are the symbology of the PITS display, the coordinate systems used to generate the display and the magnitudes of pertinent geometric characteristics selected during the display development Also included are examples of the PITS display generated on a stand-alone graphics computer Author

N78-10063# Ohio Univ Athens Avionics Engineering Center
INSTRUMENT LANDING SYSTEM IMPROVEMENT PROGRAM FAR-FIELD MONITORING Final Report, Oct 1972 - Jan 1975
Jan 1975 87 p refs
(Contract DOT-FA69WA-2066)
(AD-A042320/2 EER-5-21, FAA-RD-75-201) Avail NTIS HC A05/MF A01 CSCL 01/2

Methods of far-field extrapolation monitoring of the ILS glide slope angle were investigated The use of a quasilinearization algorithm to determine path angle and width from measurements below obstruction heights at the middle marker is described with results for various fault conditions tabulated A precision space modulation quotient monitor for measuring high values of DDM at low signal levels is described A description of investigations of a field strength monitor using the capture effect principle to sense changes in low altitude field strength caused by environmental effects is included Author

N78-10064# Army War Coll Carlisle Barracks Pa Field Artillery
IMPROVING RELIABILITY OF AVIONICS EQUIPMENTS THROUGH ENGINEERING TESTING
Calvin G Franklin 8 Jun 1977 170 p refs
(AD-A042454) Avail NTIS HC A08/MF A01 CSCL 09/5

The basic consideration in this exploratory study is Can the reliability of avionics be enhanced by improving (1) the reliability test methodology (2) our reliability test philosophy, and (3) performing tests in a more realistic test environment Mr Wallis J Willoughby Deputy Chief of Naval Materiel for Reliability and Maintainability, Naval Materiel Command, made the statement that testing is probably responsible more than any other single factor for the poor reliability of military procurements This study suggests a strategy for the acquisition of avionics equipment with the goal of improving reliability by finding and correcting engineering design deficiencies as early as possible in the Acquisition Process (Engineering Development Testing) Information on reliability problems as associated with avionic reliability was derived from a literature search (primarily previous studies in the field) and personal interviews with experts in the field of avionics reliability The paper concludes with a series of recommendations that may result in improved reliability and contribute to the cost of ownership of avionics equipment Author (GRA)

N78-10066# Hughes Aircraft Co Culver City Calif Display Systems Lab
SIMULTANEOUS SENSOR-PRESENTATION TECHNIQUES STUDY Final Report, 1 Jun 1976 - 30 Jan 1977
T A DuPuis Jul 1977 154 p refs
(Contract N00014-76-C-0802)
(AD-A043355 HAC-P77-197R HAC-Ref-D7344
ONR-CR-213-142-1F) Avail NTIS HC A08/MF A01 CSCL 09/5

This study investigated the utility and feasibility of combining imagery from several airborne sensors and data sources on a single real-time display The baseline sensors and data sources considered for an advanced, high performance attack aircraft included radar, FLIR TV laser spot tracker/designator/ranger warning receivers a priori data (cartography target/threat coordinates reconnaissance imagery of target) and data-linked

target/threat information Several promising simultaneous data presentations were determined for use within the key phases of an interdiction mission These were simulated by the superposition of static imagery and qualitatively evaluated The mechanization complexity of implementing each display combination as well as a highly flexible general system implementation was examined It was concluded that all of the key hardware elements required are presently available or in development Many are already onboard or scheduled for incorporation in tactical aircraft and may be time-shared for the display of multisensor information Author (GRA)

N78-10067# Army Aviation Engineering Flight Activity Edwards AFB Calif

LOW AIRSPEED SENSOR LOCATION TESTS AH-1G HELICOPTER Final Report, Dec 1975 - Apr 1976

Kenneth R Ferrell Barclay H Boirun and Gary E Hill Feb 1977 49 p refs

(AD-A044327 USAAEFA-75-19-1) Avail NTIS HC A03/MF A01 CSCL 01/4

During weapons fire control tests being conducted by Frankford Arsenal Philadelphia Pennsylvania it was necessary to determine the optimum location for an Elliott low airspeed system mounted on an AH-1G helicopter to improve the accuracy of the actual aircraft airspeed signal to the fire control computer The airspeed system was provided by Frankford Arsenal and the necessary mounting hardware was constructed by the United States Army Aviation Engineering Flight Activity Edwards Air Force Base California Nine airspeed indicator locations along the fuselage from the engine mount to the forward canopy area were tested The optimum location tested was at fuselage station 128 water line 104 and buttline -35 The Frankford system was then calibrated at the optimum location and the electronic linearization circuits were added to the computer This location for the linearized system provided accurate airspeed information out of ground effect from 15 knots calibrated airspeed (KCAS) rearward to 125 KCAS forward and lateral airspeed from 28 KCAS left to 25 KCAS in right sideward flight Author (GRA)

N78-10068*# Massachusetts Inst of Tech Cambridge Dept of Aeronautics and Astronautics

AN ASSESSMENT OF TECHNOLOGY FOR TURBOJET ENGINE ROTOR FAILURES

Emmett A Witmer ed Mar 1977 425 p Workshop held at Cambridge Mass 29-31 Mar 1977 sponsored by NASA (NASA-CP-2017 E-8305) Avail NTIS HC A18/MF A01 CSCL 21E

Design considerations, objectives and approaches used in containing rotor burst debris are discussed Methods are given for determining the fracture resistance of various materials used in providing lightweight shielding from fragment impact For individual titles see N78-10069 through N78-10090

N78-10069*# Federal Aviation Administration Washington D C

FEDERAL AVIATION ADMINISTRATION'S APPROACH TO ENGINE ROTOR INTEGRITY

A K Forney *In* MIT An Assessment of Technol for Turbojet Engine Rotor Failures Mar 1977 p 1-9

Avail NTIS HC A18/MF A01 CSCL 21E

Sections of the U S Airworthiness Standards which contribute to rotor integrity are explored Reports published under NASA s Rotor Burst Protection program are included in current FAA studies to determine the weight penalty for two different levels of increased containment and the penalty associated with protecting critical structure and systems the passenger cabin and the flight deck by strategic location of armor shields or deflector plates Findings of the two studies will be used to propose revisions to regulations to reduce uncontained rotor failures A R H

N78-10070*# Civil Aviation Authority Redhill (England) Power Plant Dept

ENGINE NON-CONTAINMENT THE UK CAA VIEW

G L Gunstone *In* MIT An Assessment of Technol for Turbojet Engine Rotor Failures Mar 1977 p 11-32

Avail NTIS HC A18/MF A01 CSCL 21E

Airworthiness accidents account for roughly one quarter of the total number of accidents to public transport turbojet aircraft The most reliable practicable and cost-effective means of minimizing damage outside the confines of the nacells is to make the aircraft design invulnerable to any debris which may affect the aircraft A failure model was developed for use by aircraft builders in measuring the freedom from catastrophe factor of their desgin Author

N78-10071*# Boeing Commercial Airplane Co Seattle Wash

ROTOR BURST PROTECTION CRITERIA AND IMPLICATIONS

Ralph B McCormick *In* MIT An Assessment of Technol for Turbojet Engine Rotor Failures Mar 1977 p 37-43 refs

Avail NTIS HC A18/MF A01 CSCL 21E

Current aircraft design practices to minimize the hazard from rotor bursts are described The consequences of non-contained engine failures and the impact of rotor burst protection systems on aircraft design are discussed Author

N78-10072*# British Aircraft Corp (Operating) Ltd Bristol (England) Commercial Airplane Div

ENGINE NON-CONTAINMENT UK RISK ASSESSMENT METHODS

J C Wallin *In* MIT An Assessment of Technol for Turbojet Engine Rotor Failures Mar 1977 p 45-63

Avail NTIS HC A18/MF A01 CSCL 21E

More realistic guideline data must be developed for use in aircraft design in order to comply with recent changes in British civil airworthiness requirements Unrealistically pessimistic results were obtained when the methodology developed during the Concorde SST certification program was extended to assess catastrophic risks resulting from uncontained engine rotors Author

N78-10073*# Rolls-Royce Ltd Derby (England) Aero Div

TYPES OF ROTOR FAILURE AND CHARACTERISTICS OF FRAGMENTS

D McCarthy *In* MIT An Assessment of Technol for Turbojet Engine Rotor Failures Mar 1977 p 65-92

Avail NTIS HC A18/MF A01 CSCL 21E

Noncontained rotor failures in U K engines resulting from low cycle fatigue low cycle fatigue with superimposed high cycle fatigue and overheating and-or overspeeding were analyzed The size shape weight velocity energy and direction of the fragments released from turbines and compressors were studied and are presented in graph Author

N78-10074*# Douglas Aircraft Co Inc Long Beach Calif

BLADE FRAGMENT ENERGY ANALYSIS

M A OConnor Jr *In* MIT An Assessment of Technol for Turbojet Engine Rotor Failures Mar 1977 p 93-95

Avail NTIS HC A18/MF A01 CSCL 21E

Two classes of fan blade fragments were considered in an analysis of blade fragment energy The first of relatively small size (15 pound) and energy tends to rebound from the fan and case when liberated in an FOD encounter These small fragments have relatively low secondary damage potential and are less demanding in terms of protection The larger fan blade fragments are ejected in a more direct release trajectory with higher energy and hence can represent a higher potential hazard Simplified analytical methods were used to describe blade fragment energy transfer kinematics establish fragment energy levels evaluate damage potential and configure protection The approach methodology and application are discussed as a possible building block for other applications Development of effective local protection using Kevlar is also discussed Analysis methods developed and applied to the rebound fragment problem and to the large direct release fragment problem are described Author

N78-10075*# Lockheed-California Co Burbank
DESIGNING THE L-1011 TO MINIMIZE ROTOR FAILURES EFFECTS
J E Wignot *In* MIT An Assessment of Technol for Turbojet Engine Rotor Failures Mar 1977 p 97-100

HC A18/MF A01 CSCL 21E

Design philosophies used in the L-1011 aircraft to provide protection against rotor fragments include (1) incorporating into the rotor design features that tend to promote small fragments if failure occurs (2) containing the fragments within the engine shell or greatly reducing the energy content of those fragments that are eventually uncontained (3) shielding vulnerable elements or systems with heavy structural members that tend to stop or deflect high velocity fragments and (4) incorporating redundant and/or backup systems into the basic design and separating these systems so as to minimize the probability that more than one system will be damaged by an uncontained rotor fragment Some of the design features that were incorporated into the Rolls-Royce RB211 engine are discussed and two in-service experiences are considered in order to illustrate the practical operation of these features Author

N78-10076*# Douglas Aircraft Co Inc Long Beach Calif
APPROACHES TO ROTOR FRAGMENT PROTECTION
M A OConnor Jr *In* MIT An Assessment of Technol for Turbojet Engine Rotor Failures Mar 1977 p 101-103

Avail NTIS HC A18/MF A01 CSCL 21E

Key airworthiness design criteria considerations for fragment protection as found in various FAA requirements in FAR Parts 25 and 33 and in interpretive 8110 orders are reviewed The impact of providing aircraft armor in lieu of engine armor for typical three- and four-engine wide bodied transports for protection within the length of the engine case as well as from fragments exiting ahead of the enlet engine inlet flange is assessed For protection *within the length of the engine case armor weight penalties* plus fuel burned and dollar cost of carrying the armor protection are defined Immediately ahead of the inlet flange direct tangential impacts are predominant but further forward rebound impacts predominate Armor thickness requirements and fuel cost impact of protection are given Author

N78-10077*# Naval Air Propulsion Test Center Trenton N J
ROTOR BURST PROTECTION PROGRAM EXPERIMENTATION TO PROVIDE GUIDELINES FOR THE DESIGN OF TURBINE ROTOR BURST FRAGMENT CONTAINMENT RINGS
G J Mangano J T Salvino and R A Delucia *In* MIT An Assessment of Technol for Turbojet Engine Rotor Failures Mar 1977 p 107-149
(NASA Order C-41581-B)
Avail NTIS HC A18/MF A01 CSCL 21E

Empirical guidelines for the design of minimum weight turbine rotor disk fragment containment rings made from a monolithic metal were generated by experimentally establishing the relationship between a variable that provides a measure of containment ring capability and several other variables that both characterized the configurational aspects of the rotor fragments and containment ring and had been found from exploratory testing to have had significant influence on the containment process Test methodology and data analysis techniques are described Results are presented in graphs and tables Author

N78-10078*# Massachusetts Inst of Tech Cambridge
***ANALYSIS OF SIMPLE 2-D AND 3-D METAL STRUCTURES* SUBJECTED TO FRAGMENT IMPACT**
E A Witmer T R Stagliano R L Spilker and J J A Rodal *In its* Assessment of Technol for Turbojet Engine Rotor Failures Mar 1977 p 151-215 refs

(Grant NGR-22-009-339)
Avail NTIS HC A18/MF A01 CSCL 21E

Theoretical methods were developed for predicting the large-deflection elastic-plastic transient structural responses of metal containment or deflector (C/D) structures to cope with rotor burst fragment impact attack For two-dimensional C/D structures both finite element and finite difference analysis methods were employed to analyze structural response produced by either prescribed transient loads or fragment impact For the latter category two time-wise step-by-step analysis procedures were devised to predict the structural responses resulting from a succession of fragment impacts the collision force method (CFM) which utilizes an approximate prediction of the force applied to the attacked structure during fragment impact and the collision imparted velocity method (CIVM) in which the impact-induced velocity increment acquired by a region of the impacted structure near the impact point is computed The merits and limitations of these approaches are discussed For the analysis of 3-d responses of C/D structures only the CIVM approach was investigated Author

N78-10079*# Boeing Co Seattle Wash
DEVELOPMENT OF FIBER SHIELDS FOR ENGINE CONTAINMENT
R J Bristow and C D Davidson *In* MIT An Assessment of Technol for Turbojet Engine Rotor Failures Mar 1977 p 217-234

Avail NTIS HC A18/MF A01 CSCL 21E

Tests were conducted in translational launchers and spin pits to generate empirical data used in the design of a Kevlar shield for containing engine burst debris Methods are given for modeling the relationship of fragment characteristics to shielding requirements The change in relative importance of shield mounting provisions as fragment energy is increased is discussed Author

N78-10080*# Pratt and Whitney Aircraft Group East Hartford, Conn
LIGHTWEIGHT ENGINE CONTAINMENT
A T Weaver *In* MIT An Assessment of Technol for Turbojet Engine Rotor Failures Mar 1977 p 235-245

Avail NTIS HC A18/MF A01 CSCL 21E

Kevlar fabric styles and weaves were studied as well as methods of application for advanced gas turbine engines The Kevlar material was subjected to high speed impacts by simple projectiles fired from a rifle as well as more complex shapes such as fan blades released from gas turbine rotors in a spin pit Just contained data was developed for a variety of weave and/or application techniques and a comparative containment weight efficiency was established for Kevlar containment applications The data generated during these tests is being incorporated into an analytical design system so that blade containment trade-off studies between Kevlar and metal case engine structures can be made Laboratory tests and engine environment tests were performed to determine the survivability of Kevlar in a gas turbine environment Author

N78-10083*# Norton Co Worcester Mass Industrial Ceramics Div
CERAMIC COMPOSITE PROTECTION FOR TURBINE DISC BURSTS
P B Gardner *In* MIT An Assessment of Technol for Turbojet Engine Rotor Failures Mar 1977 p 277-293 refs

Avail NTIS HC A18/MF A01 CSCL 21E

Ceramic composite turbine disc protection panels for the A300B were developed using armor technology Analytical predictions for modifying the ballistic projectile armor system *were verified by a test program conducted to qualify the rotor* containment system With only a slight change in the areal density of the armor system a more than two-fold increase in kinetic energy protection level was achieved Thickness of the fiberglass reinforced plastic backing material was increased to achieve an optimum ratio of ceramic thickness to backing thickness for the different ballistic defeat condition Author

N78-10084*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio

CONCEPTS FOR THE DEVELOPMENT OF LIGHT-WEIGHT COMPOSITE STRUCTURES FOR ROTOR BURST CONTAINMENT
Arthur G Holms *In* MIT An Assessment of Technol for Turbojet Engine Rotor Failures Mar 1977 p 295-330 refs

Avail NTIS HC A18/MF A01 CSCL 21E

Published results on rotor burst containment with single materials and on body armor using composite materials were used to establish a set of hypotheses about what variables might control the design of a weight-efficient protective device Based on modern concepts for the design and analysis of small optimum seeking experiments a particular experiment for evaluating the hypotheses and materials was designed The design and methods for the analysis of results are described The consequence of such hypotheses is that the device should consist of as many as four concentric rings each to consist of a material uniquely chosen for its position in the penetration sequence Author

N78-10085*# Pratt and Whitney Aircraft Group East Hartford Conn Commercial Products Div
DESIGN OF ROTORS FOR IMPROVED STRUCTURAL LIFE
J T Hill *In* MIT An Assessment of Technol for Turbojet Engine Rotor Failures Mar 1977 p 331-346

Avail NTIS HC A18/MF A01 CSCL 21E

Major rotor design criteria are discussed with particular emphasis on those aspects of rotor design that ensure long life component integrity Dynamic considerations that necessitate tuning of bladed disk and seal assemblies to avoid excessive vibratory stress at both design and off-design conditions are reviewed as well as low cycle fatigue considerations which have resulted in detailed analysis procedures to establish part temperature and stress variation throughout an operating cycle and extensive specimen and component fatigue testing to establish safe cyclic operating limits The frequency size, and behavior of intrinsic material defects were investigated Manufacturing process improvements including the application of increasingly sophisticated inspection techniques and quality control procedures are reviewed in light of their impact on component durability Author

N78-10086*# General Electric Co Cincinnati Ohio Aircraft Engine Group
MATERIALS AND MANUFACTURING PROCESSES FOR INCREASED LIFE/RELIABILITY
R E Duttweiler *In* MIT An Assessment of Technol for Turbojet Engine Rotor Failures Mar 1977 p 347-368

Avail NTIS HC A18/MF A01 CSCL 21E

Improvements in both quality and durability of disk raw material for both military and commercial engines necessitated an entirely new concept in raw material process control which imposes careful selection screening and sampling of the basic alloy ingredients followed by careful monitoring of the melting parameters in all phases of the vacuum melting sequence Special care is taken to preclude solidification conditions that produce adverse levels of segregation Melt furnaces are routinely cleaned and inspected for contamination Ingots are also cleaned and inspected before entering the final melt step Author

N78-10087*# Pratt and Whitney Aircraft Group, Middletown, Conn Commercial Products Div
NDE A KEY TO ENGINE ROTOR LIFE PREDICTION
J E Doherty *In* MIT An Assessment of Technol for Turbojet Engine Rotor Failures Mar 1977 p 369-382

Avail NTIS HC A18/MF A01 CSCL 21E

A key ingredient in the establishment of safe life times for critical components is the means of reliably detecting flaws which may potentially exist Currently used nondestructive evaluation procedures are successful in detecting life limiting defects, however the development of automated and computer aided NDE technology permits even greater assurance of flight safety Author

N78-10088*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
APPLICATION OF A FLIGHT-LINE DISK CRACK DETECTOR TO A SMALL ENGINE
John R Barranger *In* MIT An Assessment of Technol for Turbojet Engine Rotor Failures Mar 1977 383-388

Avail NTIS HC A18/MF A01 CSCL 21E

A disk crack detector was developed and applied to a small military engine for use as a flight-line turbine crack monitor The system consists of an eddy current type sensor and its cables within the engine external connecting cables and a remotely located electrical capacitance-conductance bridge and signal analyzer As the turbine spins the rotor is monitored by the sensor for radial surface cracks emanating from the interblade region of the rotor Author

N78-10089*# National Aeronautics and Space Administration Lewis Research Center Cleveland, Ohio
TURBINE DISKS FOR IMPROVED RELIABILITY
Albert Kaufman *In* MIT An Assessment of Technol for Turbojet Engine Rotor Failures Mar 1977 p 389-411

Avail NTIS HC A18/MF A01 CSCL 21E

Advanced disk structural concepts were employed to improve the cyclic lives and reliability of turbine disks Analytical studies were conducted to evaluate bore-entry disks as potential replacements for the existing first-stage turbine disks in the CF6-50 and JT8D-17 engines Results of low cycle fatigue burst fracture mechanics, and fragment energy analyses are summarized for the advanced disk designs and the existing disk designs with both conventional and advanced disk materials Other disk concepts such as composite laminated link multibore multidisk and spline disks were also evaluated for the CF6-50 engine Author

N78-10090*# Trans World Airlines Inc Kansas City Mo
SOME AIRLINE EXPERIENCE IN PREVENTING ENGINE ROTOR FAILURES
John J Morelli *In* MIT An Assessment of Technol for Turbojet Engine Rotor Failures Mar 1977 p 413-418

Avail NTIS HC A18/MF A01 CSCL 21E

Methods used by airlines with the assistance of the engine manufacturers to achieve control over the type of problems which lead to uncontained failure and avoid many potential problems are discussed Author

N78-10091*# Lockheed-Georgia Co Marietta
NOISE CHARACTERISTICS OF UPPER SURFACE BLOWN CONFIGURATIONS EXPERIMENTAL PROGRAM AND RESULTS Final Report
W H Brown N Searle D F Blakney, A P Pennock and J S Gibson Oct 1977 532 p refs
(Contract NAS1-13870)
(NASA-CR-145143 LG77ER0198) Avail NTIS HC A23/MF A01 CSCL 20A

An experimental data base was developed from the model upper surface blowing (USB) propulsive lift system hardware While the emphasis was on far field noise data a considerable amount of relevant flow field data were also obtained The data were derived from experiments in four different facilities resulting in (1) small scale static flow field data (2) small scale static noise data (3) small scale simulated forward speed noise and load data and (4) limited larger-scale static noise flow field and load data All of the small scale tests used the same USB flap parts Operational and geometrical variables covered in the test program included jet velocity nozzle shape nozzle area nozzle impingement angle nozzle vertical and horizontal location flap length flap deflection angle, and flap radius of curvature Author

N78-10092*# TRW Inc , Cleveland Ohio
COST ANALYSIS OF ADVANCED TURBINE BLADE MANUFACTURING PROCESSES Final Report, Oct 1976 - April 1977

C F Barth D E Blake and T S Stelson Oct 1977 89 p refs
(NAS3-20378)
(NASA-CR-135203, TRW-1ER-7930) Avail NTIS HC A05/MF A01 CSCL 21E

A rigorous analysis was conducted to estimate relative manufacturing costs for high technology gas turbine blades prepared by three candidate materials process systems The manufacturing costs for the same turbine blade configuration of directionally solidified eutectic alloy an oxide dispersion strengthened superalloy and a fiber reinforced superalloy were compared on a relative basis to the costs of the same blade currently in production utilizing the directional solidification process An analytical process cost model was developed to quantitatively perform the cost comparisons The impact of individual process yield factors on costs was also assessed as well as effects of process parameters raw materials labor rates and consumable items Author

N78-10093*# Douglas Aircraft Co, Inc Long Beach Calif
EFFECT OF FORWARD MOTION ON ENGINE NOISE
G L Blankenship J K C Low J A Watkins and J E Merriman Oct 1977 198 p refs
(Contract NAS3-20031)
(NASA-CR-134954, MDC-J7708) Avail NTIS HC A09/MF A01 CSCL 20A

Methods used to determine a procedure for correcting static engine data for the effects of forward motion are described Data were analyzed from airplane flyover and static-engine tests with a JT8D-109 low-bypass-ratio turbofan engine installed on a DC-9-30 with a CF6-6D high-bypass-ratio turbofan engine installed on a DC-10-10 and with a JT9D-59A high-bypass-ratio turbofan engine installed on a DC-10-40 The observed differences between the static and the flyover data bases are discussed in terms of noise generation convective amplification atmospheric propagation and engine installation The results indicate that each noise source must be adjusted separately for forward-motion and installation effects and then projected to flight conditions as a function of source-path angle directivity angle, and acoustic range relative to the microphones on the ground Author

N78-10094*# Systems Control Inc Palo Alto, Calif
IDENTIFICATION OF SPEY ENGINE DYNAMICS IN THE AUGMENTOR WING JET STOL RESEARCH AIRCRAFT FROM FLIGHT DATA
Ronald L DeHoff W Brady Reed, and Thomas L Trankle Oct 1977 155 p
(NASA Order A-36074-B)
(NASA-CR-152054) Avail NTIS HC A08/MF A01 CSCL 21E

The development and validation of a spey engine model is described An analysis of the dynamical interactions involved in the propulsion unit is presented The model was reduced to contain only significant effects, and was used in conjunction with flight data obtained from an augmentor wing jet STOL research aircraft to develop initial estimates of parameters in the system The theoretical background employed in estimating the parameters is outlined The software package developed for processing the flight data is described Results are summarized Author

N78-10095# Tennessee Univ Tullahoma Space Inst
INVESTIGATION OF FEASIBLE NOZZLE CONFIGURATIONS FOR NOISE REDUCTION IN TURBOFAN AND TURBOJET AIRCRAFT VOLUME 3 SHROUDED SLOT NOZZLES Final Report, Aug 1975 - Mar 1977
B H Goethert J R Maus W A Dunnill, M C Joshi, and V Veerasamy Mar 1977 126 p refs
(Contract DOT-FA72WA-3053)
(AD-A041782/4 FAA-RD-75-162-Vol-3) Avail NTIS HC A07/MF A01 CSCL 21/5

The acoustic and fluid dynamic characteristics of a slot nozzle were studied The nozzle had an aspect ratio of 27 with an ejector shroud having a cross sectional area of 4 times the primary nozzle area Shroud length shroud divergence ratio, and acoustical impedance of the shroud wall were varied Tests were conducted for primary flow Mach numbers from 0 5 to choking and stagnation temperatures from ambient to 1200 R It is shown that both the thrust and the noise attenuation characteristics of the ejector shroud improve with increasing length Thrust increases of near 40% were obtained for the longest shroud tested A noise reduction of 13 db was obtained for the lined shroud with a near choked, high temperature primary jet The corresponding thrust augmentation was approximately 20% Author

N78-10096*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
INDEPENDENT POWER GENERATOR Patent Application
Richard N Young inventor (to NASA) Filed 30 Jul 1976 16 p
(NASA-Case-LAR-11208-1 US-Patent-Appl-SN-710036) Avail NTIS HC A02/MF A01 CSCL 21E

A gas turbine powered aircraft auxiliary power system is described The system is capable of efficiently supplying all aircraft auxiliary services both in flight and on the ground It is capable also of operating independently of the aircraft main engines The system employs multiple gas turbine compressor stages and utilizes the aircraft cabin as a plenum chamber between the first and second compressor stages thereby accomplishing cabin pressurization ventilation and heating NASA

N78-10097*# National Aeronautics and Space Administration Lewis Research Center, Cleveland Ohio
EVALUATION OF AN F100 MULTIVARIABLE CONTROL USING A REAL-TIME ENGINE SIMULATION
John R Szuch Charles Skira (AFSC) and James F Soeder 1977 17 p refs Presented at 13th Propulsion Conf Orlando Fla 11-13 Jul 1977 sponsored by AIAA and Soc of Automotive Engr
(NASA-TM-X-73648 E-9155) Avail NTIS HC A02/MF A01 CSCL 21E

A multivariable control design for the F100 turbofan engine was evaluated, as part of the F100 multivariable control synthesis (MVCS) program The evaluation utilized a real-time hybrid computer simulation of the engine and a digital computer implementation of the control Significant results of the evaluation are presented and recommendations concerning future engine testing of the control are made Author

N78-10098*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
THE PROMISE OF EUTECTICS FOR AIRCRAFT TURBINES
Hugh R Gray 1977 21 p refs Presented at Mater Show and Conf Chicago, 25-27 Oct 1977 sponsored by ASM
(NASA-TM-73714 E-9258) Avail NTIS HC A02/MF A01 CSCL 21E

The current status of the first generation eutectics gamma/gamma transition - delta and NiTaC-13, is described in detail Several second generation systems such as gamma/gamma transition - alpha and NiTaC 3-116A gamma - beta and COTAC 74 are also reviewed with particular emphasis on their critical physical and mechanical properties future research directions and potential applications Results of recent cost-benefit analyses of eutectic turbine blades are discussed Author

N78-10100# General Electric Co Cincinnati Ohio Aircraft Engine Group
HIGH VELOCITY JET NOISE SOURCE LOCATION AND REDUCTION TASK 1 ACTIVATION OF FACILITIES AND VALIDATION OF SOURCE LOCATION TECHNIQUES Final Report, Aug 1973 - Mar 1976
C T Savell and E J Stringas 22 Feb 1977 601 p refs
(Contract DOT-OS-30034)
(AD-A041848, R77AEG187 FAA-RD-76-79-1) Avail NTIS HC A99/MF A01 CSCL 14/2

This report summarizes the results of Task 1 as conducted under the subject program The intent of this 29-month effort was to check out candidate test facilities and noise source location techniques to ensure that the best possible jet noise data over

the full range of conditions (velocities ranging from 600 fps to 3000 fps with the best instrumentations are obtained The facilities activated and validated included two anechoic facilities the University of Southern California in Los Angeles California and the University of British Columbia in Vancouver Canada two outdoor scale-model jet noise facilities the General Electric Jet Exhaust Noise Outdoor Test Stand in Evendale, Ohio and the General Electric Corporate Research and Development Center Hot Jet Noise Facility at Schenectady, New York one large-scale engine outdoor test stand, a super suppressed J79 engine at the General Electric Facility at Edwards Air Force Flight Test Center California one aerodynamic performance facility, the FluiDyne Engineering Corporation Aerodynamic Laboratory at Medicine Lake Minnesota, and the GE Anechoic Jet Noise Test Facility Numerous noise source location techniques were subjected to a preliminary screening study from which three techniques the in-jet to far-field correlation approach the hole-in-the-wall, and ellipsoidal mirror were selected and carried through an experimental demonstration stage Based on the results from this phase of the activity the ellipsoidal mirror microphone technique was recommended for use in subsequent program tasks GRA

N78-10101# Bendix Corp, South Bend Ind
AN EVALUATION OF THERMOELECTRIC COOLING AS APPLIED TO ENGINE CONTROL ELECTRONICS
C S Longstreet W Lorenz W J McPhee, and D C Thoman May 1977 116 p refs
(Contract F33615-74 C-2068)
(AD-A042378, AFAPL-TR-77-24) Avail NTIS HC A06/MF A01 CSCL 21/5

Electronic elements of the engine control systems of future military aircraft will require protection against the high ambient temperatures expected at their mounting locations on the engines The thermally conditioned module built and tested in this program was designed to provide this protection with substantial margins ambient temperatures to 750 F and fuel (coolant) temperatures to 300 F were employed The unit employs thermal shields to minimize heat conducted to the electronics The electronics themselves were cooled by a thermoelectric cooler High efficiency heat exchangers were designed for this unit The unit weighed 1 45 lbs Under worst case operating conditions, it pumped approximately 1300 BTU/hour to the fuel Author (GRA)

N78-10102# Mechanical Technology Inc Latham, N Y
ADVANCED COMPRESSOR SEAL TESTS Final Technical Report, Apr 1975 - Dec 1976
M Eusepi and L W Winn Apr 1977 73 p
(Contract F33615-75-C-2062)
(AD-A042390 AFAPL-TR-77-22) Avail NTIS HC A04/MF A01 CSCL 21/5

The continuation of the development of a new resilient seal concept entitled the J'-Seal is described The concept uses a pressure loaded membrane and hydrostatic bearing principles to maintain a minimum stator to rotor clearance Following the development of a complex seal analyses performed in an earlier phase of this program the seal was built and tested Seal distortions due to inadequate manufacturing techniques have been substantially reduced through the use of brazing with a high temperature gold alloy instead of welding The test results presented in this report support the analytically predicted trends Author (GRA)

N78-10104# Vought Corp Advanced Technology Center Inc Dallas Tex
V-STOL EJECTOR SHORT DIFFUSER STUDY Final Report, Mar 1975 - Jun 1976
R M ODonnell and R A Squyers 16 Jun 1976 90 p refs
(Contract N62269-75-C-0317)
(AD-A042319 ATC-B-94300/6CR-26 NADC-77165-30) Avail NTIS HC A05/MF A01 CSCL 01/3

Development of thrust augmenting ejectors has produced ejector/diffuser configurations capable of achieving the high levels of thrust augmentation necessary for V/TOL aircraft propulsion requirements Experimental testing has shown that thrust augmenting ejectors can be made more compact by reducing diffuser length with active diffusion boundary layer control employing the Antiseparation Tailored Contour (ATC) Thrust augmentation and internal flow measurements were determined in compact high performance thrust augmentors with various length diffusers The short ATC/diffusers tested showed significant improvements when compared to previous ejector diffusers Measured thrust augmentation ratios with an optimum short ATC/diffuser were 10% greater than those with an equivalent straight wall diffuser Length reductions of 36% were indicated for nominal augmentation ratios of 1 7 The important factors which influence the design and operation of compact thrust augmentor ejector/diffusers have been defined Author (GRA)

N78-10107# ARO Inc Arnold Air Force Station Tenn
AN ANALYSIS OF THE INFLUENCE OF SOME EXTERNAL DISTURBANCES ON THE AERODYNAMIC STABILITY OF TURBINE ENGINE AXIAL FLOW FANS AND COMPRESSORS Final Report, Jun 1973 - Jun 1977
William F Kimzey AEDC Aug 1977 282 p refs
(AD-A043543 ARO-ETF-TR-77-47 AEDC-TR-77-80) Avail NTIS HC A13/MF A01 CSCL 21/5

The overall objective of the work described herein was to develop an improved method for the computation of the influence of external disturbances on turbine engine compressor stability and in so doing to gain added physical insight into the destabilizing processes The objectives were accomplished through the development of a one-dimensional, time-dependent mathematical compressor model for analysis of planar disturbances and an extension of the model to a three-dimensional form for analysis of distorted inflows The models satisfy mass momentum and energy equations on a time-dependent basis Compressor stage force and shaft work were determined from empirical stage characteristics with corrections made for unsteady cascade airfoil aerodynamics The system of equations comprising the model is solved using a digital computer Example problems with comparisons to experiments are presented for three different compressors Example problems solved using the one-dimensional analysis include determination of the steady-state stability limit (surge line) with undisturbed flow instability caused by oscillating planar inflow dynamic response of a compressor to oscillating entry pressure dynamic response to oscillating discharge pressure and compressor instability caused by rapid upward ramps of entry temperature Example problems solved using the distortion model include stability limit (surge) line reduction caused by a combined radial and circumferential pressure distortion time-variant distortion effects, pure radial pressure distortion effects, and pure pressure and temperature circumferential distortion effects GRA

N78-10108# McDonnell Aircraft Co St Louis, Mo
TURBINE ENGINE VARIABLE CYCLE SELECTION PROGRAM SUMMARY Final Report, Jul. 1973 - Jan 1977
F C Glaser and W B Weber Apr 1977 57 p refs
(Contract F33615-73-C-2070 AFAPL-TR-77-17)
(AD-A043408) Avail NTIS HC A04/MF A01 CSCL 21/5

A systematic engine/airframe evaluation procedure was developed and used to assess interactions for fixed and variable geometry engine concepts in tactical aircraft The evaluation procedure provides a rapid and inexpensive technique for evaluations of advanced engine concepts for extensive matrices of potential aircraft maneuverability and multi-mission requirements Author (GRA)

N78-10109# General Electric Co Lynn Mass Aircraft Engine Group
DEVELOPMENT OF HOT ISOSTATICALLY PRESSED RENE 95 TURBINE PARTS Final Report, Jul 1973 - Jul 1976
P S Mathur and J L Bartos May 1977 313 p
(Contract DAAJ02-73-C-0106)
(AD-A043688, USAAMRDL-TR-76-30) Avail NTIS HC A14/MF A01 CSCL 21/5

To arrest the increasing cost of materials and fabrication techniques for high-strength gas turbine components, a contract was awarded to the General Electric Company to develop a reliable low-cost reproducible powder metallurgy production

process for manufacturing premium quality HIP Rene 95 T700 gas generator turbine disks and cooling plates The work to accomplish this objective was subdivided into four tasks GRA

N78-10110# *General Electric Co , Cincinnati Ohio Aircraft* Engine Group
COMPRESSOR BLADE MANUFACTURE BY ELECTRO-CHEMICAL MACHINING ADVANCED TURBINE ENGINE GAS GENERATOR Final Technical Report, Dec 1973 - Mar 1977
W I Westphal and A Lingen Wright-Patterson AFB Ohio AFAPL Aug 1977 62 p
(Contract F33657-72-C-0206)
(AD-A043742, AFAPL-TR-77-33) Avail NTIS HC A04/MF A01 CSCL 21/5

Compressor blades for the ATEGG GE14 engine were manufactured using electrochemical machining to form the airfoils Elaborate dimensional inspections were performed on the as-machined surfaces The blades were tested for frequency nodal patterns, and fatigue strength and were compared to control blades made by conventional methods Author (GRA)

N78-10111 Georgia Inst of Tech , Atlanta
AN ANALYSIS OF THE FLUTTER AND DAMPING CHARACTERISTICS OF HELICOPTER ROTORS Ph D Thesis
Sathy Padmanaban Viswanathan 1977 161 p
Avail Univ Microfilms Order No 77-15044

Two relatively new methods of vibrational analysis of nonuniform rotor blades in combined flapwise bending and torsion are reviewed The structural dynamic characteristics of an example blade are evaluated using the transmission matrix method and are later used in flutter analyses An automated procedure is developed to obtain the matched flutter point of a rotor in an axial flight condition The determinant method of flutter prediction turns out to be impracticable The principles of the p-k method are explained and it is shown that this method is well suited to analyze the damping and flutter characteristics of rotor blades An unsteady rotor aerodynamic theory of the p type is derived and the results from this analysis tend to show that the implied assumption of the p-k method is sound Dissert Abstr

N78-10113# Air Force Flight Test Center Edwards AFB, Calif
STABILITY AND CONTROL FLIGHT TEST TECHNIQUES, VOLUME 2 Final Report
Feb 1977 128 p
(AD-A042593 AFFTC-TIH-77-1-Vol-2) Avail NTIS HC A07/MF A01 CSCL 01/3

Qualitative flight test techniques and data reduction methods used in pilot training courses at Edwards Air Force Base are presented in this handbook Topics include attitude flying stalls post-stall/spin maneuverability engine-out operations, longitudinal static stability lateral direction timing trim changes, and dynamic stability A R H

N78-10114# Analytic Sciences Corp Reading Mass
MODERN METHODS OF AIRCRAFT STABILITY AND CONTROL ANALYSIS Annual Technical Report, 1 Feb 1976 - 31 Jan 1977
Robert F Stengel John R Broussard Paul W Berry and James H Taylor 25 May 1977 250 p refs
(Contract N00014-75-C-0432 RR0141184)
(AD-A043399 TASC-TR-612-2 ONR-CR-215-237-2) Avail NTIS HC A11/MF A01 CSCL 01/2

This report presents new methodologies and results in the study of aircraft stability and control including detailed consideration of piloting effects on the aircraft s motion The potential for departure (i e loss of control) in transonic and supersonic flight is addressed using linear time-invariant dynamic models which incorporate longitudinal-lateral-directional coupling A method for designing departure-prevention command augmentation systems (DPCAS) is developed and is applied to the subsonic model of the F-14A aircraft This design technique can provide excellent flying qualities for the aircraft throughout its flight envelope A multivariable limit cycle analysis technique (MULCAT] is used to predict possible self-induced nonlinear oscillations and the results of this prediction are evaluated using a direct simulation of the nonlinear dynamic model GRA

N78-10115*# General Electric Co , Schenectady N Y Applied Mechanics Branch
AERO-ACOUSTIC EXPERIMENTAL VERIFICATION OF OPTIMUM CONFIGURATION OF VARIABLE-PITCH FANS FOR 40 X 80 FOOT SUBSONIC WIND TUNNEL Final Report
Harold Lown Aug 1977 65 p refs
(Contract NAS2-8364)
(NASA-CR-152040 SRD-77-133) Avail NTIS HC A04/MF A01 CSCL 14B

The aerodynamic and acoustic performance of two drive fan configurations (low-speed and high-speed variable pitch design) for a 40 x 80 foot wind tunnel were monitored A 1/7-scale model was utilized The necessary aero-acoustic data reduction computer program logic was supplied Test results were evaluated and the optimum configuration to be employed in the 40 foot full scale fan was recommended Author

N78-10116*# Bolt Beranek and Newman, Inc Cambridge Mass
ACOUSTICAL PROPERTIES OF MATERIALS AND MUFFLER CONFIGURATIONS FOR THE 80- BY 120 FOOT WIND TUNNEL
Terry D Scharton and Matthew D Sneddon 25 Aug 1977 70 p refs
(Contract NAS2-9549)
(NASA-CR-152065 Rept-3563) Avail NTIS HC A04/MF A01 CSCL 14B

Techniques for measuring the impedance of the muffler configurations and of porous plates with grazing flow were investigated and changes in the configuration parameters to enhance acoustic performance are explored The feasibility of a pulse reflection technique for measuring the impedance of built-up structures in situ was demonstrated A second technique involving the use of an open-end impedance tube with grazing flow was used to obtain detailed design data for the perforated plate configuration Acoustic benefits associated with configuration changes such as curving the baffles spacing and staggering baffle partitions, and techniques for alleviating baffle self-generated noise are described Author

N78-10117*# Systems Technology Inc , Mountain View, Calif
THE DETERMINATION OF SOME REQUIREMENTS FOR A HELICOPTER FLIGHT RESEARCH SIMULATION FACILITY
J B Sinacori Sep 1977 59 p refs
(Contract NAS2-9421)
(NASA-CR-152066 TR-1097-1) Avail NTIS HC A04/MF A01 CSCL 14B

Important requirements were defined for a flight simulation facility to support Army helicopter development In particular requirements associated with the visual and motion subsystems of the planned simulator were studied The method used in the motion requirements study is presented together with the underlying assumptions and a description of the supporting data Results are given in a form suitable for use in a preliminary design Visual requirements associated with a television camera/model concept are related The important parameters are described together with substantiating data and assumptions Research recommendations are given Author

N78-10118# Air Force Flight Dynamics Lab Wright-Patterson AFB, Ohio
COLLECTION OF COMMERCIAL AIRCRAFT CHARACTERISTICS FOR STUDY OF RUNWAY ROUGHNESS Final Report
Anthony G Gerardi May 1977 137 p refs
(Contract DOT-FA73WAI-361)
(AD-A042623/9 AFCEC-TR-75-23 FAA-RD-76-64) Avail NTIS HC A07/MF A01 CSCL 01/5

Engineering data compatible with the computer program TAXI were collected for six commercial jet aircraft These were the Boeing 707-320C 727-200, and 747 and the McDonnell Douglas

DC-8-63 DC-9-40 and the DC-10-10 The data were presented in the form required by TAXI A simulation was made for each aircraft taking off from two separate airfields The purpose of using two profiles was to point out the differences in aircraft response to different runway profiles The calcomp plotted results are presented A program users manual is also presented A sample problem simulating a Boeing 707-320C during a constant speed taxi over a runway profile is included All of the FORTRAN symbols used in TAXI are defined, and a complete listing of the program is contained in appendices A B C and D Appendix E contains airplane data representing a typical wide body tri-jet transport and two simulations using this data Author

N78-10119# General Electric Co Cincinnati Ohio Aircraft Engine Group

HIGH VELOCITY JET NOISE SOURCE LOCATION AND REDUCTION TASK 1 SUPPLEMENT CERTIFICATION OF THE GENERAL ELECTRIC JET NOISE ANECHOIC TEST FACILITY Final Report, Oct 1975 - Mar 1976

C T Savell 22 Feb 1977 238 p refs
(Contract DOT-OS-30034)
(AD-A042327/7 R77AEG188-Suppl
FAA-RD-76-79-1-A-Suppl-1) Avail NTIS HC A11/MF A01 CSCL 14/2

The operating limits of the facility are presented The precision and accuracy of acoustic measurements were evaluated in terms of (1) anechoic and far-field environment (2) ambient levels in the chamber (3) contamination from piping and combustors (4) contamination from electronic noise floor (5) variation of the frequency response of the data acquisition and reduction systems (6) inaccuracies in aerodynamic instrumentation or fluctuations in the jet aeroconditions and (7) precision errors in the air attenuation model due to environmental fluctuations gradients and measurement inaccuracies The accuracy of the aerodynamic and acoustic instrumentation is excellent The jet noise measurements were taken from circular conical nozzles and were compared with classical referee data Author

N78-10120# Transportation Research Board Washington D C

RESEARCH IN AIRPORT PAVEMENTS Special Report No 175

May 1977 13 p Conf held at Atlanta 15-17 Nov 1976 Sponsored by FAA
(AD-A043179 FAA-RD-77-101) Avail NTIS HC A02/MF A01 CSCL 01/5

A conference on research in airport pavements was held to present the findings from recent research activities by FAA to invite comments on the conclusions from these findings, and to address areas of future research needs Research results that can now be implemented are in the following areas (1) the pavement-aircraft compatibility study provides a basis for tradeoffs between aircraft and pavement design (2) aircraft distribution on airport pavements can be reasonably defined for design and rehabilitation purposes (3) mix design and construction procedures for fibrous concrete are adequate to permit its use where appropriate (4) mix design and construction procedures are adequate for porous friction courses and performance data demonstrate their suitability for in-service use, (5) suitable equipment and procedures are available for measuring pavement unevenness and (6) statistical quality control and quality assurance procedures are well defined for use in pavement construction and rehabilitation Author

N78-10124# Westinghouse Defense and Electronic Systems Center Baltimore Md

F-4E FIRE CONTROL SYSTEM SIMULATOR, F-4E AUSTERE/HEADS UP DISPLAY (HUD), SEAFAC PROGRAMS Final Report, 1 Apr 1974 - 31 Dec 1975

Walter Patterson Wright-Patterson AFB Ohio AFAL May 1977 424 p
(Contract F33615-74-C-1173)
(AD-A042255, AFAL-TR-76-190) Avail NTIS HC A18/MF A01 CSCL 19/5,

This Final Phase A report covers two major task areas of this contract One is the establishment and support of the Air Force-ASD/ENA Seafac Facilities in Building 485 at Wright-Patterson Air Force Base The second task is the establishment and support of an F4E (aircraft 304) flight test program at the Air Force Flight Test Center for evaluating an Austere HUD in mission modes off air-to-air missile air-to-ground weapons and and air-to-air gunnery mechanizations GRA

N78-10126# Naval Training Equipment Center Orlando Fla Computer Lab

COMPUTER SYSTEM REQUIREMENTS ANALYSIS DEVICE 2F112, F-14 WEAPON SYSTEM TRAINER Final Research Report, Jun 1975 - Aug 1976

Charles F Summer Jr Gerald A Wyndle and David E Daniel Apr 1977 118 p refs
(AD-A043578 NAVTRAEQUIPC-IH-262) Avail NTIS HC A06/MF A01 CSCL 09/2

This report documents the procedures and methodology used in determining the computer speed and storage requirements for Device 2F112 WST F-14A aircraft with a wide angle visual system Three candidate computer systems are chosen for detailed analysis to determine the processing requirements These requirements are best met using a multiple SEL 32/55 computer configuration The information and data derived serve three basic needs (a) Identification of total computer system requirements of a typical modern real-time simulator/training device (b) Base-line requirements guidance for future trainer computer system architectural concepts being investigated in an in-house research task involving application of microprogramming techniques microcomputer technology and high level languages and (c) Delineation of the fundamental analysis procedural steps necessary to adequately evaluate and define computer system requirements for trainers Author (GRA)

N78-10224* National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio

FUEL COMBUSTOR Patent

Cecil J Marek, inventor (to NASA) Issued 4 Oct 1977 5 p Filed 31 Mar 1976 Supersedes N76-20215 (14 - 11 p 1358)
(NASA-Case-LEW-12137-1 US-Patent-4 052 144
US-Patent-Appl-SN-672210 US-Patent-Class-431-352
US-Patent-Class-431-158 US-Patent-Class-60-39 51R,
US-Patent-165-105) Avail US Patent Office CSCL 21B

A fuel combustor comprises a chamber with air and fuel inlets and a combination gas outlet The fuel is supplied to a vaporization zone and fuel and air are mixed in a pair of mixing chambers each exemplified by a swirl can The resultant mixture is directed into a combustion zone within the combustor Heat pipes are arranged with one end portion substantially in the combustion zone and the other end in the vaporization zone of its appropriate mixing chamber Some of the heat of combustion is thus carried back upstream into the swirl cans to vaporize the fuel as it enters the vaporization zone in the swirl can, thereby improving vaporization and fuel mixing
Official Gazette of the U S Patent Office

N78-10306*# National Aeronautics and Space Administration Langley Research Center Langley Station Va

THE LIQUID HYDROGEN OPTION FOR THE SUBSONIC TRANSPORT A STATUS REPORT

Peter F Korycinski Sep 1977 28 p refs Presented at 12th Intersoc Energy Conversion Eng Conf Washington D C, 28 Aug - 2 Sep 1977
(NASA-TM-74089) Avail NTIS HC A03/MF A01 CSCL 21D

Continued subsonic air transport design studies include the option for a liquid hydrogen fuel system as an aircraft fuel conservation measure Elements of this option discussed include (1) economical production of hydrogen (2) efficient liquefaction of hydrogen (3) materials for long service life LH2 fuel tanks (4) insulation materials (5) LH2 fuel service and installations at major air terminals (6) assessment of LH2 hazards and (7) the engineering definition of an LH2 fuel system for a large subsonic passenger air transport Author

N78-10342# Verve Research Corp, Rockville, Md

STUDY REQUIREMENTS FOR AN INTEGRATED AIR/

GROUND COMMUNICATIONS FACILITY Final Report, Jun 1975 - Aug 1976
J Hansen A Webster and B Reynolds May 1977 333 p refs
(Contract DOT-FA75WAI-570)
(AD-A042514/0, VS-29) Avail NTIS HC A15/MF A01 CSCL 17/2

The structure performance, maintenance and versatility of FAA air/ground communication facilities are evaluated, using a system approach to analyze requirements and costs Guidelines were developed for effectively defining air/ground facilities to support present and future operations of the National Airspace System As a primary example an integrated OAKLAND ARTCC model was designed which consolidates its associated communication facilities and is responsive to its operational and maintenance requirements Author

N78-10343# National Aviation Facilities Experimental Center, Atlantic City, N J
TEST AND EVALUATION OF THE DALLAS/FORT WORTH TERMINAL COMMUNICATIONS SWITCHING SYSTEM Final Report, May - Jun 1975
Richard W Cleary Anthony Spingola Stephen Karovic and P E Hinely Nov 1976 79 p
(FAA Proj 063-221-000)
(AD-A040665/2 FAA-NA-75-61) Avail NTIS HC A05/MF A01 CSCL 17/2

An operational and technical evaluation is reported of the Air Traffic Control (ATC) Terminal Communications Switching System (TCSS) at the Dallas/Fort Worth Tower terminal Radar Approach Control (TRACON) facility The system is innovative in its use of frequency division multiplexing techniques for ATC instead of conventional communication-channel separation methods The following are other TRACON communication innovations communications are carried over a single coaxial cable in the 10-MHz to 15-MHz band, solid state logic circuitry is used for electronic switching of voice and radio-remoting interconnections positional communications reconfiguration is under processor control and all direct access keys and radio-select keys use light-emitting diodes for designators In addition to a technical evaluation of equipment performance, an evaluation of the ATC operational performance of the TCSS was conducted using facility personnel Responses indicated that, with minor exceptions the system satisfies requirements Learning to operate a system position requires a minimal amount of training, and the system has the capabilities of growth and flexibility Author

N78-10468* National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio
IMPACT ABSORBING BLADE MOUNTS FOR VARIABLE PITCH BLADES Patent
Richard Ravenhall (GE Cincinnati) Charles T Salemme (GE Cincinnati), and Arthur P Adamson, Inventors (to NASA) (GE Cincinnati) Issued 13 Sep 1977 6 p Filed 29 May 1975 Sponsored by NASA
(NASA-Case-LEW-12313-1 US-Patent-4 047 840
US-Patent-Appl-SN-581751 US-Patent-Class-416-135
US-Patent-Class-416-141, US-Patent-Class-416-220R
US-Patent-Class-416-248) Avail US Patent Office CSCL 13I

A variable pitch blade and blade mount are reported that are suitable for propellers, fans and the like and which have improved impact resistance Composite fan blades and blade mounting arrangements permit the blades to pivot relative to a turbine hub about an axis generally parallel to the centerline of the engine upon impact of a large foreign object such as a bird Centrifugal force recovery becomes the principal energy absorbing mechanism and a blade having improved impact strength is obtained Official Gazette of the U S Patent Office

N78-10609# Army Aeromedical Research Lab Fort Rucker Ala
SUBJECTIVE RATINGS OF ANNOYANCE PRODUCED BY ROTARY-WING AIRCRAFT NOISE
James H Patterson, Jr Ben T Mozo Robert D Schomer, and Robert T Camp, Jr May 1977 39 p refs
(AD-A043435 USAARL-77-12) Avail NTIS HC A03/MF A01 CSCL 20/1

Subjective ratings of annoyance caused by helicopter noise relative to that caused by fixed-wing aircraft were obtained Comparison of the subjective ratings with various physical predictors of annoyance indicated that the integrated A-weighted level (dBA) predicted as well as any of the predictors with the D2-weighted level and EPNL almost equivalent The B-weighted level and C-weighted level did not predict as well No correction factor for the impulsive character (blade slap) of the helicopter noise was required No substantial penalty for helicopters compared to fixed-wing aircraft noise was required
Author (GRA)

N78-10624# General Accounting Office, Washington D C Community and Economic Developments Div
NOISE POLLUTION FEDERAL PROGRAM TO CONTROL IT HAS BEEN SLOW AND INEFFECTIVE ENVIRONMENTAL PROTECTION AGENCY DEPARTMENT OF TRANSPORTATION
7 Mar 1977 69 p
(PB-268690/5 CED-77-42) Avail NTIS HC A04/MF A01 CSCL 13B

Federal efforts to control and abate noise pollution are reviewed Although some progress has been made in fulfilling the requirements of the Noise Control Act of 1972 implementing many of the provisions has been slow and, in some cases, ineffective Areas needing improvements are identified GRA

N78-10839*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
CONCORDE NOISE-INDUCED BUILDING VIBRATIONS INTERNATIONAL AIRPORT DULLES Final Report
W H Mayes H F Scholl, D G Stephens B G Holliday R DeLoach T D Finley H K Holmes R B Lewis and J W Lynch Sep 1977 19 p
(NASA-TM-74083) Avail NTIS HC A02/MF A01 CSCL 20A

A series of studies were conducted to assess the noise-induced building vibrations associated with Concorde operations The vibration levels of windows walls and floors were measured along with the associated noise levels of Concorde subsonic aircraft and some nonaircraft events Test sites included Sully Plantation which is adjacent to Dulles International Airport and three residential homes located in Montgomery County Maryland The measured vibration response levels due to Concorde operations were found to be (1) higher than the levels due to other aircraft (2) less than the levels due to certain household events which involve direct impulsive loading such as door and window closing, (3) less than criteria levels for building damage and (4) comparable to levels which are perceptible to people
Author

N78-10873# Human Engineering Labs Aberdeen Proving Ground, Md
COMPUTING INTERNAL COCKPIT REFLECTIONS OF EXTERNAL POINT LIGHT SOURCES FOR THE MODEL YAH-64 ADVANCED ATTACK HELICOPTER LOW GLARE CANOPY DESIGN Final Report
Christopher C Smyth Jul 1977 64 p refs
(AD-A043367 HEL-TM-24-77) Avail NTIS HC A04/MF A01 CSCL 20/6

The US Army Human Engineering Laboratoy (HEL) has developed a computer program for computing the internal cockpit reflections on the transparent canopy surfaces of external point light sources Computations have been completed for the Model YAH-64 Advanced Attack Helicopter (low glare canopy design) The results show that primary reflections as seen from the pilot s position are possible on (1) the upper rear corners of the forward side canopy surfaces (2) the upper edges of the rear sides and (3) the sides of the top surface Computations have also been completed for the copilot s position and show possible reflections on the front and side surfaces A computer graphics output is used to show reflection points on canopy layouts and perspectives of the cockpit Author (GRA)

N78-11002*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio

EXPERIMENTAL PERFORMANCE OF A 13 65-CENTIMETER-TIP-DIAMETER TANDEM-BLADED SWEPT-BACK CENTRIFUGAL COMPRESSOR DESIGNED FOR A PRESSURE RATIO OF 6

Hugh A Klassen Jerry R Wood (Army Air Mobility Res and Develop Lab Cleveland) and Lawrence F Schumann (Army Air Mobility Res and Develop Lab Cleveland) Nov 1977 27 p refs

(NASA-TP-1091) Avail NTIS HC A03/MF A01 CSCL 01A

A 13 65 cm tip diameter backswept centrifugal impeller having a tandem inducer and a design mass flow rate of 0 907 kg/sec was experimentally investigated to establish stage and impeller characteristics Tests were conducted with both a cascade diffuser and a vaneless diffuser A pressure ratio of 5 9 was obtained near surge for the smallest clearance tested Flow range at design speed was 6 3 percent for the smallest clearance test Impeller exit to shroud axial clearance at design speed was varied to determine the effect on stage and impeller performance Author

N78-11003*# National Aeronautics and Space Administration Washington D C

EFFECT OF FLAP DEFLECTION ON THE LIFT COEFFICIENT OF WINGS OPERATING IN A BIPLANE CONFIGURATION

J Stasiak Nov 1977 38 p refs Transl into ENGLISH from Wplyw Wychylenia Klapy na Wspolczynniki Sily Noswej Platow Pracujacych w Ukladzie Dwuplata Prace Inst Lotnichtwa no 64 1976 p 5-28 Original language document was announced as A76-41918 Transl by Kanner (Leo) Associates Redwood City Calif

(Contract NASw-2790)

(NASA-TM-75059) Avail NTIS HC A03/MF A01 CSCL 01A

Biplane models with a lift flap were tested in a wind tunnel to study the effect of flap deflection on the aerodynamic coefficient of the biplane as well as of the individual wings Optimization of the position flap was carried out and the effect of changes in the chord length of the lower wing was determined for the aerodynamic structure of a biplane with a lift flap on the upper wing Author

N78-11004*# National Aeronautics and Space Administration Langley Research Center Langley Station Va

F-16 FLUTTER MODEL STUDIES WITH EXTERNAL WING STORES

Jerome T Foughner Jr and Charles T Bensinger (General Dynamics Corp) Oct 1977 17 p refs Presented at the 4th JTCG/MD Aircraft Stores Compatibility Symp Fort Walton Beach Fla 12-14 Oct 1977

(NASA-TM-74078) Avail NTIS HC A02/MF A01 CSCL 01A

Results from transonic flutter model studies are presented The flutter model was constructed to support the flutter prevention and clearance program from preliminary design through flight flutter tests The model tests were conducted in the Langley transonic dynamics tunnel The large full span free-flying model was shown to be an effective tool in defining airplane flutter characteristics by demonstrating freedom from flutter for most configurations and by defining optimum solutions for a few troublesome configurations Author

N78-11007*# National Aeronautics and Space Administration Washington D C

A SURVEY OF COMPUTATIONAL AERODYNAMICS IN THE UNITED STATES

Alfred Gessow and Dana J Morris 1977 49 p refs

(NASA-SP-394) Avail NTIS HC A03/MF A01 CSCL 01A

Programs in theoretical and computational aerodynamics in the United States are described Those aspects of programs that relate to aeronautics are detailed The role of analysis at various levels of sophistication is discussed as well as the inverse solution techniques that are of primary importance in design methodology The research is divided into the broad categories of application for boundary layer flow Navier-Stokes turbulence modeling internal flows two-dimensional configurations subsonic and supersonic aircraft transonic aircraft and the space shuttle A survey of representative work in each area is presented Author

N78-11008*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio

EFFECT OF COOLANT FLOW EJECTION ON AERODYNAMIC PERFORMANCE OF LOW-ASPECT-RATIO VANES 2 PERFORMANCE WITH COOLANT FLOW EJECTION AT TEMPERATURE RATIOS UP TO 2

Jeffrey E Hass (Army Air Mobility Res and Develop Lab Cleveland) and Milton G Kofskey Oct 1977 34 p refs

(NASA-TP-1057 E-9213) Avail NTIS HC A03/MF A01 CSCL 21E

The aerodynamic performance of a 0 5 aspect ratio turbine vane configuration with coolant flow ejection was experimentally determined in a full annular cascade The vanes were tested at a nominal mean section ideal critical velocity ratio of 0 890 over a range of primary to coolant total temperature ratio from 1 0 to 2 08 and a range of coolant to primary total pressure ratio from 1 0 to 1 4 which corresponded to coolant flows from 3 0 to 10 7 percent of the primary flow The variations in primary and thermodynamic efficiency and exit flow conditions with circumferential and radial position were obtained Author

N78-11009# McDonnell Aircraft Co St Louis Mo

MULTI JET INDUCED FORCES AND MOMENTS ON VTOL AIRCRAFT HOVERING IN AND OUT OF GROUND EFFECT Final Report, 19 Apr 1976 - 19 Apr 1977

Donald R Kotansky Norbert A Durando Dean R Bristow and Philip W Saunders 19 Jun 1977 161 p refs

(Contract N62269-76-C-0086)

(AD-A042450 NADC-77229-30) Avail NTIS HC A08/MF A01 CSCL 01/1

An engineering methodology has been developed for the prediction of propulsive lift system induced aerodynamic effects for multi-lift-jet VTOL aircraft operating in the hover mode in an out of ground effect The developed methdology takes into account the effects of aircraft geometry aircraft orientation (pitch roll) and height above the ground plane cross-flow lift-jet vector directions with respect to the airframe lift-jet exit flow conditions and noncircular nozzle exit geometry for low aspect ratio nozzles GRA

N78-11011# Grumman Aerospace Corp Bethpage N Y Research Dept

AN ANALYSIS OF THE INVISCID TRANSONIC FLOW OVER TWO-ELEMENT AIRFOIL SYSTEMS Interim Report, 19 May 1975 - 31 Dec 1976

B Grossman and G Volpe 1 Jun 1977 54 p refs

(Contract N00017-75-C-0722)

(AD-A043460 RE-543 ONR-CR215-241-1) Avail NTIS HC A04/MF A01 CSCL 20/4

This report describes the development of a method for numerically computing the inviscid transonic flow field over an airfoil with a leading-edge slat or a trailing-edge flap The approach is to solve the full inviscid irrotational flow equations about two-element airfoil systems The methodology consists of the development of a suitable computational plane and grid system through the application of a series of conformal mappings The appropriate set of equations and boundary conditions are derived in terms of a smoothly varying single-valued reduced potential function through analytic removal of all singularities in the computational domain A stable and accurate relaxation procedure is established for the numerical solution of the governing equations The method is applied to a variety of transonic supercritical two-element airfoil configurations Results are presented depicting the surface pressure distribution streamline patterns in the physical and computational domain and Mach number contours

Author (GRA)

N78-11012# Naval Ship Research and Development Center Bethesda Md Aviation and Surface Effects Dept

AN ASSESSMENT OF CIRCULATION CONTROL AIRFOIL DEVELOPMENT Research and Development Report, Jul 1975 - Sep 1976

Joseph B Wilkerson Aug 1977 57 p refs

(AD-A043826 AERO-1238 DTNSRDC-77-0084) Avail NTIS HC A04/MF A01 CSCL 20/4

A circulation control (CC) airfoil development program is presented, including an airfoil designation system Specific performance objectives are set forth as development goals Background information includes an assessment of state-of-the-art design practices, a comparison of operational requirements with those of conventional airfoils and a discussion of previous airfoil performance Selection and design criteria are described for five new CC airfoils These designs were wind tunnel evaluated as two-dimensional models and a limited amount of airfoil data is shown for comparison to the prior data base Two of the airfoils were designed with the objective of maintaining high lift augmentation and improving the critical Mach number characteristics a combination of qualities that was previously nonexistent Both designs theoretically accomplished the prescribed goals and were validated by experimental results The development program has advanced the state of the art and nearly doubled the available data base for CC airfoils Author (GRA)

N78-11013# McDonnell-Douglas Research Labs St Louis, Mo
VISCOUS FLOWFIELDS AND AIRFRAME FORCES INDUCED BY TWO-DIMENSIONAL LIFT JETS IN GROUND EFFECT Interim Technical Report, 1 Feb 1976 - 28 Feb 1977
D R Kotansky and W W Bower 1 Mar 1977 88 p refs
(Contract N00014-76-C-0494 NR Proj 215-246 RR0141184)
(AD-A043518 ONR-CR215-246-1) Avail NTIS HC A05/MF A01 CSCL 20/4

The interaction of the lift jets and the ground is an important consideration with regard to the design of VTOL aircraft A key element of this ground effect problem is turbulent jet entrainment which causes otherwise static air to be set into motion and leads to aerodynamic loads on airframe surfaces As a first step toward gaining an understanding of this phenomenon a theoretical analysis of two-dimensional (planar) turbulent jet impingement flowfields has been undertaken Lift jets emanating from flat and curved surfaces jets in close ground effect have been modeled using the the incompressible Reynolds equations in combination with a one-equation turbulence model Distributions of the flow properties are computed as functions of Reynolds number based on jet exit properties and height of the jet exit plane above ground Author (GRA)

N78-11016# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt Brunswick (West Germany) Abt Entwurfsaerodynamik
CALCULATION OF THE NONLINEAR COEFFICIENTS OF LOW AND MEDIUM ASPECT RATIO WINGS USING THE VORTEX LATTICE PROCEDURE IN INCOMPRESSIBLE FLOW [BERECHNUNG DER NICHTLINEAREN BEIWERTE VON FLUEGELN MIT KLEINEM UND MITTLEREM SEITENVERHAELTNIS NACH DEM WIRBELLEITERVERFAHREN IN INKOMPRESSIBLER STROEMUNG]
W Schroeder Dec 1976 82 p refs In GERMAN
(DLR-IB-151-76/18) Avail NTIS HC A05/MF A01

A method for the calculation of the nonlinear coefficients of airfoil wings in incompressible symmetrical incident flow using the principle of the vortex lattice method in which the free discrete leading edge trailing edge and lateral edge vortices roll up without force, is described In extended test calculations the influence of the following numerical stability of the rolling up process was tested the force-free condition, number of panels and their subdivision into lateral and longitudinal directions, and subdivision of the free vortices in chains of linear vortex fragments For the favorable parameters found systematic calculations on plane wings with lambda ranging from 0 5 to 5 0 were made Results for identical wing planforms both with rolled up vortices at the trailing edge and with rolled up vortices at the trailing lateral and leading edge are given ESA

N78-11017# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt Goettingen (West Germany) Inst fuer Aeroelastik
UNSTEADY PRESSURE MEASUREMENTS ON WING-STORE COMBINATIONS IN INCOMPRESSIBLE FLOW
Hermann Triebstein 28 Mar 1977 73 p refs In GERMAN ENGLISH summary Report will also be announced as translation (ESA-TT-426)
(DLR-FB-77-12) Avail NTIS HC A04/MF A01 DFVLR Cologne DM 36,20

Measurements of unsteady pressures on harmonically oscillating wing-store combinations in incompressible flow are dealt with The measurements were made in a subsonic wind tunnel The pressure was measured for yaw- pitch- and heave-oscillations of the store at different locations of the store in x- y-, and z-directions The pitching and yawing oscillations were made about two different axes Further unsteady pressure distributions were measured on the wing-store combination at harmonically pitching oscillations of the wing and on the store at pitching and heaving oscillations of the store without the wing Some results were compared with theoretical results The flow speed was V = 40 m/s and the oscillation frequencies were f = 6, 12 and 20 Hz Author (ESA)

N78-11018# Poitiers Univ (France) Centre d Etudes Aerodynamiques et Thermiques
TURBULENT SUPERSONIC WAKES [SILLAGES SUPERSONIQUES TURBULENTS]
J P Bonnet and R AlziarydeRoquefort Paris Assoc Aeron et Astronautique de France 1977 39 p refs In FRENCH Presented at the 13th Colloq d Aerodyn Appl Lyon 8-10 Nov 1976
(Contract DRME-76/371)
(AAAF-NT-77-06 ISBN-2-7170-0423-8) Avail NTIS HC A03/MF A01, CEDOCAR Paris FF 25 (France and EEC) FF 29 (others)

A simple model of compressible turbulent wake was tested experimentally The experimental setup is detailed and the measurements giving mean values are discussed The calibration requirements needed for turbulence measurements are described The measurements were correlated with a mathematical model first constructed for the incompressible case and extended to the compressible case A fair agreement was found ESA

N78-11019# Association Aeronautique et Astronautique de France Paris
CALCULATION OF THE COMPRESSIBLE BOUNDARY LAYER AROUND A PROFILE [CALCUL DE LA COUCHE LIMITE COMPRESSIBLE AUTOUR D'UN PROFIL]
C Mari 1977 20 p refs In FRENCH Presented at the 13th Colloq d Aerodyn Appl Lyon 8-10 Nov 1976
(AAAF-NT-77-08 ISBN-2-7170-0425-4) Avail NTIS HC A02/MF A01 CEDOCAR Paris FF 15 (France and EEC) FF 19 (others)

An attempt to calculate the compressible boundary layer without insertion of empirical criteria is presented A one parameter model was constructed based on the Prandtl hypothesis and retaining the friction normal to the wall in the expression of the turbulent kinetic energy Structural coefficients were introduced to take care of the longitudinal variation of turbulent shear and a fundamental parameter was considered with Gaussian density of probability as a weighting function and based on shear The Spalding numerical method was used to solve the momentum and enthalpy equations Applications of the model was performed on cylinders rectangular wings and turbocompressor blades in fair agreement with experimental results ESA

N78-11022*# National Aeronautics and Space Administration Marshall Space Flight Center Huntsville Ala
WIND SHEAR MODELING FOR AIRCRAFT HAZARD DEFINITION Interim Report Apr 1976 - Mar 1977
Walter Frost (FWG Associates Inc) and Dennis W Camp Mar 1977 152 p refs
(Contracts NAS8-32217 DOT-FA76WAI-620)
(NASA-CR-155223 AD-A042326/9 FAA-RD-77-36) Avail NTIS HC A08/MF A01 CSCL 01/2

A discussion of the various types of wind shear which causes problems to aircraft operations is presented The discussion is limited to low-level wind shear such as could be encountered in the vicinity of airports by by aircraft on approach to landing and on takeoff The types of shear analyzed are primarily limited

to frontal thunderstorm and shears associated with stable and neutral boundary layers Modeling of the wind shear for simulation purposes is emphasized Wind shear is discussed not only as a change in absolute wind speed but also as a result of wind direction change Some insight is given relative to a combination of wind speed and direction change It is to be noted that the condition affecting aircraft operations is not one shear parameter but is a combination of several e g horizontal shear vertical shear wind direction change and height of shear above ground level Author

N78-11023*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
BASIC ANALYSIS OF TERMINAL OPERATION BENEFITS RESULTING FROM REDUCED VORTEX SEPARATION MINIMA
Leonard Credeur Oct 1977 25 p refs
(NASA-TM-78624) Avail NTIS HC A02/MF A01 CSCL 01C

The impact of reducing the wake vortex minimum separation required behind heavy jets on terminal area operation rate was analyzed The effect on arrival saturation and steady state average delay was determined for various percentages mix of heavy and large jet traffic samples operating under various precision of interarrival spacing Benefits increase with percentage of heavy aircraft and with precision of control These results demonstrate the payoff possible from research to reduce the severity of the trailing vortex by aerodynamic means Author

N78-11024*# General Electric Co Pittsfield Mass
LIGHTNING PROTECTION OF AIRCRAFT
Franklin A Fisher and J Anderson Plumer Oct 1977 530 p refs
(Contract NAS3-19080)
(NASA-RP-1008) Avail NTIS HC A23/MF A01 CSCL 01C

The current knowledge concerning potential lightning effects on aircraft and the means that are available to designers and operators to protect against these effects are summarized The increased use of nonmetallic materials in the structure of aircraft and the constant trend toward using electronic equipment to handle flight-critical control and navigation functions have served as impetus for this study

N78-11025*# General Electric Co Pittsfield Mass
THE LIGHTNING ENVIRONMENT
In its Lightning Protect of Aircraft Oct 1977 p 1-35 refs

Avail NTIS HC A23/MF A01 CSCL 01C

Basic characteristics of lightning were studied Generation and development of the lightning flash were summarized as were lightning polarity and direction Thunderstorm frequency and lightning flash density were considered and an engineering model of lightning flashes was delineated B L P

N78-11026*# General Electric Co Pittsfield Mass
AIRCRAFT LIGHTNING ATTACHMENT PHENOMENA
In its Lightning Protect of Aircraft Oct 1977 p 37-55 refs

Avail NTIS HC A23/MF A01 CSCL 01C

An aircraft s influence on lightning-strike occurrence was investigated The compression of an electric field around an aircraft was considered in mathematical calculations of an aircraft s ability to store charge Model test results were used to predict lightning-strike attachment zones in an analysis of aircraft design B L P

N78-11027*# General Electric Co Pittsfield Mass
LIGHTNING STRIKE EXPERIENCE
In its Lightning Protect of Aircraft Oct 1977 p 57-74 refs

Avail NTIS HC A23/MF A01 CSCL 01C

A program implemented to report various lightning-strike incidents was reviewed Strike incidence data was summarized according to aircraft altitude flight path meteorological conditions and atmospheric air temperature Data was given indicating the incidence of reported lightning strikes to commercial and U S Air Force aircraft and an outline of pilot opinion in lightning avoidance was given B L P

N78-11028*# General Electric Co Pittsfield Mass
LIGHTNING EFFECTS ON AIRCRAFT
In its Lightning Protect of Aircraft Oct 1977 p 75-103 refs

Avail NTIS HC A23/MF A01 CSCL 01C

Direct and indirect effects of lightning on aircraft were examined in relation to aircraft design Specific trends in design leading to more frequent lightning strikes were individually investigated These trends included the increasing use of miniaturized solid state components in aircraft electronics and electric power systems A second trend studied was the increasing use of reinforced plastics and other nonconducting materials in place of aluminum skins a practice that reduces the electromagnetic shielding furnished by a conductive skin B L P

N78-11029*# General Electric Co Pittsfield Mass
DIRECT EFFECTS PROTECTION
In its Lightning Protect of Aircraft Oct 1977 p 105-114 refs
Avail NTIS HC A23/MF A01 CSCL 01C

Protection of an aircraft and each of its various systems against the direct effects of lightning were analyzed Components located in different sections of the aircraft were individually examined since they are likely to experience different degrees of susceptibility to lightning and may be vulnerable to different components of the lightning flash The basic steps to be followed in establishing lightning protection were presented by discussing the varieties of arc entry and current flow-through damage The lightning-strike zones and lightning current environments are established since environmental conditions in the zones are those under which specific potective measures must perform Airworthiness regulations which apply to lightning protection are cited Author

N78-11030*# General Electric Co Pittsfield Mass
FUEL SYSTEM PROTECTION
In its Lightning Protect of Aircraft Oct 1977 p 115-184 refs
Avail NTIS HC A23/MF A01 CSCL 01C

The hazardous nature of most fuels and the potential for catastrophe if ignition should occur was investigated in regard to the design of adequate lightning protection for aircraft fuel systems Typical aircraft fuel flammability characteristics and possible ways to control fuel flammability and ignition were reviewed Guidelines for effective protection of fuel systems were delineated Author

N78-11031*# General Electric Co Pittsfield Mass
STRUCTURES PROTECTION
In its Lightning Protect of Aircraft Oct 1977 p 185-252 refs
Avail NTIS HC A23/MF A01 CSCL 01C

Materials of which an aircraft is made and the methods used to hold these materials together forming the aircraft structure were studied as factors important in protecting a modern aircraft from hazardous natural environments Since all-metal aircraft are being replaced by aircraft constructed partly of fiber reinforced plastics with desirable light weight and high strength properties but with poor electrical conductivity the danger of lightning strikes has become more serious Lightning effects on metal structures were reviewed and design protection was discussed The expected lightning effects on nonmetallic materials such as fiberglass and advanced composites were also reviewed Author

N78-11032*# General Electric Co Pittsfield Mass
VOLTAGES AND CURRENTS INDUCED BY LIGHTNING
In its Lightning Protect of Aircraft Oct 1977 p 253-267 ref

Avail NTIS HC A23/MF A01 CSCL 01C

Indirect effects of lightning the damage to or malfunction of electrical equipment that results from lightning flashes, were considered These effects range from tripped circuit breakers to computer upset to physical damage to input or output circuits of electronic equipment Voltages and currents induced by lightning on the electrical wiring of the aircraft were emphasized regardless of whether or not such voltages and currents cause damage or upset of electrical equipment Author

N78-11033*# General Electric Co Pittsfield Mass
THE EXTERNAL MAGNETIC FIELD ENVIRONMENT
In its Lightning Protect of Aircraft Oct 1977 p 269-292 refs
Avail NTIS HC A23/MF A01 CSCL 01C

Calculations were made to predict magnetic field intensities surrounding an aircraft following a lightning strike Aircraft design and aircraft structural geometry were considered in the computations A wire grid aircraft model was used to aid in magnetic flux estimation B L P

N78-11034*# General Electric Co Pittsfield Mass
THE INTERNAL MAGNETIC FIELDS CREATED BY DIFFUSION
In its Lightning Protect of Aircraft Oct 1977 p 293-327 refs
Avail NTIS HC A23/MF A01 CSCL 01C

Electrical resistance along with internal and external loop voltages were considered in a calculation of internal magnetic fields observed in aircraft structures following a lightning strike The geometry of cylindrical bodies, both circular and elliptical was utilized in the computation in order to model fuselage and wing cross sections B L P

N78-11035*# General Electric Co Pittsfield Mass
THE INTERNAL FIELDS COUPLED THROUGH APERTURES
In its Lightning Protect of Aircraft Oct 1977 p 329-348 refs
Avail NTIS HC A23/MF A01 CSCL 01C

Magnetic fields coupled through apertures in an aircraft structure were calculated These fields were shown to be important since some apertures are quite large and since the waveshape of interior fields is not retarded but tends to be the same for small apertures as for that of the external magnetic field Aperture geometry and reflecting surfaces were considered for computations of field strength and direction B L P

N78-11036*# General Electric Co , Pittsfield, Mass
VOLTAGES AND CURRENTS INDUCED ON WIRING
In its Lightning Protect of Aircraft Oct 1977 p 349-360 refs
Avail NTIS HC A23/MF A01 CSCL 01C

Aircraft lightning strikes were investigated in regard to their effects on voltages and currents in aircraft wiring An electrical conductor's response to magnetic fields and electric fields was examined as part of the voltage and current calculations The wiring system of the space shuttle was briefly considered as an example B L P

N78-11037*# General Electric Co Pittsfield Mass
EFFECTS OF SHIELDS ON CABLES
In its Lightning Protect of Aircraft Oct 1977 p 361-405 refs
Avail NTIS HC A23/MF A01 CSCL 01C

Aircraft wiring subjected to rapidly changing electromagnetic fields was considered The ways in which shielded cables reduce surge voltages were studied along with the ways in which common practice regarding the use of shields may be at variance with the use required for the control of lightning effects Courses in which this apparent conflict of use may be resolved were suggested Noise currents flowing on shields of cables related to the noise signals coupled onto signal conductors were also investigated Author

N78-11038*# General Electric Co Pittsfield Mass
EXAMPLES OF INDUCED VOLTAGES MEASURED ON AIRCRAFT
In its Lightning Protect of Aircraft Oct 1977 p 407-427 refs
Avail NTIS HC A23/MF A01 CSCL 01C

Tests were made on aircraft in which simulated lightning currents were injected into the aircraft and the resultant voltages and currents on the aircraft wiring measured Aircraft used in the tests were the F-8 aircraft and the F-89J Author

N78-11039*# General Electric Co Pittsfield Mass
DESIGN TO MINIMIZE INDIRECT EFFECTS
In its Lightning Protect of Aircraft Oct 1977 p 429-450 refs
Avail NTIS HC A23/MF A01 CSCL 01C

Design criteria presented aimed at minimizing or eliminating the indirect effects of lightning Certain premises were cited on which the criteria were based Premises indicate that it is desirable to prevent irreversible damage to the aircraft and that safety of the crew and vehicle is essential Electronic equipment must be located in regions where the electromagnetic fields produced by lightning are lowest and must be designed with protective shielding Author

N78-11040*# General Electric Co Pittsfield, Mass
COMPONENT DAMAGE ANALYSIS
In its Lightning Protect of Aircraft Oct 1977 p 451-493 refs
Avail NTIS HC A23/MF A01 CSCL 01C

Semiconductor breakdown in aircraft was investigated since lightning strikes induce large current and voltage pulses which may cause failure Work was done to determine whether or not these voltages and currents cause upset or damage to active or passive components Failure thresholds were studied extensively and an assessment was made of the vulnerability of a system to a transient environment Author

N78-11041*# *General Electric Co Pittsfield, Mass*
TEST TECHNIQUES FOR EVALUATION OF INDIRECT EFFECTS
In its Lightning Protect of Aircraft Oct 1977 p 495-529 refs
Avail NTIS HC A23/MF A01 CSCL 01C

Test techniques for evaluation of how well electrical and electronic equipment withstands the indirect effects of lightning were studied The existing test techniques and the philosophy behind some of the existing or evolving standards are discussed Possible avenues of improvement in test techniques are suggested Author

N78-11042*# Douglas Aircraft Co Inc , Long Beach Calif
STUDY TO DEVELOP IMPROVED FIRE RESISTANT AIRCRAFT PASSENGER SEAT MATERIALS, PHASE 1
Edward L Trabold 1977 124 p refs
(Contract NAS2-9337)
(NASA-CR-152056) Avail NTIS HC A06/MF A01 CSCL 01C

The procurement and testing of a wide range of candidate materials is reported Improved fire resistant nonmetallic materials were subjected to tests to evaluate their thermal characteristics, such as burn, smoke generation heat release rate and toxicity In addition candidate materials were evaluated for mechanical, physical and aesthetic properties Other properties considered included safety, comfort, durability and maintainability The fiscal year 1977 and the projected 1980 cost data were obtained for aircraft seat materials Author

N78-11044# *Rome Air Development Center Griffiss AFB N Y*
FAA LIGHTNING PROTECTION STUDY LIGHTNING PROTECTION REQUIREMENTS FOR WILCOX MARK I/D INSTRUMENT LANDING SYSTEM Final Report, May 1976 - Apr 1977
Marvin D Drake May 1977 123 p refs
(Contract DOT-FA72WAI-356)

(AD-A043907 RADC/RBC FAA-RD-77-102) Avail NTIS HC A06/MF A01 CSCL 17/7

The degree of susceptibility of the Wilcox Mark I/D to induced electromagnetic pulse effects due to lightning was determined Protective devices adequate for low voltage electronic systems were proposed Lightning protection requirements were cited while types of susceptible components and methods used to determine their withstand capabilities were delineated Recommendations were made for specific protective devices and circuitry Author

N78-11045# National Aviation Facilities Experimental Center Atlantic City N J

SIMULATION MODEL FOR AIR TRAFFIC CONTROL COMMUNICATIONS Final Report

Robert Mulholland Jul 1977 35 p refs

(FAA Proj 061-221-100)

(AD-A044256 FAA-RD-77-69 FAA-NA-76-30) Avail NTIS HC A03/MF A01 CSCL 17/7

A computer simulation model designed to mimic second-by-second behavior of air/ground communications in an air traffic control sector is described The model can simulate any one of nine sector functions (e g high altitude enroute low altitude transitional radar arrival control etc) The model exists as a computer program written in the GPSS 5 and FORTRAN 4 languages Input variables include aircraft arrival rate into sector distribution of transmission length distribution of number of transmissions in an air/ground exchange etc Response variables include sector aircraft loading channel utilization and communications delay Model output is obtained in the form of time series (e g minute-by-minute averages of channel utilization) exhibiting the dynamics of sector communications or simple averages of such series taken over several hours of simulated time Author

N78-11046# National Aviation Facilities Experimental Center Atlantic City N J

COLLISION RISK AND ECONOMIC BENEFIT ANALYSIS OF COMPOSITE SEPARATION FOR THE CENTRAL EAST PACIFIC TRACK SYSTEM Final Report, Dec 1973 - Jun 1974

Allen C Busch Brian Colamosca and John R VanderVeer Jun 1977 144 p refs

(FAA Proj 012-102-230)

(AD-A044317 FAA-NA-77-32 FAA-EM-77-5) Avail NTIS HC A07/MF A01 CSCL 17/7

Criteria for the application of composite separation to the Central East Pacific (CEP) track system were a collision risk and an economic benefit s comparison of the existing four-route and proposed composite six-route systems Radar data from land-based facilities in California and Hawaii and from Ocean Station Vessel November were processed to determine aircraft navigation performance Lateral longitudinal and composite collision risks were estimated for the existing and proposed composite systems based upon accepted North Atlantic Systems Planning Group (NAT/SPG) methodology while vertical collision risk was calculated based upon previous NAT/SPG studies Lateral collision risk for the proposed composite system was found to be lower than for the existing structure Comparisons of fuel burned and flight times indicated that the proposite composite system are more economically beneficial than the existing route configuration Author

N78-11050# Air Force Flight Dynamics Lab Wright-Patterson AFB Ohio

AWLS OPERATIONAL FLIGHT TEST Final Report, 1 Nov 1972 - 31 May 1975

Michael J Lipcsey Jun 1977 43 p

(AF Proj 2187)

(AD-A043814 AFFDL-TR-77-39) Avail NTIS HC A03/MF A01 CSCL 01/2

This report describes operational aspects and procedures developed for use in the flight testing phase of the all weather landing system program Included is a brief system description with an outline operational procedure used while making Category III instrument approaches Problems with present day landing systems and procedures unique to very low visibility operations are brought out analyzed and possible improvements suggested Author (GRA)

N78-11052*# National Aeronautics and Space Administration Langley Research Center Langley Station, Va

EXPERIMENTAL AND ANALYTICAL DETERMINATION OF CHARACTERISTICS AFFECTING LIGHT AIRCRAFT LANDING-GEAR DYNAMICS

Edwin L Fasanella (Vought Corp Hampton Va) John R McGehee and M Susan Pappas Nov 1977 46 p refs

(NASA-TM-X-3561 L-11472) Avail NTIS HC A03/MF A01 CSCL 01C

An experimental and analytical investigation was conducted to determine which characteristics of a light aircraft landing gear influence gear dynamic behavior significantly The investigation focused particularly on possible modification for load control Pseudostatic tests were conducted to determine the gear fore-and-aft spring constant axial friction as a function of drag load brake pressure-torque characteristics and tire force-deflection characteristics To study dynamic tire response vertical drops were conducted at impact velocities of 1 2 1 5 and 1 8 m/s onto a level surface to determine axial-friction effects a second series of vertical drops were made at 1 5 m/s onto surfaces inclined 5 deg and 10 deg to the horizontal An average dynamic axial-friction coefficient of 0 15 was obtained by comparing analytical data with inclined surface drop test data Dynamic strut bending and associated axial friction were found to be severe for the drop tests on the 10 deg surface Author

N78-11053*# National Aeronautics and Space Administration Langley Research Center Langley Station, Va

WIND-TUNNEL TESTS OF WIDE-CHORD TEETERING ROTORS WITH AND WITHOUT OUTBOARD FLAPPING HINGES

William H Weller (Army Aviat Res and Develop Command St Louis Mo) and Bill L Lee Washington Nov 1977 76 p refs

(DA Proj 1L2-62209-AH-76)

(NASA-TP-1046 L-11749) Avail NTIS HC A05/MF A01 CSCL 01C

Wind tunnel tests of aeroelastically designed helicopter rotor models were conducted to obtain rotor aerodynamic performance and dynamic response data pertaining to two-bladed teetering rotors with a wider chord and lower hover tip speed than currently employed on production helicopters The effects of a flapping hinge at 62 percent radius were also studied Finally the effects of changing tip mass on operating characteristics of the rotor with the outboard flapping hinge were examined The models were tested at several shaft angles of attack for five advance ratios 0 15 0 25 0 35 0 40 and 0 45 For each combination of shaft angle and advance ratio the rotor lift was varied over a wide range to include simulated maneuver conditions At each test condition rotor aerodynamic performance and dynamic response data were obtained From these tests it was found that wide-chord rotors may be subject to large control forces An outboard flapping hinge may be used to reduce beamwise bending moments over a significant part of the blade radius without significantly affecting the chordwise bending moments Author

N78-11054# McDonnell Aircraft Co St Louis Mo

EFFECT OF FIGHTER ATTACK SPECTRUM ON CRACK GROWTH Final Technical Report, May 1975 - Jul 1976

H D Dill and C R Saff Wright-Patterson AFB Ohio AFFDL Mar 1977 149 p refs

(Contract F33615-75-C-3112)

(AD-A042369 AFFDL-TR-76-112) Avail NTIS HC A07/MF A01 CSCL 01/3

The purpose of this program was to systematically evaluate the effect of variations in flight stress spectra on crack propagation using current analysis techniques in conjunction with experimental correlations Over 100 spectra variations were generated derived from four baseline load factor spectra The spectra variation types considered were (a) Reordering of loads within a mission

(b) Sequence of missions (c) Mission mix (d) Individual length, (e) High and low load truncation (f) Compression loads (g) Exceedance curve (h) Coupling of peaks and valleys (i) Test limit stress Crack growth was predicted for each baseline spectrum and spectra variation prior to test with the exception of tests for one baseline spectrum The generalized Willenborg Model was the primary method of crack growth analysis Additionally predictions were made using a closure model based on analyses of crack surface contact Three constant amplitude and thirty spectrum tests were performed to verify the predictions of the analysis methods to evaluate the effects of spectra variations and to provide data useful for defining guidelines for structural verification of future aircraft Spectrum variations shown to have the greatest impact on crack growth life are those involving modifications of the maximum peak stresses The experimental data were evaluated and summarized and recommendations and guidelines were developed for deriving spectra for multi-mission tactical fighter aircraft GRA

N78-11055# Naval Weapons Support Center Crane Ind
SENSITIVITY OF THE SHOE-BOX IN P001 ANALYSIS
Jerry L Kemp and Norman L Parke 23 Jul 1977 64 p refs (AD-A043707 NWSC/CR/RDTR-61) Avail NTIS HC A04/MF A01 CSCL 01/3

Survivability of aircraft against artillery threats can be assessed by a computer program P001 which assumes that the vulnerable components are all centrally located on the aircraft This report examines the sensitivity of this assumption and suggests a change to P001 to indicate when the assumption is not valid
Author (GRA)

N78-11056# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt Brunswick (West Germany) Abt Festigkeit von Bauteilen
PARTS TESTS FOR THE LANDING FLAP SUPPORT OF THE AIRBUS A-300 B [BAUTEILVERSUCHE FUER DEN LANDEKLAPPENTRAEGER DES AIRBUS A 300 B]
D Wetzel 15 Apr 1977 38 p refs In GERMAN
(DLR-IB-152-77/07) Avail NTIS HC A03/MF A01

The guide rails for the landing flap support of the Airbus A-300 B aircraft were tested for replacement of material (steel) by carbon reinforced titanium alloy with a view to an overall parts weight reduction of 16% Parts tests which allow investigation of the complete landing flap support are described Results are presented of static fatigue and wear tests Materials tests concerning the joint between the reinforced material and the metallic support were also conducted ESA

N78-11057# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt Brunswick (West Germany) Abt Festigkeit von Bauteilen
FATIGUE STRENGTH OF THE UPPER GUIDE RAIL OF THE A-300 NO 4 LANDING FLAP SUPPORT (TESTS, RESULTS, AND EVALUATION) [SCHWINGFESTIGKEIT DER OBEREN SCHIENE DES LANDEKLAPPENTRAEGERS 4 DES A 300 (VERSUCHSDURCHFUEHRUNG, VERSUCHSERGEBNISSE UND VERSUCHSAUSWERTUNG)]
D Wetzel 13 May 1977 26 p refs In GERMAN
(DLR-IB-152-77/09) Avail NTIS HC A03/MF A01

The guide rails for the landing flap support of the Airbus A-300 B aircraft were tested for replacement of material (steel) by carbon fiber reinforced titanium alloy with a view to an overall parts weight reduction of 16 % Fatigue tests are described for the upper guide rail Results show an increase in fatigue life over steel rails ESA

N78-11058# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany) Abt Festigkeit von Bauteilen
WEAR AND VIBRATIONAL STRENGTH INVESTIGATIONS ON THE UPPER TRACK, MADE OF Ti A16 V4, OF LANDING FLAP 4 OF THE A 300 B [VERSCHLEISS- UND SCHWINGFESTIGKEITSUNTERSUCHUNGEN AN DER OBEREN SCHIENE AUS Ti A16 V4 DES LANDEKLAPPENTRAEGERS 4 DES A 300 B]
D Wetzel 24 May 1977 27 p refs In GERMAN
(DLR-IB-152-77/11) Avail NTIS HC A03/MF A01

Wear and vibration strength tests were made on the landing flap upper track of the European Airbus A-300 B The rolling contact load tests are described and the results of the tests are presented It is concluded that the vibrational strength is sufficient under operational loads and that even under extreme wear conditions the limits of operation of the contact surface are not reached ESA

N78-11061*# National Aeronautics and Space Administration, Washington D C
AERODYNAMIC INVESTIGATION OF AN AIR-COOLED AXIAL-FLOW TURBINE PART 2 ROTOR BLADE TIP-CLEARANCE EFFECTS ON OVERALL TURBINE PERFORMANCE AND INTERNAL GAS FLOW CONDITIONS EXPERIMENTAL RESULTS AND PREDICTION METHODS
A Yamamoto K Takahara H Nouse F Mimura S Inoue and H Usui Sep 1977 84 p refs Transl into ENGLISH from Kurei Jikuryu Tabin no Kuryoku Seino ni Kan-Suru Kenkyu' Rept NAL-TR-466 Natl Aerospace Lab Tokyo Japan Aug 1976 p 1-28 Translations were announced as N74-30241 and N75-13273 Transl by Sci Transl Serv Santa Barbara Calif
(Contract NASw-2483)
(NASA-TM-75138) Avail NTIS HC A05/MF A01 CSCL 21E

Total turbine blade performance was investigated while changing the blade tip clearance in three ways The internal flow at the moving blade outlet point was measured Experimental results were compared with various theoretical methods Increased blade clearance leads to decreased turbine efficiency Author

N78-11062*# Pratt and Whitney Aircraft Group East Hartford Conn Commercial Products Div
ADVANCED SUPERSONIC PROPULSION STUDY, PHASE 4 Final Report
R A Howlett Sep 1977 109 p
(Contract NAS3-19540)
(NASA-CR-135273 PWA-5547-4) Avail NTIS HC A06/MF A01 CSCL 21E

Installation characteristics for a Variable Stream Control Engine (VSCE) were studied for three advanced supersonic airplane designs Sensitivity of the VSCE concept to change in technology projections was evaluated in terms of impact on overall installed performance Based on these sensitivity results critical technology requirements were reviewed resulting in the reaffirmation of the following requirements low-noise nozzle system a high performance low emissions duct burner and main burner hot section technology variable geometry components and propulsion integration features including an integrated electronic control system Author

N78-11063*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
AIRCRAFT ENGINE EMISSIONS
Oct 1977 452 p Conf held in Cleveland 18-19 May 1977 (NASA-CP-2021 E-9262) Avail NTIS HC A20/MF A01 CSCL 21E

A conference on a aircraft engine emissions was held to present the results of recent and current work Such diverse areas as components controls energy efficient engine designs and noise and pollution reduction are discussed For individual titles see N78-11064 through N78-11080

N78-11064*# Environmental Protection Agency Washington D C
ENVIRONMENTAL PROTECTION AGENCY AIRCRAFT EMISSIONS STANDARDS
George D Kittredge *In* NASA Lewis Res Center Aircraft Eng Emissions Oct 1977 p 1-17 refs (For availability see N78-11063 02-07)
Avail NTIS HC A20/MF A01 CSCL 21E

Emissions of air pollutants from aircraft were investigated in order to determine (1) the extent to which such emissions affect air quality in air quality control regions througnout the

United States and (2) the technological feasibility of controlling such emissions The basic information supporting the need for aircraft emissions standards is summarized The EPA ambient air quality standards are presented Only the primary (health related) standards are shown Of the six pollutants only the first three carbon monoxide (CO) hydrocarbons (HC) and nitrogen oxides are influenced significantly by aircraft Author

N78-11065*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
EMISSIONS REDUCTION TECHNOLOGY PROGRAM
Robert E Jones *In its* Aircraft Eng Emissions Oct 1977 p 19-58
Avail NTIS HC A20/MF A01 CSCL 21E

Combustor concepts having the potential for significantly lower emissions levels were investigated The combustor emissions reduction was measured in an engine test Emission characteristics common to all engine classes are shown Multiple-burning zone combustors specifically the double-annular and swirl-can combustors were studied Airblast and air-assist fuel injection techniques were evaluated for emissions control potential The combustor sceening and refining phases are summarized Author

N78-11066*# General Electric Co Philadelphia Pa Aircraft Engine Group
STATUS OF THE NASA/GENERAL ELECTRIC EXPERIMENTAL CLEAN COMBUSTOR PROGRAM, PHASE 3
Donald W Bahr *In* NASA Lewis Res Center Aircraft Eng Emissions Oct 1977 p 37-58

Avail NTIS HC A20/MF A01 CSCL 21E

The technology required to design and develop advanced commercial conventional-takeoff-and-landing aircraft engines with significantly lower pollutant exhaust emissions levels than those of current-technology engines was generated and demonstrated The target pollutant emissions reductions in tests of an advanced commercial aircraft turbofan engine were attained by developing advanced combustor designs This technology is intended to be applicable to advanced military aircraft engines The primary focus was on reducing the levels of the gaseous pollutant emissions Author

N78-11067*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
POLLUTION REDUCTION TECHNOLOGY PROGRAM FOR CLASS T4(JT8D) ENGINES
R Roberts (Pratt and Whitney Aircraft Group East Hartford Conn) A J Fiorentino (Pratt and Whitney Aircraft Group East Hartford Conn) and L A Diehl *In its* Aircraft Eng Emissions Oct 1977 p 29-89 refs
Avail NTIS HC A20/MF A01 CSCL 21E

The technology required to develop commercial gas turbine engines with reduced exhaust emissions was demonstrated Can-annular combustor systems for the JT8D engine family (EPA class T4) were investigated The JT8D turbofan engine is an axial-flow dual-spool moderate-bypass-ratio design It has a two-stage fan a four-stage low-pressure compressor driven by a three-stage low-pressure turbine and a seven-stage high-pressure compressor driven by a single-stage high-pressure turbine A cross section of the JT8D-17 showing the mechanical configuration is given Key specifications for this engine are listed Author

N78-11068*# Pratt and Whitney Aircraft Group East Hartford Conn
NASA/PRATT AND WHITNEY EXPERIMENTAL CLEAN COMBUSTOR PROGRAM ENGINE TEST RESULTS
R Roberts A J Fiorentino and W Greene *In* NASA Lewis Res Center Aircraft Eng Emissions Oct 1977 p 91-123 refs
Avail NTIS HC A20/MF A01 CSCL 21E

A two-stage vorbix (vortex burning and mixing) combustor and associated fuel system components were successfully tested in an experimental JT9D engine at steady-state and transient operating conditions using ASTM Jet-A fuel Full-scale JT9D experimental engine tests were conducted in a phase three aircraft experimental clean combustor program The low-pollution combustor fuel system and fuel control concepts were derived from phase one and phase two programs in which several combustor concepts were evaluated refined and optimized in a component test rig Significant pollution reductions were achieved with the combustor which meets the performance operating and installation requirements of the engine Author

N78-11069*# Detroit Diesel Allison Indianapolis Ind
POLLUTION REDUCTION TECHNOLOGY PROGRAM FOR TURBOPROP ENGINES
J G Tomlinson *In* NASA Lewis Res Center Aircraft Eng Emissions Oct 1977 p 125-147 refs

Avail NTIS HC A20/MF A01 CSCL 21E

The reduction of CO HC and smoke emissions while maintaining acceptable NO(x) emissions without affecting fuel consumption durability maintainability and safety was accomplished Component combustor concept screening directed toward the demonstration of advanced combustor technology required to meet the EPA exhaust emissions standards for class P2 turboprop engines was covered The combustion system for the Allison 501-D22A engine was used and three combustor design concepts - reverse flow, prechamber and staged fuel were evaluated Author

N78-11070*# AiResearch Mfg Co Phoenix Ariz
POLLUTION REDUCTION TECHNOLOGY PROGRAM FOR SMALL JET AIRCRAFT ENGINES CLASS T1
T W Bruce F G Davis and H C Mongia *In* NASA Lewis Res Center Aircraft Eng Emissions Oct 1977 p 149-180 ref
Avail NTIS HC A20/MF A01 CSCL 21E

Small jet aircraft engines (EPA class T1 turbojet and turbofan engines of less than 35 6 kN thrust) were evaluated with the objective of attaining emissions reduction consistent with performance constraints Configurations employing the technological advances were screened and developed through full scale rig testing The most promising approaches in full-scale engine testing were evaluated Author

N78-11071*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
SUMMARY OF EMISSIONS REDUCTION TECHNOLOGY PROGRAMS
Richard W Niedzwiecki *In its* Aircraft Eng Emissions Oct 1977 p 181-202
Avail NTIS HC A20/MF A01 CSCL 21E

The NASA emissions reduction contract programs for EPA aircraft engine classes P2 (turboshaft engines) T1 (jet engines with thrust under 8000 lb) T4 (JT8D) engines) and T2 (jet engines with thrust over 8000 lb) are discussed The most important aspects of these programs, the commonality of approaches used the test results, and assessments regarding applications of the derived technology are summarized Author

N78-11072*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
EMISSIONS CONTROL FOR GROUND POWER GAS TURBINES
Richard A Rudney Richard J Priem Albert J Juhasz, David N Anderson Thaddeus S Mroz and Edward J Mularz *In its* Aircraft Eng Emissions Oct 1977 p 203-242 refs

Avail NTIS HC A20/MF A01 CSCL 21E

The similarities and differences of emissions reduction technology for aircraft and ground power gas turbines is described The capability of this technology to reduce ground power emissions to meet existing and proposed emissions standards is presented and discussed Those areas where the developing aircraft gas turbine technology may have direct application to ground power and those areas where the needed technology may be unique to the ground power mission are pointed out Emissions reduction technology varying from simple combustor modifications to the

use of advanced combustor concepts, such as catalysis is described and discussed Author

N78-11073*# National Aeronautics and Space Administration Lewis Research Center, Cleveland Ohio
GENERAL AVIATION PISTON-ENGINE EXHAUST EMISSION REDUCTION
Erwin E Kempke Jr William H Houtman (EPA Washington D C) William T Westfield (FAA Washington D C) Larry C Duke (AVCO Lycoming Williamsport Pa) and Bernard J Rezy (Teledyne Continental Motors Los Angeles) *In its* Aircraft Eng Emissions Oct 1977 p 243-275 refs

Avail NTIS HC A20/MF A01 CSCL 21E

To support the promulgation of aircraft regulations two airports were examined Van Nuys and Tamiami It was determined that the carbon monoxide (CO) emissions from piston-engine aircraft have a significant influence on the CO levels in the ambient air in and around airports where workers and travelers would be exposed Emissions standards were set up for control of emissions from aircraft piston engines manufactured after December 31 1979 The standards selected were based on a technologically feasible and economically reasonable control of carbon monoxide It was concluded that substantial CO reductions could be realized if the range of typical fuel-air ratios could be narrowed Thus improvements in fuel management were determined as reasonable controls Author

N78-11074*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
ALTERNATIVE FUELS
Jack S Grobman Helmut F Butze Robert Friedman Albert C Antoine, and Thaine W Reynolds *In its* Aircraft Eng Emissions Oct 1977 p 277-308 refs

Avail NTIS HC A20/MF A01 CSCL 21E

Potential problems related to the use of alternative aviation turbine fuels are discussed and both ongoing and required research into these fuels is described This discussion is limited to aviation turbine fuels composed of liquid hydrocarbons The advantages and disadvantages of the various solutions to the problems are summarized The first solution is to continue to develop the necessary technology at the refinery to produce specification jet fuels regardless of the crude source The second solution is to minimize energy consumption at the refinery and keep fuel costs down by relaxing specifications Author

N78-11075*# Massachusetts Inst of Tech Cambridge Dept of Mechanical Engineering
SOOT FORMATION IN A TURBULENT SWIRLING FLOW
David P Hoult *In* NASA Lewis Res Center Aircraft Eng Emissions Oct 1977 p 309-321 refs

Avail NTIS HC A20/MF A01 CSCL 21E

The qualitative understanding of soot formation in simple models of gas turbine primary-zone combustors is summarized Soot formation in flame radiation and air pollution was investigated Results are presented namely (1) if the fuel is premixed with air in approximately stoichiometric proportions the sequence of states that a fluid element undergoes as it burns is quite different from the sequence when liquid or vapor fuel is injected into an air-flow (2) swirling flows as are typical or swirl-can combustors when burning can amplify small aerodynamic disturbances upstream of the swirl vanes and (3) different fuels form significantly different amounts of soot Each of these effects makes major changes in the amount of soot formed in a given combustor Author

N78-11076*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
GLOBAL ATMOSPHERIC SAMPLING PROGRAM
Erwin A Lezberg, Porter J Perkins David R Englund Daniel J Gauntner and James D Holdeman *In its* Aircraft Eng Emissions Oct 1977 p 323-355 refs

Avail NTIS HC A20/MF A01 CSCL 21E

Automated instruments were installed on a commercial B-747 aircraft during the program to obtain baseline data and to monitor key atmospheric constituents associated with emissions of aircraft engines in order to determine if aircraft are contributing to pollution of the upper atmosphere Data thus acquired on a global basis over the commercial air routes for 5 to 10 years will be analyzed Ozone measurements in the 29 000 to 45 000 foot altitude were expanded over what has been available from ozonesondes Limited aerosol composition measurements from filter samples show low levels of sulfates and nitrates in the upper troposphere Recently installed instruments for measurement of carbon monoxide and condensation nuclei are beginning to return data Author

N78-11077*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
STRATOSPHERIC CRUISE EMISSION REDUCTION PROGRAM
Larry A Diehl Gregory M Reck Cecil J Marek and Andrew J Szaniszlo *In its* Aircraft Eng Emissions Oct 1977 p 357-391

Avail NTIS HC A20/MF A01 CSCL 21E

A recently implemented NASA effort specifically aimed at reducing cruise oxides of nitrogen from high-altitude aircraft is discussed The desired emission levels and the combustor technology required to achieve them are discussed A brief overview of the SCERP operating plan is given Lean premixed-prevaporized combustion and some of the potential difficulties that are associated with applying this technique to gas turbine combustors are examined Base technology was developed in several key areas These fundamental studies are viewed as a requirement for successful implementation of the lean premixed combustion technique Author

N78-11078*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
ADVANCED LOW-NO(x) COMBUSTORS FOR SUPERSONIC HIGH-ALTITUDE GAS TURBINES
Peter B Roberts (International Harvester Chicago) *In its* Aircraft Eng Emissions Oct 1977 p 393-415 ref

Avail NTIS HC A20/MF A01 CSCL 21E

The impact of gas-turbine-engine-powered aircraft on worldwide pollution was defined within two major areas of contribution First the contribution of aircraft to the local air pollution of metropolitan areas and second the long-term effects on the chemical balance of the stratosphere of pollutants emitted from future generations of high-altitude supersonic commercial and military aircraft Preliminary findings indicate that stratospheric oxides of nitrogen (NOx) emissions may have to be limited to very low levels if for example ozone depletion with concomitant increases in sea-level radiation are to be avoided Theoretical considerations suggest that (NOx) levels as low as 1 0 gram per kilogram of fuel and less should be attainable from an idealized premixed type of combustor Experimental rig studies were intended to explore new combustor concepts designed to minimize the formation of (NOx) in aircraft gas turbines and to define their major operational problems and limitations Author

N78-11079*# California Univ Berkeley Dept of Mechanical Engineering
LABORATORY STUDIES OF LEAN COMBUSTION
R F Sawyer R W Schefer A R Ganji J W Daily R W Pitz A K Oppenheim and J W Angeli *In* NASA Lewis Res Center Aircraft Eng Emissions Oct 1977 p 417-436 refs

Avail NTIS HC A20/MF A01 CSCL 21E

The fundamental processes controlling lean combustion were observed for better understanding with particular emphasis on the formation and measurement of gas-phase pollutants the stability of the combustion process (blowout limits) methods of improving stability and the application of probe and optical diagnostics for flow field characterization temperature mapping and composition measurements The following areas of investiga

tion are described in detail (1) axisymmetric opposed-reacting-jet-stabilized combustor studies (2) stabilization through heat recirculation (3) two dimensional combustor studies and (4) spectroscopic methods A departure from conventional combustor design to a premixed/prevaporized lean combustion configuration is attractive for the control of oxides of nitrogen and smoke emissions, the promotion of uniform turbine inlet temperatures and, possibly the reduction of carbon monoxide and hydrocarbons at idle Author

N78-11080*# Cincinnati Univ, Ohio Dept of Aerospace Engineering and Applied Mechanics
EFFECT OF AMBIENT TEMPERATURE AND HUMIDITY ON EMISSIONS OF AN IDLING GAS TURBINE
C W Kauffman *In* NASA Lewis Res Center Aircraft Eng Emissions Oct 1977 p 437-456 refs

Avail NTIS HC A20/MF A01 CSCL 21E

The effects of inlet pressure temperature and humidity on the oxides of nitrogen produced by an engine operating at takeoff power setting were investigated and numerous correction factors were formulated The effect of ambient relative humidity on gas turbine idle emissions was ascertained Experimentally, a nonvitiating combustor rig was employed to simulate changing combustor inlet conditions as generated by changing ambient conditions Emissions measurements were made at the combustor exit For carbon monoxide a reaction kinetic scheme was applied within each zone of the combustor where initial species concentrations reflected not only local combustor characteristics but also changing ambient conditions Author

N78-11081*# General Electric Co, Cincinnati, Ohio
COST BENEFIT STUDY OF ADVANCED MATERIALS TECHNOLOGY FOR AIRCRAFT TURBINE ENGINES
R V Hillery and R P Johnston Sep 1977 89 p refs
(Contract NAS3-20074)
(NASA-CR-135235) Avail NTIS HC A05/MF A01 CSCL 21E

The cost/benefits of eight advanced materials technologies were evaluated for two aircraft missions The overall study was based on a time frame of commercial engine use of the advanced material technologies by 1985 The material technologies evaluated were eutectic turbine blades titanium aluminide components ceramic vanes shrouds and combustor liners tungsten composite FeCrAly blades gamma prime oxide dispersion strengthened (ODS) alloy blades and no coat ODS alloy combustor liners They were evaluated in two conventional takeoff and landing missions one transcontinental and one intercontinental Author

N78-11083# Advisory Group for Aerospace Research and Development Paris (France)
SECONDARY FLOWS IN TURBOMACHINES
Sep 1977 304 p In ENGLISH and FRENCH Presented at the 49th meeting of the AGARD Propulsion and Energetics Panel held at The Hague Netherlands 28-30 Mar 1977
(AGARD-CP-214 ISBN-92-835-0199-3) Avail NTIS HC A14/MF A01

The consensus of research which was presented suggested that (1) simplified secondary vortivity considerations and pseudo-boundary layer approaches seem to be promising for multistage compressor analysis if backed by experimental results, (2) this analysis seems to be inadequate for turbines and fully three-dimensional calculation methods must be used These are still time consuming but are certainly less expensive than experiments and (3) new experimental techniques must be used in spite of cost and effort to provide the necessary flow models However experiments must be carefully planned For individual titles see N78-11084 through N78-11104

N78-11097 Air Force Aero Propulsion Lab Wright-Patterson AFB Ohio
UNDERSTANDING TURBINE SECONDARY FLOW
Wayne A Tall *In* AGARD Secondary Flows in Turbomachines Sep 1977 12 p refs
Avail NTIS HC A14/MF A01

Careful control of flow in three dimensions, particularly in low aspect ratio axial turbines was considered in practical utilization of high temperature technology A review of the literature of radial fluid motion and three-dimensional viscous flow in such cascades was done and many contradictory interpretations were disclosed which did not lead to improved understanding of low aspect ratio cascade flow More recent experiments demonstrated that earlier experiments were guided by a false understanding of such flows, especially near the cascade endwalls A recent effort using annular cascades and a three- dimensional viscous flow analysis to improve stage performance rather than merely to correlate cascade results demonstrated the tremendous potential of three-dimensional viscous flow analysis techniques to help in the understanding of this flow problem Author

N78-11098* National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
EFFECT OF ENDWALL COOLING ON SECONDARY FLOWS IN TURBINE STATOR VANES
Louis J Goldman and Kerry L McLallin *In* AGARD Secondary Flows in Turbomachines Sep 1977 29 p refs

Avail NTIS HC A14/MF A01 CSCL 21E

An experimental investigation was performed to determine the effect of endwall cooling on the secondary flow behavior and the aerodynamic performance of a coreturbine stator vane The investigation was conducted in a cold-air full-annular cascade where three-dimensional effects could be obtained Two endwall cooling configurations were tested In the first configuration the cooling holes were oriented so that the coolant was injected in line with the inviscid streamline direction In the second configuration the coolant was injected at an angle of 15 deg to the inviscid streamline direction and oriented toward the-vane pressure surface In both cases the stator vanes were solid and uncooled so that the effect of endwall cooling could be obtained directly Total-pressure surveys were taken downstream of the stator vanes over a range of cooling flows at the design mean-radius critical velocity ratio of 0 778 Changes in the total-pressure contours downstream of the vanes were used to obtain the effect of endwall cooling on the secondary flows in the stator Comparisons were made between the two cooled-endwall configurations and with the results obtained previously for solid endwalls Author

N78-11105# Avco Lycoming Div Stratford Conn
IMPROVED RESISTANCE TO ENGINE BIRD INGESTION
Final Report
Herbert B Kaehler Mar 1977 234 p refs
(Contract DOT-FA76WA-3806)
(AD-A044203 FAA-RD-77-55) Avail NTIS HC A11/MF A01 CSCL 21/5

An analytical design method capable of quantitatively evaluating and ranking rotor blades for resistance to bird impact damage was investigated This method was used to design blades having sufficient tolerance to meet the bird-ingestion requirements of FAR 33 77 for turbofan engines in the 6800 to 1600 lbf thrust class The design procedure was also used for the preliminary design of a damage-resistant boron/aluminum composite fan blade for the 6800 lbf thrust class engine In addition two protective devices designed to prevent an ingested bird from striking sensitive engine parts were presented Author

N78-11106*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
ALTITUDE TEST OF SEVERAL AFTERBURNER CONFIGURATIONS ON A TURBOFAN ENGINE WITH A HYDROGEN HEATER TO SIMULATE AN ELEVATED TURBINE DISCHARGE TEMPERATURE
Roy L Johnsen and Richard R Cullom Nov 1977 57 p refs
(NASA-TP-1068 E-9207) Avail NTIS HC A04/MF A01 CSCL 21E

A performance test of several experimental afterburner configurations was conducted with a mixed-flow turbofan engine in an altitude facility The simulated flight conditions were for Mach 1 4 at two altitudes 12 190 and 14 630 meters Turbine

discharge temperatures of 889 and 1056 K were used A production afterburner was tested for comparison The research afterburners included partial forced mixers with V-gutter flameholders a carbureted V-gutter flameholder and a triple ring V-gutter flameholder with four swirl-can fuel mixers Fuel injection variations were included Performance data shown include augmented thrust ratio thrust specific fuel consumption combustion efficiency and total pressure drop across the afterburner Author

N78-11107# Rocket Research Corp Redmond Wash
HYDRAZINE-FUELED AIRCRAFT STARTER FEASIBILITY DEMONSTRATION Final Report, 30 May 1975 - 31 Mar 1977
W E Jorgenson and B Schmitz Wright-Patterson AFB Ohio AFAPL Mar 1977 150 p
(Contract F33615-75-C-2027)
(AD-A042463 AFAPL-TR-77-16) Avail NTIS HC A07/MF A01 CSCL 21/2

The purpose of this program was to determine the feasibility of converting an aircraft jet engine starter that is normally powered with an 8LBm solid propellant cartridge (type MXU4A/A) to an equivalent liquid monopropellant-fueled device utilizing state-of-the-art hydrazine technology the single most difficult development constraint being that the complete hydrazine system must package within the space normally occupied by the MXU4A/A solid propellant cartridge in the starter breech The feasibility of packaging a hydrazine fueled cartridge in the existing solid propellant breech volume and meeting performance requirements was successfully demonstrated using a breadboard hydrazine system in conjunction with actual cartridge starter hardware GRA

N78-11108# General Motors Corp Indianapolis Ind Detroit Diesel Allison Div
DSTR/501-M62B DYNAMIC INTERFACE CRITICAL SPEED PROBLEM Final Report, Oct 1976 - Feb 1977
W H Parker May 1977 46 p
(Contract DAAJ02-76-C-0072 DA Proj 1F2-62209-AH-76)
(AD-A042441 DDA-EDR-9127 USAAMRDL-TR-77-12) Avail NTIS HC A03/MF A01 CSCL 01/3

A dynamic interface problem was encountered during the Dynamic System Test Rig (DSTR) portion of the Heavy Lift Helicopter (HLH) program This problem involved the dynamic incompatibility of the original designs of the Detroit Diesel Allison (DDA) 501-M62B engine and the Boeing Vertol (BV) DSTR shafting Presented is a detailed discussion of the interface problem and the steps taken toward solution Design modifications to both the engine and shafting were necessary to synthesize an acceptable drive train configuration Recommendations are proposed for avoidance of engine/airframe interface problems in future programs Author (GRA)

N78-11110# ARO Inc Arnold Air Force Station, Tenn
INFRARED RADIATION FROM THE EXHAUST JET OF A J85-GE-5 TURBOJET Final Report
W T Bertrand AEDC Aug 1977 15 p ref
(AF Proj 3048)
(AD-A043282, ARO-ETF-TR-77-39 AEDC-TR-77-70) Avail NTIS HC A02/MF A01 CSCL 17/5

Spectral measurements were made to compare infrared radiation from the exhaust jet of an engine burning JP-4 and fuel blends which simulate fuels derived from oil shale A circular variable filter spectroradiometer was used to obtain spectral radiation data from the exhaust of a J85-GE-5 turbojet engine Xylene was added to JP-4 to simulate the aromatic content of oil shale fuels Radiation data were obtained at each of seven instrument locations with the engine operating at four power levels Author (GRA)

N78-11112# Detroit Diesel Allison Indianapolis Ind
THE EFFECT OF SPLITTER VANE CIRCUMFERENTIAL LOCATION ON THE AERODYNAMIC PERFORMANCE OF A SUPERSONIC COMPRESSOR CASCADE Final Technical Report, 1 Mar 1976 - 1 Feb 1977
Ronald E Riffel and Sanford Fleeter Wright-Patterson AFB Ohio AFAPL Feb 1977 686 p refs
(Contract F33615-76-C-2052 AF Proj 2307)
(AD-A043860 AFAPL-TR-77-20 FTR-9169) Avail NTIS MF A01 CSCL 21/5

This report describes the experimental investigation of a linear stationary supersonic compressor cascade incorporating splitter vanes blades of constant spanwise geometry and contoured sidewalls Previous experimental studies of this cascade showed that the cascade performance concurred with the modeled rotor data and that the splitter vane location and/or shape was not optimal Hence the overall objective of this program was to experimentally determine if a preferred circumferential position for the splitter vane existed This was accomplished by modifying the original cascade hardware to permit the splitter vanes to be moved in the equivalent circumferential direction with respect to the principal blades The aerodynamic characteristics of the cascade were then experimentally determined at 41 test conditions These covered a range of static pressure ratios between 1 6 and the spill point at the design inlet Mach number for each of eight splitter vane locations one of which was the original 50 percent spacing location Author (GRA)

N78-11113# Pratt and Whitney Aircraft West Palm Beach Fla Government Products Div
APPLICATION OF FRACTURE MECHANICS AT ELEVATED TEMPERATURES Final Report
Raymond M Wallace Charles G Annis Jr and David L Sims Wright-Patterson AFB Ohio AFML Apr 1977 66 p refs
(Contract F33615-75-C-5097)
(AD-A044239 FR-8100 AFML-TR-76-176-Pt-2) Avail NTIS HC A04/MF A01 CSCL 21/5

The applicability of linear elastic fracture mechanics to predict crack growth at elevated temperatures is investigated The interactive effects of stress temperature time and environment on the crack growth of an advanced gas turbine disk alloy IN-100 are described with an interpolative empirical model based on the hyperbolic sine Author (GRA)

N78-11114*# National Aeronautics and Space Administration Washington D C
CONCEPTS FOR THE DESIGN OF A COMPLETELY ACTIVE HELICOPTER ISOLATION SYSTEM USING OUTPUT VECTOR FEEDBACK
G Schulz Oct 1977 68 p refs Transl into ENGLISH of Konzepte zur Auslegung eines Vollaktiven Hubschrauber-Schwingungs Isolations Systems mittels Ausgangsvektorrueckfuehrung Rept DLR-DB-552-76/12 DFVLR Oberpfaffenhofen West Germ Sep 1976 63 p Original language document was announced as N77-21085 Transl by Sci Transl Serv Santa Barbara Calif
(Contract NASw-2791)
(NASA-TM-75161 DLR-DB-552-76/12) Avail NTIS HC A04/MF A01 CSCL 01C

The theory of output vector feedback (a few measured quantities) is used to derive completely active oscillation isolation functions for helicopters These feedback controller concepts are tested with various versions of the BO 105 helicopter and their performance is demonstrated A compensation of the vibrational excitations from the rotor and harmonics of the number of blades are considered There is also a fast and automatic trim function for maneuvers Author

N78-11115# Air Force Flight Test Center Edwards AFB Calif
STABILITY AND CONTROL FLIGHT TEST THEORY, VOLUME 1 Final Report
Feb 1977 390 p refs Revised 2 Vol
(AD-A042583 AFFTC-TIH-77-1-Vol-1-Rev) Avail NTIS HC A11/MF A01 CSCL 01/3

This handbook has been compiled by the instructors of the USAF Test Pilot School for use in the Stability and Control portion of the School s course Most of the material in Volume I of this handbook has been extracted from several reference books and is oriented towards the test pilot The flight test techniques and data reduction methods in Volume II

have been developed at the Air Force Flight Test Center Edwards Air Force Base California Author (GRA)

N78-11116# Boeing Commercial Airplane Co Seattle Wash
AIRCRAFT ALERTING SYSTEMS CRITERIA STUDY VOLUME 2 HUMAN FACTORS GUIDELINES FOR AIRCRAFT ALERTING SYSTEMS Final Report, Jan - Nov 1976
G P Boucek Jr J E Veitengruber and W D Smith May 1977 140 p refs
(Contract DOT-FA73WA-3233)
(AD-A043383 D6-44200-Vol-2 FAA RD-76-222-2) Avail NTIS HC A07/MF A01 CSCL 01/4

Human factors literature that describes pilot response characteristics when confronted with aircraft warning caution and advisory signals was reviewed The review covered visual aural (sounds and voice) tactile and bimodal alerts Data obtained therefrom were categorized into (1) non-aircraft-related test results (2) aircraft-related test results and (3) military standards/design guidelines so as to establish the applicability of the data and to identify technical areas in which more human factors data relevant to aircraft-alerting systems may be required Summaries of the literature for (1) factors that affect signal detection and (2) factors that affect time from detection to response are provided The results of the review were used to establish preliminary design guidelines for alerting systems in future commercial transport aircraft Author (GRA)

N78-11117# Dynamic Controls Inc Dayton Ohio
THE EVALUATION OF A DIGITAL HARDWARE VOTER/MONITOR IN AN AIRCRAFT CONTROL SYSTEM Final Report, Jan 1975 - Jan 1977
Harry W Schreadley Wright-Patterson AFB Ohio AFFDL May 1977 170 p refs
(Contract F33615-75-C-3068 AF Proj 2049)
(AD-A043979 AFFDL-TR-77-30) Avail NTIS HC A08/MF A01 CSCL 01/4

This report describes an evaluation and presents the test results of a Digital Hardware Voter/Monitor used as an input signal selector and fault detector when used in conjunction with an electro-hydraulic control system The DHVM operated as intended by design although asynchronous operation caused the failure detection to be frequency dependent A digital filter could be incorporated to reduce the frequency dependency of the failure detection circuitry Author (GRA)

N78-11118# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt Brunswick (West Germany) Abt Experimentelle Aerodynamik
AN INVESTIGATION ON THRUST VECTOR CONTROL [EINE UNTERSUCHUNG ZUR STEUERUNG DES SCHUBVEKTORS]
A Zacharias Oct 1976 32 p refs In GERMAN
(DLR-IB-151-76/15) Avail NTIS HC A03/MF A01

Work on pneumatic thrust vector control to increase the lift and maneuverability of an aircraft is presented By sequential generation of reduced pressure zones near the jet exit plane of a propulsion gondola model the thrust jet was deflected Results of the tests show that pneumatic thrust vector control is in principle possible ESA

N78-11119*# National Aeronautics and Space Administration Washington D C
FLIGHT SIMULATORS PART 1 PRESENT SITUATION AND TRENDS PART 2 IMPLICATIONS FOR TRAINING
D Hass and W Volk Aug 1977 39 p Transl into ENGLISH from Flugsimulatoren Teil 1 Stand und Entwicklungstendenzen Teil 2 Auswirdung auf die Ausbildung Deut Gesellschaft Fuer Ortung und Nationale Tagung Ueber Simulation im Dienste des Verkehrs Bremen (W Germany) 15-17 Apr 1975 paper 3 4 p 34 Original Language Document was announced as A75-44115
Transl by Kanner (Leo) Associates Redwood City Calif
(Contract NASw-2790)
(NASA-TM-75156) Avail NTIS HC A03/MF A01 CSCL 14B

The present situation and developments in the technology of flight simulators based on digital computers are evaluated from the standpoint of training airline flight crews Areas covered are minicomputers and their advantages in terms of cost space and time savings software data packets motion simulation visual simulation and instructor aids The division of training time between aircraft and simulator training and the possible advantages from increased use of simulators are evaluated Author

N78-11120# Federal Aviation Administration Washington D C Systems Research and Development Service
FIELD COMPACTION OF BITUMINOUS MIXES FOR AIRPORT PAVEMENTS Final Report
Aston L McLaughlin Apr 1977 64 p refs
(AD-A041335/1 FAA-RD-77-42) Avail NTIS HC A04/MF A01 CSCL 01/5

The mix design and construction factors directly affecting pavement compactibility are discussed The rationale for the Federal Aviation Administration requirement concerning the compaction of bituminous airport pavements (98 percent minimum of Marshall density) is given and justified on the basis of expected pavement strength and durability If certain design construction and testing procedures are not within strict limits difficulty or failure to achieve adequate compaction will result Recommendations are made that will assure and facilitate the attainment of high quality pavements Author

N78-11121*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
CALIBRATION AND TEST CAPABILITIES OF THE LANGLEY 7- BY 10- FOOT HIGH SPEED TUNNEL
Charles H Fox Jr and Jarrett K Huffman May 1977 75 p
(NASA-TM-X-74027) Avail NTIS HC A04/MF A01 CSCL 14B

The results of a new subsonic calibration of the Langley 7 by 10 foot high speed tunnel with the test section in a solid wall configuration are presented A description of the test capabilities of the 7 by 10 foot high speed tunnel is also given Author

N78-11122# Connecticut International Corp Windsor Locks SEPCO Div
DEVELOPMENT OF A FRANGIBLE APPROACH LIGHT Final Report, Mar 1975 - Mar 1977
James N Usko Mar 1977 38 p
(Contract DOT-FA75WA-3610)
(AD-A043859 FAA-RD-77-71 Rept-7681) Avail NTIS HC A03/MF A01 CSCL 17/7

An effort expended to develop a lightweight frangible approach light housing is described The goal of frangibility was not achievable as initially conceived however significant progress was made in the state of the art relative to housings which are lightweight, suitable for the visual aid purpose intended and with a substantial measure of frangibility Author

N78-11123# Naval Air Test Facility Lakehurst N J Launching Div
DEADLOAD CALIBRATION PROGRAM OF CVN 68 CATAPULT CONFIGURATION Final Report, 28 Aug 1972 - 17 Nov 1976
Edward J Yesunas 9 Mar 1977 38 p refs
(AD-A042225 NATF-EN-1137) Avail NTIS HC A03/MF A01 CSCL 01/5

This report describes a deadload calibration program conducted at the Naval Air Test Facility with the TC13 Mod 1 catapult in the final CVN 68 configuration During the program the standard CVN 68 catapult configuration was tested and then various catapult control parameters were varied during tests in order to clarify the operational limits of the CVN 68 catapult configuration Tests were conducted with deadloads weighing from 10 500 to 84 500 pounds Author (GRA)

N78-11124# Naval Civil Engineering Lab Port Hueneme Calif
POROUS FRICTION SURFACE RUNWAY AT USNAS DALLAS, TEXAS Final Report, Sep - Jun 1976

R B Brownie Jun 1977 34 p refs
(AD-A042181 CEL-TN-1487) Avail NTIS HC A03/MF A01 CSCL 01/5

The performance of the porous friction surfacing (PFS) on a runway at the U S Naval Air Station Dallas Texas was evaluated Runway friction measurements with a mu-meter field permeability measurements visual condition surveys corings of the pavement for determination of asphalt binder properties and an investigation of aircraft accidents attributed to hydroplaning were accomplished The results of these investigations show that the porous friction surface is providing (1) a highly skid-resistant surface for high-speed jet aircraft operations (2) an excellent surface with few visible defects and (3) a minimum service life of 5 years with a potentially much longer life Author (GRA)

N78-11126# Naval Postgraduate School, Monterey Calif
DESIGN, CONSTRUCTION AND TESTING OF A SUB-SCALE TURBOJET TEST CELL M S Thesis
Holden Willets Hewlett Mar 1977 74 p refs
(AD-A043005) Avail NTIS HC A04/MF A01 CSCL 21/5

A one-eighth scale turbojet test cell was designed and constructed and initially operated to determine facility characteristics Experiments were then conducted to determine engine operating characteristics inlet velocity profiles and cell pressure profiles for two augmentor-to-engine spacings Experimental data were compared to existing computer model predictions and showed qualitative agreement Recommendations are made for facility improvements Author (GRA)

N78-11127# Human Resources Research Organization Alexandria, Va
SOME CURRENT PROBLEMS IN SIMULATOR DESIGN, TESTING AND USE
Paul W Caro Mar 1977 15 p refs Presented at the 38th Military Operations Res Symp Fort Eustis Va 7-9 Dec 1976 Prepared in cooperation with Seville Research Corp Pensacola Fla
(Contract F44620-76-C-0118 AF Proj 2313)
(AD-A043240 HumRRO-PP-2-77 AFOSR-77-0990TR) Avail NTIS HC A02/MF A01 CSCL 14/2

This report is concerned with the general problem of the effectiveness of simulator training and reflects information developed during the conduct of aircraft simulator training research projects sponsored by the Air Force Army, Navy and Cost Guard Problems are identified related to simulator design testing and use that impact simulator training effectiveness These problems are (1) isolation of the simulator user from the design and development process (2) inattention to behavioral and training models during that process (3) ignoring training considerations during simulator testing (4) inadequate feedback to simulator designers concerning simulator training effectiveness (5) inattention to techniques of simulator training that differ from techniques of aircraft training (6) inadequate training for simulator instructors (7) use of rate of simulator utilization as an index of its training effectiveness and (8) inadequacies of simulator training cost effectiveness data Author (GRA)

N78-11128# Human Resources Research Organization Alexandria Va
SOME FACTORS INFLUENCING AIR FORCE SIMULATOR TRAINING EFFECTIVENESS Interim Report
Paul W Caro Mar 1977 106 p refs Prepared in cooperation with Seville Research Corp Pensacola Fla
(Contract F44620-76-C-0118 AF Proj 2313)
(AD-A043239 HumRRO-TR-77-2 AFOSR-77-0971TR) Avail NTIS HC A06/MF A01 CSCL 14/2

A study of U S Air Force simulator training was conducted to identify factors that influence the effectiveness of such training and to learn how its effectiveness is being determined The research consisted of a survey of ten representative Air Force simulator training programs and a review of the simulator training research literature A number of suspected or potential factors influencing simulator training effectiveness were identified These factors include simulator design for training visual display fidelity platform motion system fidelity handling characteristics training program features trainee and instructor characteristics and attitudes and expectations toward simulator training The discussion of each factor reviews relevant literature and Air Force simulator design features and training practices Ten simulator training effectiveness study design models were identified Efforts by the Air Force to validate the simulator training activities surveyed are described in relation to these ten models It was found that the programs surveyed had not been subjected to formal evaluation studies that would establish their training effectiveness in quantitative terms Therefore the influence of factors identified during the survey upon such training could only be hypothesized Recommendations were made concerning research and administrative action that could enhance future simulator training effectiveness Author (GRA)

N78-11130# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt Brunswick (West Germany) Abt Experimentelle Aerodynamik
DESCRIPTION OF THE NEW REGULATING VALVE FOR THE TRANSONIC SUPERSONIC WIND TUNNEL [BESCHREIBUNG DES NEUEN REGELVENTILS FUER DEN TRANS-UEBERSCHALLWINDKANAL]
G Kausche and W Puffert Nov 1976 42 p refs In GERMAN
(DLR-IB-151-76/6) Avail NTIS HC A03/MF A01

Reliability tests of the automatic regulating valve of the transonic/supersonic wind tunnel of the Institute for Aerodynamics are described The required constancy of the prechamber pressure during a test with a sufficiently high storage pressure could be achieved At prechamber pressures above 2 bar the values guaranteed after 2 sec during pressure increase were not reached but the values guaranteed after 4 sec were achieved Tests of an additional high pressure safety device for transonic operation are also described ESA

N78-11199*# Boeing Commercial Airplane Co Seattle Wash
***THE 737 GRAPHITE COMPOSITE FLIGHT SPOILER FLIGHT* SERVICE EVALUATION Annual Report, Apr 1975 - Mar 1976**
Robert L Stoecklin May 1976 33 p refs
(Contract NAS1-11668)
(NASA-CR-144984, AR-2) Avail NTIS HC A03/MF A01 CSCL 11D

The flight-service experience of 110 graphite-epoxy spoilers on 737 transport aircraft and related ground-based environmental exposure of graphite-epoxy material specimens is reported Spoilers were installed on each of 27 aircraft representing seven major airlines operating throughout the world Based on visual, ultrasonic and destructive testing, there is no evidence of moisture migration into the honeycomb core and no core corrosion Tests of removed spoilers and of ground-based exposure specimens after the second year of service indicate modest changes in composite strength Author

N78-11201# IIT Research Inst Chicago Ill
DETERMINATION OF THE PRINCIPAL MECHANICAL PROPERTIES OF REINFORCED PLASTIC LAMINATES FOR AIRCRAFT Final Technical Report, Oct 1973 - Apr 1977
K E Hofer Apr 1977 47 p refs
(Contract DAAA21-74-C-0114)
(AD-A043350) Avail NTIS HC A03/MF A01 CSCL 11/9

The purpose of the test program described in this report was to develop engineering data on the mechanical and physical properties of reinforced plastic laminates for aircraft Following are the systems tested Modmor I Graphite/Narmco 5208 AS Graphite/Hercules 3501-5 T300 Graphite/Narmco 5208 RAC-7350/1014S-24 Kevlar 49 (PRD III)/Hexcel F161 The laminates were subjected to the following tests tension fatigue, compression in-plane shear, flexural and interlaminar shear and bearing stress Author (GRA)

N78-11204# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt Brunswick (West Germany) Abt Kunststoffe

STRENGTH INVESTIGATIONS FOR THE APPLICATION OF FIBER REINFORCED PLASTICS TO AERONAUTICAL EQUIPMENT FITTINGS [FESTIGKEITSUNTERSUCHUNGEN ZUM EINSATZ FASERVERSTAERKTER KUNSTSTOFFE FUER BESCHLAGTEILE VON LUFTFAHRTGERAET]

M Gaedke and H J Hesselbrock 18 Dec 1975 85 p refs In GERMAN ENGLISH summary

(DLR-IB-152-75/25) Avail NTIS HC A05/MF A01

Results of technological and experimental investigations of unidirectional filament wounded rings and loops with various geometrical shapes and different reinforced materials such as glass fibers carbon fibers and polyamide (Kerlar) fibers are reported For critical examination of different fittings a quality factor was defined This comparison factor representing the ratio of fracture load to fitting weight shows more favorable values for fittings out of reinforced than out of metal material Another advantage is the higher energy of deformation for these materials Author (ESA)

N78-11236# Boeing Aerospace Co Seattle Wash

CAST ALUMINUM STRUCTURES TECHNOLOGY (CAST) Final Report, Jun 1976 - Feb 1977

Donald Goehler May 1977 76 p refs

(Contract F33615-76-C-3111)

(AD-A043469 D180-20526-1 AFFDL-TR-77-36) Avail NTIS HC A05/MF A01 CSCL 01/3

The objective of CAST is to establish the necessary structural and manufacturing technologies and to demonstrate and validate the integrity producibility and viability of cast aluminum primary airframe structures The baseline design is the AMST prototype YC-14 and the component selected was the Nose Landing Gear Support Bulkhead Preliminary design activities are described that were aimed at the minimum goal of 30% acquisition cost savings with no weight penalty Preliminary design data were developed and a design recommended that could save 38% on cost and result in a 10-pound weight savings Author (GRA)

N78-11238# Lockheed Missiles and Space Co Palo Alto, Calif Research Lab

CORRELATION OF MICROSTRUCTURE WITH FRACTURE TOUGHNESS PROPERTIES IN METALS, PART 3 Final Report, 11 Apr 1975 - 10 Jan 1977

Richard E Lewis and Frank A Crossley 10 Jan 1977 145 p refs

(Contract N00019-75-C-0378)

(AD-A043741 LMSC-D555813-Pt-3) Avail NTIS HC A07/MF A01 CSCL 11/6

Ti-6Al-4V alloy 1-in plate was studied for the purpose of establishing a correlation between microstructures and fracture toughness stress-corrosion cracking and fatigue crack growth Both standard and ELI grades mill-annealed vacuum-creep-furnace flattened and recrystallization-annealed were included Reheat-treatments by duplex-annealing and beta- plus duplex-annealing were performed including air and furnace cooling from the final annealing temperature A total of 17 conditions were studied complementing the 49 conditions previously studied on two contracts to Naval Air Systems Command Tensile fracture toughness stress-corrosion cracking and fatigue crack growth properties were determined Optical microscopy and scanning electron microfractography were employed Six conditions studied previously were reexamined by transmission electron microscopy to investigate the effect of cooling rate on the interface phase between alpha and beta phases and on development of short-range order in the alpha phase GRA

N78-11251# National Aviation Facilities Experimental Center Atlantic City N J

FULL-SCALE AIRCRAFT CRASH TESTS OF MODIFIED JET FUEL Final Report, Jul 1972 - May 1974

Robert H Ahlers Jul 1977 98 p

(FAA Proj 181-520-000)

(AD-A043843 FAA-NA-77-35 FAA-RD-77-13) Avail NTIS HC A05/MF A01 CSCL 21/4

Crash tests were conducted with two A3 and two RB66 aircraft under impact-survivable crash conditions The wing tanks in the first RB66 aircraft contained Jet A fuel modified with an 0 7-percent polymeric additive The aircraft was crash tested into the specially constructed test site at 104 6 knots The fuel mist generated by the fuel released from four crash-inflicted openings in the front wing spar was not ignited by the array of ignition sources The wing tanks in the second RB66 aircraft were filled with JET A fuel modified with 0 5-percent of the same polymeric additive The aircraft was crashed into the test site at 102 4 knots The test conditions for the second RB66 test were made more severe by increasing the fuel temperature partially drilling out areas in the front spar to increase the opened fuel spillage area and by adding four fuel release openings under the wing larger ignition sources, and operating the engines The fuel mist burst into flame and followed the aircraft down the test site continuing to burn until extinguished by the firefighting crew These full-scale tests indicate that modified fuels have a potential for reducing the postcrash fire hazard Author

N78-11260*# National Aeronautics and Space Administration Langley Research Center Langley Station Va

LIQUID HYDROGEN FLASH VAPORIZER Patent Application

Albert M Momenthy inventor (to NASA) (Boeing Commercial Airplane Co Seattle) Filed 21 Oct 1977 9 p Sponsored by NASA

(NASA-Case-LAR-12159-1 US-Patent-Appl-SN-844347) Avail NTIS HC A02/MF A01 CSCL 13I

A method and device are disclosed for initially reducing the temperature of a stream of LH2 in a fuel distribution line The device allows some LH2 to escape into and vaporize in a shroud surrounding a length of the line just upstream of the nozzle The effect of this controlled evaporation is to cool the LH2 in the line to satisfactorily low temperatures before it exits the line This prevents the immediate vaporization of the fuel as it leaves the line NASA

N78-11330 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt Cologne (West Germany) Inst fuer Luftstrahlantriebe

A NEW TECHNIQUE FOR CONTROLLING THE EXIT FLOW PERIODICITY OF SUPERSONIC CASCADES

Hans Starken *In* Ecole Polytech Federale de Lausanne Meas Tech in Transonic and Supersonic Cascades and Turbomachines 1977 p 83-86 ref

Avail Juris-Verlag Sw Fr 16

A solution is proposed for controlling the outlet flow periodicity of supersonic cascades This consists in a slotted tailboard combined with an attached chamber The tailboard is similar to the ones used in normal transonic wind tunnels but also needs to provide the necessary back pressure This is done by feeding the pressure just upstream of the throttle through the chamber to the open slots ESA

N78-11391# Advisory Group for Aerospace Research and Development Paris (France)

ADVANCED MANUFACTURING TECHNIQUES IN JOINING OF AEROSPACE MATERIALS

Sep 1977 192 p refs

(AGARD-LS-91 ISBN-92-838-0203-5) Avail NTIS HC A09/MF A01

A comprehensive survey is presented of joining processes and their application in aerospace industries thus contributing to an exploitation of welding and similar processes in production technology

N78-11392 Grumman Aerospace Corp Bethpage N Y Advanced Materials and Processes Development

ADVANCED JOINING TECHNIQUES IN AEROSPACE CELL STRUCTURES

Robert H Witt *In* AGARD Advanced Manufacturing Tech in Joining of Aerospace Mater Sep 1977 29 p refs

Avail NTIS HC A09/MF A01

General aspects of advantages and difficulties in welding critical primary aircraft structures are discussed The all-welded F-14A wing center-section is used as an example to delineate the types of problems inherent in selecting the optimum welding process and procedures to assure structural integrity minimum cost distortion control and light weight The aerospace industry is particularly interested in joining titanium steel and aluminum alloys in various gages ranging from thin sheet to heavy plate 2 to 3 in (50 to 75 mm) thick Various welding processes and applications are discussed in relation to selection criteria Developments in electron-beam welding small and large titanium structures are presented with particular attention given to high vacuum welding and directions being taken in non-vacuum and sliding-seal electron-beam welding Applications of pulsed gas-tungsten-arc plasma-arc (welding and cutting) laser beam (welding and cutting) weld-bonding diffusion bonding and brazing are discussed The survey continues with a discussion of design for use of modern methods of weld inspection the effects of defects on weld performance and some experiences in testing large structures Recommendations for use of design and test data evaluations to minimize cost increase ease of fabrication facilitate inspection and increase reliability confidence conclude the paper Author

N78-11393 Pratt and Whitney Aircraft Group East Hartford Conn Materials Engineering and Research Lab
PROCESS AND METALLURGICAL FACTORS IN JOINING SUPERALLOYS AND OTHER HIGH SERVICE TEMPERATURE MATERIALS
William A Owczarski *In* AGARD Advanced Manufacturing Tech in Joining of Aerospace Mater Sep 1977 32p refs

Avail NTIS HC A08/MF A01

Aircraft gas turbines rely on materials which must operate durably at elevated temperatures Fabrication methods to make turbine parts are selected for reliability and cost effectiveness Thus nickel-base superalloys which are the dominant heat resistant material used in aircraft gas turbines are frequently metallurgically joined in manufacture or repair of a gas turbine The nature of the superalloy class of materials makes joining difficult Several problems exist in welding the superalloys such as heat affected zone hot cracking and post-weld heat treatment cracking The nature of these difficulties is described including a metallurgical discussion of their causes Methods for reducing or eliminating these problems are discussed along with some general guidelines for joining this material class Some examples of the processes and applications for joining are reviewed along with descriptions of how processes are adapted to provide the quality properties and reliability required for gas turbine use of welded superalloys Author

N78-11395 Dortmund Univ (West Germany)
NON-WELDING JOINING, CUTTING AND THERMAL SPRAYING METHODS
H D Steffens *In* AGARD Advanced Manufacturing Tech in Joining Aerospace Mater Sep 1977 25 p refs

Avail NTIS HC A09/MF A01

No heat at all will necessarily be used in metal or polymer bonding where no restrictions are given in the selection of material to be joined The short term low temperature properties of the joints are excellent when thermal resistivity is poor but long term properties especially under environmental conditions are widely unknown However many examples are known for applied bonding joints in aerospace industries Thermal cutting processes are used as preparation methods for metallic components prior to welding or other joining processes Oxy-acetylene plasma arc and laser beam cutting offer certain advantages for particular materials and sheet thicknesses There is a strong development in laser techniques by which cutting processes in aircraft industries will be affected Author

N78-11426# Laboratorium fuer Betriebsfestigkeit Darmstadt (West Germany)
REVIEW OF INVESTIGATIONS ON AERONAUTICAL FATIGUE IN THE FEDERAL REPUBLIC OF GERMANY, MAY 1975 - APRIL 1977
O Buxbaum and D Schuetz 1977 149 p refs Presented at the 15th Conf of the Intern Comm on Aeron Fatigue Darmstadt, West Ger 1977
(LBF-S-133) Avail NTIS HC A07/MF A01

Research carried out in the field of fatigue of aircraft structures is reviewed Topics covered include measurement and analysis of operational loads, fatigue behavior of notched specimens and joints fatigue life prediction cyclic stress-strain behavior, and low cycle fatigue crack propagation fracture mechanics and residual static strength fatigue of fiber reinforced plastics and full-scale tests tests with large components and service failures ESA

N78-11536# Research Inst for Environmental Hygiene TNO Delft (Netherlands)
[ACTIVITIES OF THE TNO RESEARCH INSTITUTE FOR ENVIRONMENTAL HYGIENE] Annual Report, 1974-1975
[1976] 50 p refs
Avail NTIS HC A03/MF A01

Various sections deal with water and soils atmospheric pollution indoor air pollution indoor climate sound lighting and isolation housing and living ESA

N78-11802# National Gas Turbine Establishment Pyestock (England)
THE USE OF CO-FLOWING AIRSTREAMS FOR THE SIMULATION OF FLIGHT EFFECTS ON JET NOISE
D J Way and B J Cocking Jun 1977 47 p refs
(NGTE-R-345 BR58372) Avail NTIS HC A03/MF A01

The influence of a co-flowing airstream on the noise of subsonic air jets was investigated over a range of secondary-to-primary area ratios from 1 8 to 1800 The simulation consists of surrounding the air jet emitted from a stationary nozzle with a concentric secondary jet blowing at an appreciably lower velocity representing that of flight Correlations of the data confirm that the effects of flight on jet mixing noise may be investigated using a comparatively small secondary stream and with the microphone positioned outside the flow Results show that a minimum area ratio of about 50 is necessary to model adequately the effects of flight for the main noise-producing regions of the jet As the size of the secondary stream is reduced information for the lower frequencies is progressively lost Author (ESA)

N78-11974# European Space Agency Paris (France)
WIND TUNNEL STUDY OF AN ACTIVE FLUTTER SUPPRESSION SYSTEM **c08**
Roger Destuynder *In its* La Rech Aerospatiale, Bi-monthly Bull No 1976-4 (ESA-TT-396) Jul 1977 p 117-134 refs Transl into ENGLISH from La Rech Aerospatiale Bull Bimestriel (Paris), no 1976-4 Jul-Aug 1976 p 233-241 Original report in FRENCH previously announced as A77-11159

Avail NTIS HC A08/MF A01

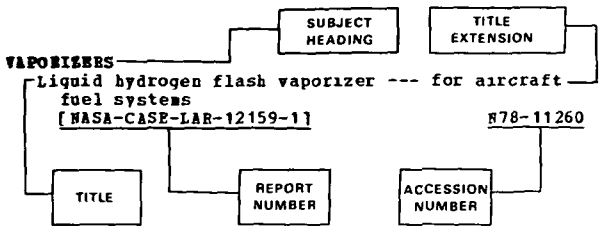
Active flutter control was experimented in a wind tunnel on a model of wing carrying an external tank The aerodynamic forces of the control system were generated by a classical aileron piloted by a miniaturized servo-control from a signal issued by an accelerometer detecting the wing movement A single control law was used in the whole velocity range A gain of more than 15% was obtained on the flutter critical velocity Author (ESA)

N78-11983# European Space Agency, Paris (France)
AMPLIFICATION OF DISTORTIONS IN AN AXIAL COMPRESSOR STAGE **c07**
Lionel Ravet *In its* La Rech Aerospatiale Bi-monthly Bull No 1976-3 (ESA-TT-356) Nov 1976 p 133-140 refs Transl into ENGLISH from La Rech Aerospatiale Bull Bimestriel (Paris) no 1976-3 May - Jun 1976 p 183-185 Original report in FRENCH previously announced as A76-41130

Avail NTIS HC A09/MF A01

Linear theory is used to study the steady-state flow in an axial compressor fed by a stream with low-amplitude azimuthal heterogeneity It is shown that there exist critical conditions for which a perturbation of very low amplitude is multiplied thousands of times by interaction of the fixed and mobile blade grids This amplification can occur only when there is coupling between the wheel and the diffuser which follows it and if there exist irreversibilities resulting from flow separation in the interblade channels In this case the equilibrium required for lateral readjustment of the streams with different energies can only be obtained by large modifications in velocity This amplification effect is impossible in a perfect fluid Author (ESA)

Typical Subject Index Listing



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A-300 AIRCRAFT
Ceramic composite protection for turbine disc bursts --- for the A-300 aircraft
N78-10083
Parts tests for the landing flap support of the Airbus A-300 B
[DLR-IB-152-77/07] N78-11056
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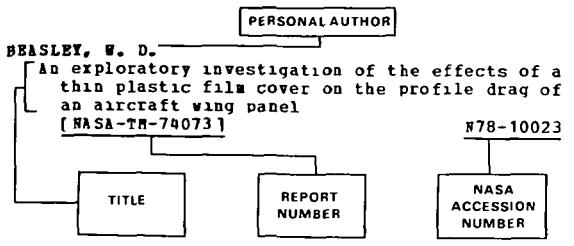

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