



Aeronautical
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A Continuing
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NASA SP-7037 (109)
May 1979

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Pages 183 - 245

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AERONAUTICAL ENGINEERING

A Continuing Bibliography

Supplement 109

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in April 1979 in

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

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INTRODUCTION

Under the terms of an interagency agreement with the Federal Aviation Administration this publication has been prepared by the National Aeronautics and Space Administration for the joint use of both agencies and the scientific and technical community concerned with the field of aeronautical engineering. The first issue of this bibliography was published in September 1970 and the first supplement in January 1971. Since that time, monthly supplements have been issued.

This supplement to *Aeronautical Engineering -- A Continuing Bibliography* (NASA SP-7037) lists 466 reports, journal articles, and other documents originally announced in April 1979 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*.

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

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

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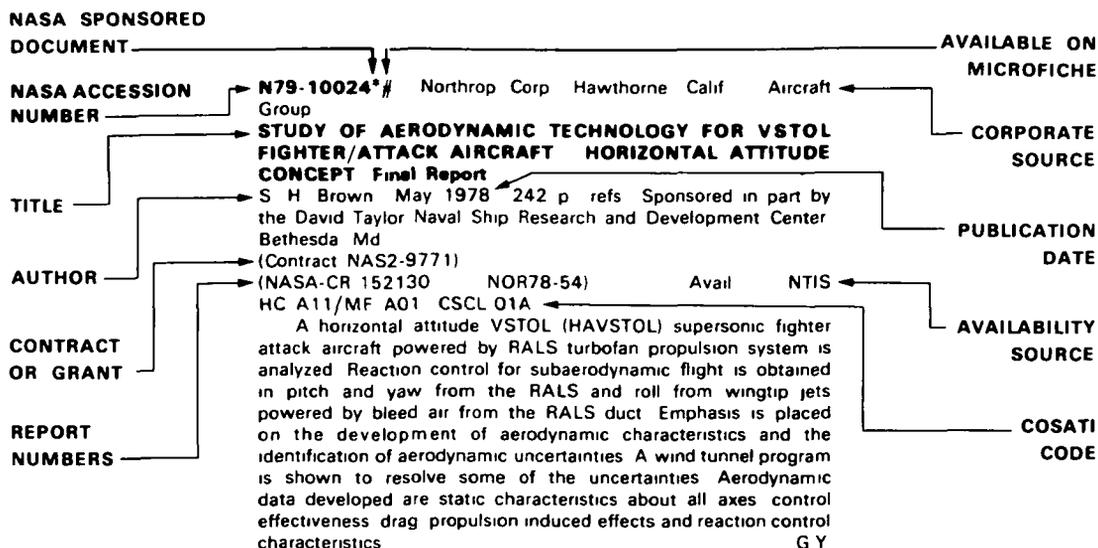
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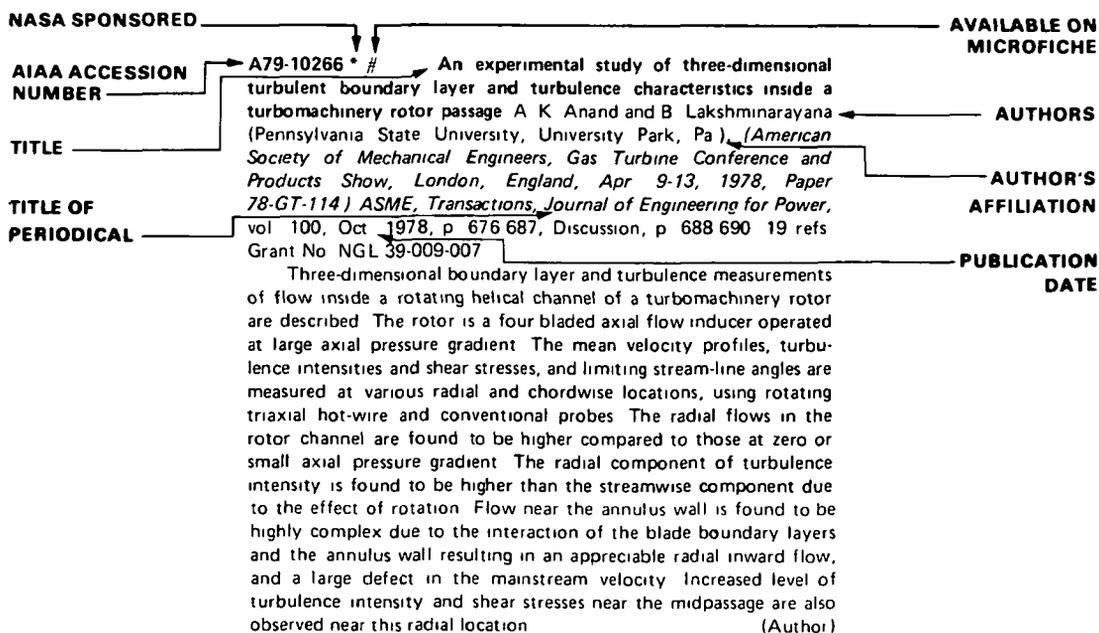
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AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 109)

MAY 1979

IAA ENTRIES

A79-20477 # The role of fluid mechanics in aviation technology (Die Rolle der Stromungsmechanik in der Luftfahrttechnik) H Hertrich (Bundesministerium für Forschung und Technologie, Bonn, West Germany) *Deutsche Gesellschaft für Luft- und Raumfahrt, Symposium über Forschung und Entwicklung auf dem Gebiet der Stromungsmechanik und Aerodynamik in der Bundesrepublik Deutschland, Bonn, West Germany, Nov 29-Dec 1, 1978, Paper 78-218* 23 p In German

The paper outlines the future role of experimental fluid mechanics, including acoustics, in aircraft engineering. The increased role of experimental fluid mechanics in the total air research picture of the countries in GARTeUR (Group for Aeronautical Research and Technology in Europe) is noted. Large subsonic projects are the 5 m wind tunnel of the RAE, the ONERA F1 wind tunnel, the Dutch German wind tunnel of maximum size 9.5 x 9.5 m, and the 40 x 80 ft NASA Ames facility. Among transonic facilities, mention is made of the NASA Langley cryogenic facility with maximum Reynolds number of 120 million, and the projected European transonic wind tunnel, measuring 1.95 x 1.65 m with maximum Reynolds number of 40 million. The costs of these projects are discussed. Principal areas of further fluid mechanics research are identified. In particular, the development of fuel-saving aircraft and the problem of maintaining laminarity by suction or new wing design are mentioned. P T H

A79-20479 # Experimental results on boundary layers and detached flows (Experimentelle Ergebnisse über Grenzschichten und abgeloste Strömungen) H U Meier (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für experimentelle Stromungsmechanik, Göttingen, West Germany) *Deutsche Gesellschaft für Luft- und Raumfahrt, Symposium über Forschung und Entwicklung auf dem Gebiet der Stromungsmechanik und Aerodynamik in der Bundesrepublik Deutschland, Bonn, West Germany, Nov 29-Dec 1, 1978, Paper 78-220* 56 p 36 refs In German

The paper reviews experimental results on boundary layers and detached flows and summarizes the current status of such investigations. Attention is given to two-dimensional shock boundary layer interference, three-dimensional boundary layers, boundary layer control, and detached flows on flight vehicles and slender bodies. Three-dimensional turbulent boundary layers on a ship model, three-dimensional turbulent wall boundary layers in front of a cylinder, three-dimensional turbulent boundary layers on a cylinder placed lengthwise in the flow, three-dimensional boundary layers on a fuselage-like model, and detached flows on slender wings and delta wings are revealed in flow visualization experiments. P T H

A79 20480 # Unsteady flows (Instationäre Strömungen) W Geissler (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Cologne, West Germany) *Deutsche Gesellschaft für Luft- und Raumfahrt, Symposium über Forschung und Entwicklung auf dem Gebiet der Stromungsmechanik und Aerodynamik in der Bundesrepublik Deutschland, Bonn, West Germany, Nov 29-Dec 1, 1978, Paper 78-222* 28 p In German

A system of computational methods for determining unsteady forces acting on harmonically oscillating airfoils and displacement bodies in incompressible and compressible subsonic flows is described. New results for oscillating airfoils in supersonic flow are also given. Parallel wind tunnel results are also brought into the discussion in order to illustrate the usefulness and limitations of the computations. P T H

A79-20481 # Research and development in the area of fluid mechanics and aerodynamics in the Federal Republic of Germany (Forschung und Entwicklung auf dem Gebiet der Stromungsmechanik und Aerodynamik in der Bundesrepublik Deutschland) M Lotz (Dornier GmbH, Friedrichshafen, West Germany) *Deutsche Gesellschaft für Luft- und Raumfahrt, Symposium über Forschung und Entwicklung auf dem Gebiet der Stromungsmechanik und Aerodynamik in der Bundesrepublik Deutschland, Bonn, West Germany, Nov 29-Dec 1, 1978, Paper 78-223* 41 p 23 refs In German

The paper reports on some of the more significant results attained recently in experimental aerodynamics with relevance to possible future aircraft design projects. Drag-rise data on the supercritical wing for large transport aircraft are presented. Work on increasing the maneuverability of supersonic fighter aircraft and on the advanced technology airfoil is also reported. P T H

A79-20482 # Helicopter aerodynamics (Hubschrauber-aerodynamik) H Huber (Messerschmitt-Bolkow-Block GmbH, Munich, West Germany) *Deutsche Gesellschaft für Luft- und Raumfahrt, Symposium über Forschung und Entwicklung auf dem Gebiet der Stromungsmechanik und Aerodynamik in der Bundesrepublik Deutschland, Bonn, West Germany, Nov 29-Dec 1, 1978, Paper 78-225* 35 p 18 refs In German

A survey is provided of the significant problems of current helicopter aerodynamics, taking into account for purposes of illustration work presently conducted in a German aerospace company. Points of particular interest are related to the presentation of the flow characteristics at the exposed areas of the rotor blade, requirements regarding the design of blade profiles and blade tip forms, and problems of airflow calculations. Aspects of fuselage aerodynamics are considered and procedures for the calculation of the characteristics of detached fuselage flow in interaction with the rotor wake are shown. Possibilities concerning a practical evaluation in the wind tunnel and at the flying device are briefly considered. Recommendations for future activities in the area of helicopter aerodynamics from the point of view of industry are also presented. G R

A79-20483 # Aerodynamics of fluid flow engines (Aerodynamik der Strömungsmaschinen) H Starke (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Antriebstechnik, Cologne, West Germany) *Deutsche Gesellschaft für Luft- und Raumfahrt, Symposium über Forschung und Entwicklung auf dem Gebiet der Stromungsmechanik und Aerodynamik in der Bundesrepublik Deutschland, Bonn, West Germany, Nov 29 Dec 1, 1978, Paper 78-226* 25 p 10 refs In German

The current status of research and development with respect to fluid flow engines is examined. Development objectives for most of the various types of fluid flow engines are related to an improvement of the efficiency, the enhancement of the thrust-weight ratio in the case of aircraft engines, the improvement of operational characteristics, and a reduction of noise. The first phase in the history of fluid flow engines was mainly characterized by experimentation. The

availability of electronic computers provides nowadays possibilities for planned, systematic improvements. However, a complete theoretical solution of the flow field of a fluid flow engine is not yet possible. Investigations must, therefore, be based on simplified models. The status of research at universities and research institutes in West Germany is considered, giving attention to basic research activities involving simplified flow models and also to investigations which are concerned with complete fluid flow engines. G R

A79-20485 # The importance of experimenting in aerodynamics and fluid mechanics (Bedeutung des Experiments für Aerodynamik und Stromungsmechanik) B Ewald (Vereinigte Flugtechnische Werke-Fokker GmbH, Bremen, West Germany) *Deutsche Gesellschaft für Luft- und Raumfahrt, Symposium über Ermüdungsfestigkeit von Flugzeugen und modernen Bauweisen, Darmstadt, West Germany, Nov 29-Dec 1, 1978, Paper 78-229* 19 p 7 refs In German

By means of a historical review of the development of fluid mechanics it is shown that the role of experiments in fluid mechanics has undergone continual transition. Experimental data have contributed to progress in theory, and this progress has in turn made certain aspects of experimental work superfluous. At the same time, this progress also raised new questions which had to be solved experimentally. The development of the large computer enabled at least a partial solution of the fluid dynamics equations. This revolution in computer capabilities tended to reduce the importance of experiment in the design phase, but verification of results is possible only through experimentation. Technological improvements in experimental techniques and integrated computer control of experiments are necessary in the future. P T H

A79-20491 # Composite components under impact load and effects of defects on the loading capacity (Composite-Bauteile unter Schlagbelastung und Auswirkung von Defekten auf die Belastbarkeit) D Wurzel and R Aoki (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Bauweisen- und Konstruktionsforschung, Stuttgart, West Germany) *Deutsche Gesellschaft für Luft- und Raumfahrt, Symposium über Ermüdungsfestigkeit von Flugzeugen und modernen Bauweisen, Darmstadt, West Germany, Sept 22, 1978, Paper 78-190* 48 p In German

The reported investigations were conducted in connection with the development of a horizontal tail surface made of carbon-fiber reinforced plastic for the Alpha Jet. The possibility was studied to obtain a leading edge design which would be lighter, but not more expensive, than the metal version. An important consideration was that the leading edge must have sufficient resistance against collisions with stones or hail. This resistance must be combined with a high degree of stiffness. A survey is provided of development work which was conducted to improve the energy-reception properties of the material with the aid of a suitable laminate design. The design of components made of fiber-reinforced material is usually based on the properties of undamaged laminates. However, it can hardly be avoided that structural components have certain defects. The effects of such defects on the component characteristics was, therefore, also studied. G R

A79-20494 # An analysis of the new construction regulations for military and civil aircraft construction with respect to the demonstration of serviceability (Eine Analyse der neuen Bauvorschriften für den militärischen und zivilen Flugzeugbau im Hinblick auf den Nachweis der Betriebsfestigkeit) H Huth and D Schutz (Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung, Laboratorium für Betriebsfestigkeit, Darmstadt, West Germany) *Deutsche Gesellschaft für Luft- und Raumfahrt, Symposium über Ermüdungsfestigkeit von Flugzeugen und modernen Bauweisen, Darmstadt, West Germany, Sept 22, 1978, Paper 78-193* 19 p In German

The requirements for the computational and experimental demonstration of serviceability contained in the MIL specifications and FAR recommendations are discussed, giving particular attention to damage tolerance demands. A description is presented of obvious shortcomings and dangers related to an aircraft structure which has

been designed exclusively according to fracture-mechanics considerations. Practical examples are also used to illustrate that only a good mixture of the customary design concepts of fail safe/safe-life with requirements related to damage tolerance will lead to economical and safe aircraft structures. G R

A79-20495 # Analytical life estimation for helicopter components (Analytische Lebensdauerabschätzung von Hubschrauberbauteilen) M von Tapavicza and F Och (Messerschmitt Bolkow Blohm GmbH, Ottobrunn, West Germany) *Deutsche Gesellschaft für Luft- und Raumfahrt, Symposium über Ermüdungsfestigkeit von Flugzeugen und modernen Bauweisen, Darmstadt, West Germany, Sept 22, 1978, Paper 78-195* 16 p 8 refs In German

An analytical formulation of the fatigue properties of a component and an expression of stress conditions provided by statistical methods are employed to obtain with the aid of a formula an estimate of the operational life of a component. The considered approach is based on the utilization of a damage accumulation hypothesis. The advantage of such a method is related to the possibility to investigate by means of a simple procedure the effect of the individual parameters involved, giving attention, in particular, to the mission profile of a helicopter and the employed materials. The obtained formula for the determination of the operational life can be used in all phases of component development. G R

A79-20496 Wind-tunnel impellers in fiber composite design for the Swiss Aircraft Works in Emmen, Switzerland (Windkanalflugel in Faserverbund-Bauweise für die Eidgen, Flugzeugwerke Emmen/Schweiz) H Bansemir (Messerschmitt-Bolkow-Blohm GmbH, Ottobrunn, West Germany) *Deutsche Gesellschaft für Luft- und Raumfahrt, Symposium über Ermüdungsfestigkeit von Flugzeugen und modernen Bauweisen, Darmstadt, West Germany, Sept 22, 1978, Paper 78-196* 22 p In German

The blower of the wind tunnel of the considered Swiss aerospace company contains two impellers revolving in opposite directions. The considered problem involved the design of wind-tunnel impellers with an operational life of 30 years. Preliminary investigations showed that a fiber-composite design is particularly suited for the solution of the problem. Carbon-fiber unidirectional laminates were employed to receive the longitudinal and flexural stresses. Glass-fiber layers with a fiber inclination of 45 deg in the external layer were used with respect to torsional and transversal stresses. Attention is given to design criteria and manufacturing procedures, the characteristic parameters of the material, static computations, a calculation of the natural frequencies with the aid of the matrix transfer method, and experimental testing procedures. G R

A79-20498 # Estimation of the useful life of the lower chord of the girder of the PC-7 'Turbo-Trainer' (Lebensdauer - Abschätzung des Holm - Untergurtes PC-7 'Turbo-Trainer') K Bergius and R Meier (Pilatus-Flugzeugwerke AG, Stans, Switzerland) *Deutsche Gesellschaft für Luft- und Raumfahrt, Symposium über Ermüdungsfestigkeit von Flugzeugen und modernen Bauweisen, Darmstadt, West Germany, Sept 22, 1978, Paper 78-198* 38 p 11 refs In German

The example of the PC-7 'Turbo-Trainer' is used to describe an approach for estimating the useful life of a wing with the aid of a standard load spectrum for fighter aircraft. It is shown that the considered load spectrum and that of a training aircraft are relatively similar. It is, therefore, possible to use experimental data obtained in the prescribed fatigue tests for the life prediction procedure. The results of the experiments are compared with data reported in literature. The 'Relative Miner Rule' is used to obtain on the basis of the estimated PC-7 load spectrum a prediction for the useful life of the PC-7 wing. G R

A79-20548 # System considerations for airborne, high power superconducting generators H L Southall and C E Oberly (USAF, Aero Propulsion Laboratory, Wright Patterson AFB, Ohio) (*Applied Superconductivity Conference, Pittsburgh, Pa., Sept 25-28, 1978*) *IEEE Transactions on Magnetics*, vol MAG-15, Jan 1979, p 711 714 10 refs

The design of rotating superconducting field windings in high power generators is greatly influenced by system considerations. Experience with two superconducting generators designed to produce 5 and 20 Megawatts has resulted in a number of design restrictions. The design restrictions imposed by system considerations have not prevented low weight and high voltage power generation capability. The application of multifilament Nb₃Sn has permitted a large thermal margin to be designed into the rotating field winding. This margin permits the field winding to remain superconducting under severe system operational requirements. System considerations include fast rotational startup, fast ramped magnetic fields, load induced transient fields and airborne cryogen logistics. Preliminary selection of a multifilament Nb₃Sn cable has resulted from these considerations. The cable will carry 864 amperes at 8.5K and 6.8 Tesla. (Author)

A79-20559 Aerospace and military - Progress in space structure research, aircraft landing systems, integrated optics, and digital communications. J. F. Mason. *IEEE Spectrum*, vol 16, Jan 1979, p 71-75.

Progress in 1978 in aircraft landing systems, space structure research, military optical transmission and detection technology, and military digital communication systems are surveyed. Advantages of the MLS (microwave landing system), which will replace the ILS in the next decade are discussed together with data from Pioneer, Viking and Voyager spacecrafts which have radar-mapped the planets Venus, Mars and Jupiter, respectively. The use of the Space Shuttle to erect space structures, including satellite solar-energy collectors, is analyzed, noting costs and size details. Attention is directed to design and advantages of fiber-optic links and of integrated optical circuits, techniques for developing a video-compression module, structure and advantages of a multifunctional radar (being tested by the Air Force) and of the AN/TTC 39 circuit and message system. A. A.

A79-20566 # To the problem of starting and airfoil-shape optimization of the supersonic compressor cascade. K. Celikovský (Vyzkumný ústav letecký, Prague, Czechoslovakia) and P. Safárik (Československá Akademie věd, Ústav termomechaniky, Prague, Czechoslovakia). *Acta Technica CSAV*, vol 23, no 6, 1978, p 732-754. 18 refs.

A theoretical investigation of the flow field in supersonic compressor cascades of the external compression and the multi-circular arc type was carried out by using one and two dimensional analyses. An analysis of cascade start-up has shown that both cascades operate at high Mach number according to the 'unique incidence' concept and in the transonic region approximately according to the shock deflection model of Fabri. These results were confirmed by wind tunnel tests. The problem of the optimization of the supersonic cascade airfoil shape was formulated. The velocity distribution on the suction side under conditions of minimum entropy rise in the passage shock is given. It is characterized by a sudden expansion to the velocity value close to that corresponding to the inflection point on the shock wave, followed by a smooth compression. The compression region is shifted nearer to the trailing edge of the airfoil, which seems to affect adversely the start-up behavior of the cascade passages. P. T. H.

A79-20661 # Experimental verification of annular wing theory (Eksperimentalna proverba teorije prstenastog krila). S. Pivko. *Srpska Akademija Nauka i Umetnosti, Glas, Odeljenje Tehnichkih Nauka*, no 12, 1978, p 5-12. In Serbo-Croatian.

An approximate theory of annular wings is outlined and some results of its experimental verification are presented. It is assumed, for small angle of attack, that the local velocity is determined by the influence of the section thickness, the camber of the section mean line, and the angle of attack. By the method of singularities, the influence of section thickness is approximated by a system of source and sink rings. The influence of the section camber is approximated by a distribution of bound vortex rings on a cylinder. The influence of incidence is approximated by a bound vortex ring of variable strength and by a system of trailing vortices. Pressure distributions

along the outer and inner surfaces of the top section of a NACA 64210 airfoil were calculated for zero incidence and 1-deg incidence, and the results are compared with experimental results. P. T. H.

A79-20665 # Optoelectronic devices for flight vehicle control systems (Optiko-elektronnye pribory sistem upravleniya letatel'nymi apparatami). L. P. Lazarev and V. L. Lazarev. Moscow, Izdatel'stvo Mashinostroenie, 1978. 175 p. 23 refs. In Russian.

The principles of operation and design of optoelectronic flight vehicle control systems are set forth. The design problem is treated as a problem in the design of large systems from the standpoint of systems engineering. Systems considered include scanning thermal direction finders, thermal autonavigation heads, and optical devices used by the operator in flight during landing and in training. Methods of increasing the effectiveness of the development process of electrooptic equipment based on rational organization of the development steps and use of computer modeling are studied. P. T. H.

A79-20671 # Engineering studies of aircraft hydraulic drives (Inzhenernye issledovaniya gidroprivodov letatel'nykh apparatov). D. N. Popov, S. A. Ermakov, I. N. Loboda, V. M. Fomichev, and I. S. Shumilov. Moscow, Izdatel'stvo Mashinostroenie, 1978. 144 p. 38 refs. In Russian.

Basic engineering methods are developed for the design of electrohydraulic servo systems for aircraft control. Particular consideration is given to the resonant frequencies and vibration damping of hydraulic drives, the design and operation of electrohydraulic power amplifiers, the dynamic characteristics of electrohydraulic drives and methods for their correction, and techniques for the computer analysis and simulation of such systems. B. J.

A79-20672 # Auxiliary gas turbine engines for aircraft (Aviatsionnye gazoturbinnye vspomogatel'nye silovye ustanovki). A. M. Poliakov, Iu. I. Shal'man, V. I. Krichakin, E. P. Fedorov, A. A. Luzhin, and V. S. Petrovskii. Moscow, Izdatel'stvo Mashinostroenie, 1978. 200 p. 8 refs. In Russian.

The work treats the basic theory of auxiliary gas turbine engines and considers problems of design, control, and operation of such engines. Particular consideration is given to basic operating characteristics, integration of auxiliary engine operation with the rest of the aircraft system (i.e., the main engine, the power supplies, and the air conditioning system), startup conditions, and thermal analysis. B. J.

A79-20760 # The effect of the aerodynamic resistance of the feeder line on the operation of safety valves (Der Einfluss des Stromungswiderstandes der Zufuhrungsleitung auf die Arbeitsweise von Sicherheitsventilen). H. Zeller and B. Follmer. *Rheinisch-Westfälische Technische Hochschule, Aerodynamisches Institut, Abhandlungen*, no 23, 1978, p 18-23. 12 refs. In German.

It is pointed out that the feeder lines of safety valves might, in connection with their aerodynamic resistance and the unsteady flow processes occurring in them, have a detrimental effect on the safe operation of the valve. An investigation is, therefore, conducted to determine the effect of the resistance of feeder lines on the operation of safety valves. The resistance to flow provided by straight pipes and pipe bends is examined, and attention is given to the pressure loss in the feeder line, the reduction of the flow rate, and the effect of the pressure loss on the safety function of the valve. G. R.

A79-20761 # The low-density channel of the Aerodynamic Institute (Der low-density-Kanal des Aerodynamischen Instituts). D. Jorgens. *Rheinisch-Westfälische Technische Hochschule, Aerodynamisches Institut, Abhandlungen*, no 23, 1978, p 33-37. 14 refs. In German.

The considered testing stand, which was established during the 1960s, is mainly used for the study of flows in the transition region between continuum and free molecular flow. This region is not easily accessible to theoretical and experimental studies. In this installation

mass flow was studied as a function of pressure ratio and Reynolds number. Other investigations are related to the density distribution on the axis in free jets, the wall pressure characteristics, and the density and temperature profile in conic nozzle flow. The density and temperature are measured by means of a contactless approach based on the electron beam fluorescence procedure. The measurement process is based on the analysis of the emission spectrum of the flowing gases. G R

A79-20773 **The potential of liquid hydrogen as a military aircraft fuel** W T Mikolowsky (Rand Corp., Washington, D C.) and L W Noggle (USAF, Wright Patterson AFB, Ohio) *International Journal of Hydrogen Energy*, vol 3, Dec 11, 1978, p 449-460 15 refs

The paper is concerned with the possible use of liquid hydrogen as a fuel for very large aircraft (with maximum gross weights in excess of one million pounds). Life cycle costs and life-cycle energy consumption for both synthetic jet-fuel and liquid hydrogen-fueled aircraft are compared, and it is found for these coal derived fuels that synthetic jet fuel is more attractive than liquid hydrogen as a military aircraft fuel. Strategic airlift mission and station keeping missions are considered. M L

A79-20774 **Some environmental and safety aspects of using hydrogen as a fuel** G D Brewer (Lockheed California Co., Burbank, Calif.) (*Commission of the European Communities, EURATOM Course, Ispra, Italy, May 9-13, 1977*) *International Journal of Hydrogen Energy*, vol 3, Dec 11, 1978, p 461-474 7 refs

The use of hydrogen as a fuel for road vehicles and for aircraft is discussed from the viewpoint of environmental and safety considerations. The current pattern of hydrogen use in industrial processes is described, and the use of hydrogen for energy transmission and for household appliances is considered. The problem of air pollution from aircraft is examined. M L

A79-20790 **In-flight refuelling and the world of the eighties /Second Sir Alan Cobham Memorial Lecture/** J E McCormick (Boeing Co., Seattle, Wash.) *Aeronautical Journal*, vol 82, Aug 1978, p 327-333

Following a brief historical review of in-flight refuelling in the United States since 1921, the paper discusses the US tanker requirements in the context of the 1980s, operational techniques to enhance the contribution of tankers to long-range cargo delivery systems, new tanker aircraft, new refuelling equipment, and the capability attainable with these systems. The differences between continuous fleet refuelling operations and the single sorties typical in bomber refuelling missions are illustrated. The key elements of a novel refuelling system are a precision sensor system and a computer on the tanker that controls the system and processes the sensor-generated data in real time. A system to drive the director lights and strobe lights in manual refuelling operations can be incorporated in existing or future aircraft to provide safer, more rapid hookups and reduced training requirements. S D

A79-20791 **The development and use of simulators for helicopter flight training in the Royal Navy** G J P Wingate (Royal Navy, London, England) (*Royal Aeronautical Society, Symposium on Extending the Scope of Flight Simulation, London, England, Apr 19, 1978*) *Aeronautical Journal*, vol 82, Aug 1978, p 334-341

The paper discusses the evolution of the helicopter within naval aviation as well as the development of the helicopter simulator along with its actual aircraft counterpart. The uses to which the Royal Navy puts its simulators are detailed, with special emphasis on the most used simulator, the Sea King Flight and Mission Simulator. The expanding use of helicopters is examined, with a look at the Royal Navy's present day aircraft, the Lynx, and its simulator. The assured future for flight simulation within the Fleet Air Arm is emphasized. S D

A79-20792 **Computer generated images for aircraft use** D C Evans (Evans and Sutherland Computer Corp., Salt Lake City, Utah) (*Royal Aeronautical Society, Symposium on Extending the Scope of Flight Simulation, London, England, Apr 19, 1978*) *Aeronautical Journal*, vol 82, Aug 1978, p 342-345

The paper demonstrates how the use of computers to produce visual images to facilitate man-machine interaction has developed greatly over the past decade and has proven to be useful for pilot training and other applications. The interaction proceeds as follows: the computer produces a visual image, the operator sees the image, the operator generates a response which he sends to the computer, and the computer in turn causes some change in the visual image. Through the use of computer graphics technology the pilot training system produces a sequence of images which give the pilot the impression of seeing a continually variable out-the-window scene as he would if flying the real aircraft. The scene can include fog, clouds, landing lights and other visual effects which may be important in pilot training. The television technology permits full color and sufficient brightness for daylight simulation. Future technology will aim at improving image resolution, image quality, level of detail, scene richness, angle of view, texture, illumination, shadows and cost-effectiveness. S D

A79-20793 **Pitot-tubes at 90 and 180 degrees of yaw** O O Mojola (Ife, University, Ife, Nigeria) *Aeronautical Journal*, vol 82, Aug 1978, p 355-357 6 refs

Exploratory measurements are presented for Pitot-tube (pressure sensor) response in a uniform stream at two particular yaw angles, viz 90 and 180 deg. While the 90-deg angle is chosen largely out of pure curiosity, the choice of 180-deg yaw is motivated by questions raised in an earlier study (1973) on pressure-probe interference in a vortex flow. The effects of shear on the pitot-tube response is briefly discussed. From the full yaw calibrations at Reynolds numbers of 549 and 1200, it is deduced that the local static pressure is recorded by the Pitot tube when the angle of yaw is about 60 deg, and that the probe reading is lowest when the angle of yaw is 90 deg. The pressure coefficient is determined for 90- and 180-deg angles of yaw, in terms of the Reynolds number and the ratio of inside to outside diameters of the Pitot tube. The effects of shear on the Pitot tube are such as to increase the probe readings at 90-deg yaw but to depress them at 180-deg yaw, as compared with the corresponding results in uniform flow. S D

A79-20798 # **Fluid dynamics of diffuser-augmented wind turbines** B L Gilbert, R A Oman, and K M Foreman (Grumman Fluid Dynamics Laboratory, Bethpage, N Y.) *Journal of Energy*, vol 2, Nov Dec 1978, p 368-374 6 refs Contract No E(11-1) 2616

The diffuser-augmented wind turbine (DAWT) is one of the advanced concepts being investigated to improve the economics of wind energy conversion systems (WECS). Application of modern boundary layer control techniques has reduced the surface area requirements of an efficient diffuser by an order of magnitude. Many parameters that affect the performance of the diffuser system have been examined in small-scale wind tunnel tests with a family of compact diffusers, using screens and centerbodies to simulate the presence of turbine. Flowfield surveys, overall performance, the effect of ground proximity, and the prospects for further improvement are described. The baseline configuration is a conical, 60 deg included angle diffuser with an area ratio of 2.78 controlled by two tangential injection slots. This first-generation DAWT can provide about twice the power of a conventional WECS with the same turbine diameter and wind. Economic estimates show that this DAWT can be as much as 50% cheaper than conventional WECS for the same rated power. (Author)

A79-20800 # **An inverse problem of vertical-axis wind turbines** J V Healy (Belfast, Queen's University, Belfast, Northern Ireland) *Journal of Energy*, vol 2, Nov Dec 1978, p 382-384 5 refs

The problem of choosing the most desirable lift and drag forces for a vertical-axis wind turbine is examined. The solution is obtained simply by specifying $A = 1/3$ and $C(p) = 16/27$ (where A is the inflow factor and $C(p)$ is the maximum theoretical power coefficient), and solving for the lift and drag coefficients and the corresponding value of the angle of attack. It is found that even if it were possible to vary the angle of attack with angular position around the blade path, it would still be impossible to extract all the available energy. With the angle between the chord line and the radial line fixed, this reduces the possibilities even further. B J

A79-20807 * Extensive cost reduction studies Composite empennage component - L-1011 commercial airliner J Van Hamersveld (Lockheed-California Co, Burbank, Calif) In Selective application of materials for products and energy, Proceedings of the Twenty-third National Symposium and Exhibition, Anaheim, Calif, May 2-4, 1978 Azusa, Calif, Society for the Advancement of Material and Process Engineering, 1978, p 94-112 Contract No NAS1-14000

A series of cover skin laminate studies was conducted. The baseline laminate design is composed of 34 plies with doublers interwoven. This is costly to produce, since the broad goods tape dispersing machine must stop frequently while the doubler plies are inserted by hand during the layup sequence. The use of graphite cloth was investigated for the cover skin. Attention is also given to low resin content prepreg, the selection of optimum tape width, an increase in gap/overlap tolerances, the use of large reusable vacuum bags with mechanical edge seals for production, an integrated laminating center machine, automated hat stiffener processing, a secondary bond assembly process, and a single-stage cure process. G R

A79-20815 Phosphoric acid non-tank anodize /PANTA/ process for repair bonding M C Locke (Boeing Co, Seattle, Wash) and W M Scardino (USAF, Materials Laboratory, Wright-Patterson AFB, Ohio) In Selective application of materials for products and energy, Proceedings of the Twenty-third National Symposium and Exhibition, Anaheim, Calif, May 2-4, 1978 Azusa, Calif, Society for the Advancement of Material and Process Engineering, 1978, p 218-242 USAF-supported research

A test program was conducted to investigate and optimize the processing parameters of the phosphoric acid nontank anodize (PANTA) method of aluminum surface preparation for repair bonding. The effects of anodizing potential, temperature, time, and rinse delay were studied. In addition, the effects of anodizing mode and anodizing over fasteners were evaluated. Common errors that can occur in the application of PANTA were identified and corrective procedures developed. Bond verification data from wedge crack extension tests, bond strength tests, and stress rupture tests as well as SEM oxide thickness data were developed. This paper presents a summary of the more critical anodizing parameters of voltage potential, temperature, time, and rinse delay. (Author)

A79-20817 Nondestructive testing of adhesive bonded structure D Hagemeyer and R Fassbender (Douglas Aircraft Co, Long Beach, Calif) In Selective application of materials for products and energy, Proceedings of the Twenty-third National Symposium and Exhibition, Anaheim, Calif, May 2-4, 1978 Azusa, Calif, Society for the Advancement of Material and Process Engineering, 1978, p 253-299 13 refs USAF-sponsored research

A description is presented of the present state-of-the-art nondestructive testing as it pertains to adhesive bonded joints. A US aerospace company is fabricating a primary adhesive bonded structure for one wide body fuselage. The primary inspection instrument is the Fokker bondtester which is used to periodically evaluate damaged tolerance specimens and to inspect the bond joints during fabrication and later for periodic checks during the full-scale

structure tests. If the bonded fuselage concept went into production, automated X-ray radiography would be used in case the adhesive were X-ray opaque. If the adhesive were not X-ray opaque, through transmission ultrasonic C scan would be used. The Fokker bondtester would be used for single bond joint lap-shear strength correlations to verify voids or porosity and to determine depth or bond line position of noted defects. G R

A79-20856 Smoke hazards from aircraft materials R G McKee and S B Martin (SRI International, Chemical Engineering Laboratory, Menlo Park, Calif) In Selective application of materials for products and energy, Proceedings of the Twenty-third National Symposium and Exhibition, Anaheim, Calif, May 2-4, 1978 Azusa, Calif, Society for the Advancement of Material and Process Engineering, 1978, p 913-924

Smoke toxicity is not an intrinsic property of a material, rather it is a fire-related extrinsic property. The paper provides a rationale for the establishment of a bioassay protocol that does properly account for the 'fire-relatedness' of smoke toxicity. The biological endpoints for the test protocol must be pertinent to escape and rescue actions that may be taken in a fire, whose success or failure will often determine survival. Concentration-time relationships are discussed, and methods of evaluating the dose-response relations are described. This methodology affords a full range of data for a minimum expenditure of time and money. The use of CO as an internal standard and the derivation of the toxic hazard index are emphasized. Incapacitation studies on rats are described. Example data are provided on polymeric materials that are or might be used in aircraft. S D

A79-20861 Aerospace usage versus commercial utilization of graphite fiber reinforced epoxy composites J D Allen and J W Heth (Fiberite Corp, Winona, Minn) In Selective application of materials for products and energy, Proceedings of the Twenty-third National Symposium and Exhibition, Anaheim, Calif, May 2-4, 1978 Azusa, Calif, Society for the Advancement of Material and Process Engineering, 1978, p 980-992

Characteristics and use of high-strength graphite/epoxy composite combination are discussed. The combination, approximately 30-40% lighter in weight than aluminum and stiffer and stronger than metals, was originally used by the aerospace industry but its use is now spreading in other industries. Comparative advantages of unidirectional prepreg tapes and woven fabric prepregs are considered. Fibers and scrim used in tape prepregs are described, and applications of several combinations are reported. M L

A79-20864 Relative behavior of graphite/epoxy and aluminum in a lightning environment C D Skouby (McDonnell Aircraft Co., St Louis, Mo) In Selective application of materials for products and energy, Proceedings of the Twenty-third National Symposium and Exhibition, Anaheim, Calif, May 2-4, 1978 Azusa, Calif, Society for the Advancement of Material and Process Engineering, 1978, p 1013-1023 9 refs

The macroscopic electrical response of aluminum and Graphite/Epoxy (Gr/Ep) composite panels subject to a lightning environment was investigated to determine if metal and Gr/Ep would have different probabilities of lightning strike attachment. Results show that despite differences in electrical properties, metal and Gr/Ep do not exhibit any significant differences in lightning attach point characteristics. (Author)

A79-20865 Effects of lightning current waveform components on graphite/epoxy composite material E H Schulte (McDonnell Aircraft Co, St Louis, Mo) In Selective application of materials for products and energy, Proceedings of the Twenty-third National Symposium and Exhibition, Anaheim, Calif, May 2-4, 1978 Azusa, Calif, Society for the Advancement of Material and Process Engineering, 1978, p 1024-1038 26 refs

This paper deals principally with lightning current waveform related damage of unprotected multi-ply graphite/epoxy (Gr/Ep) composite materials. The lightning test waveform was broken into component parts, which were applied individually and in various combinations to the test panels, to observe differences in damage resulting from the different test conditions. Preliminary results indicate that testing of the material with the complete waveform may cause more damage than when the various waveform components were applied one at a time to one location. In a related experiment, a 9-ply unprotected Gr/Ep panel was punctured by the high peak current component of the lightning strike but not by the intermediate and continuing currents. In contrast, an aluminum panel will not be punctured by the high peak current but the continuing current will cause burn through or rear surface melting. (Author)

A79-20866 Lightning conductive characteristics of graphite composite structures. J T Kung and M P Amason (Douglas Aircraft Co., Long Beach, Calif.) In Selective application of materials for products and energy, Proceedings of the Twenty-third National Symposium and Exhibition, Anaheim, Calif., May 24, 1978. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1978, p 1039-1053. 9 refs.

The optimum lightning protection design approach for graphite composite aircraft structures is to fully utilize their electrical conductive properties. Douglas Aircraft Company has conducted a series of lightning tests to define various conductive properties of graphite composite panels and joints. A Thermovision mapping technique was used to successfully record the lightning current flow pattern on graphite composite panels. The conductive characteristics for different graphite fiber layouts, panel dimensions, joint interface designs, and fastener effects are presented. The conductive characteristics for precipitation static charges and the antenna ground plane effects are also discussed. (Author)

A79-20868 Flexible polyimide fuel tank sealants. R J Jones and H N Cassey (TRW Defense and Space Systems Group, Redondo Beach, Calif.) In Selective application of materials for products and energy, Proceedings of the Twenty-third National Symposium and Exhibition, Anaheim, Calif., May 24, 1978.

Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1978, p 1063-1077. 17 refs. Contracts No F33615-69-C-1541, No F33615-71-C 1397, No F33615-77-C-5134.

Requirements for elastomers or compliant polymers used as integral fuel tank sealant materials and as seals in high-performance military aircraft are examined, and a polyimide system with the appropriate properties is described. The system contains methylene dianiline, 4,4'-diaminostilbene, polyethyleneoxide diamine, and bis(4-(3,4-dicarboxyphenoxy)phenyl) sulfone dianhydride. Development, preparation, and applications of the polyimide sealant are discussed. M L

A79-20873 Advanced composite 727 elevator and 737 stabilizer programs. G Y Ohgi (Boeing Commercial Airplane Co., Renton, Wash.) In Selective application of materials for products and energy, Proceedings of the Twenty-third National Symposium and Exhibition, Anaheim, Calif., May 24, 1978.

Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1978, p 1131-1149.

Possibilities regarding the use of graphite/epoxy composite structure in commercial aircraft were investigated. The 727 elevator and 737 stabilizer are primarily stiffened designed components to satisfy certain control system and flutter requirements. The graphite/epoxy components designed to match the stiffness of such components, in general, have strains that are low enough that the chances of encountering strength related problems are minimal. Manufacturing feasibility has been verified by the fabrication of a number of components. Structural integrity has been demonstrated by development tests. G R

A79-20874 Composite structure applications for commercial aircraft. D G Smillie (Douglas Aircraft Co., Long Beach, Calif.) In Selective application of materials for products and energy, Proceedings of the Twenty-third National Symposium and Exhibition, Anaheim, Calif., May 24, 1978. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1978, p 1150-1168.

A description is presented of the technical highlights of three segments of the NASA Aircraft Energy Efficiency (ACEE) composites program. The key program decisions are defined with the rationale for their selection. A primary objective of the ACEE program is to accelerate the use of advanced composite structures by developing technology and processes for early progressive introduction of composite structures into production commercial transport aircraft. Key steps in accomplishing this objective include the development of low cost design and manufacturing approaches which will produce a cost competitive structure. A variety of advanced composite structural components are to be initiated into commercial airline service. Attention is given to a composite rudder, a composite vertical stabilizer, and the utilization of advanced composites in commercial aircraft wing structures. G R

A79-20875 Lightning protection techniques for graphite/epoxy aircraft structures. C L Hendricks, S D Schneider (Boeing Commercial Airplane Co., Seattle, Wash.), and G Shumaker (USAF, Flight Dynamics Laboratory, Dayton, Ohio). In Selective application of materials for products and energy, Proceedings of the Twenty-third National Symposium and Exhibition, Anaheim, Calif., May 24, 1978. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1978, p 1169-1180.

A number of lightning protection systems were investigated, taking into account manufacturing considerations, environmental exposure, fatigue, protection systems repair considerations, and a proof test on a full-scale wing box section. The three systems which provided the best lightning protection are based on the use of aluminum flame spray, the employment of aluminum flame spray strips, and the utilization of an aluminum wire screen. The tests indicated that lightning damage is greatest for bonded joints, and least for bolted joints. Environmental exposure did not affect the protection, and fatigue did not affect it either. Small specimen testing data can be successfully extrapolated to full scale hardware. G R

A79-20876 An advanced composite helicopter main rotor hub. F B Clark and M L White (Kaman Aerospace Corp., Bloomfield, Conn.) In Selective application of materials for products and energy, Proceedings of the Twenty-third National Symposium and Exhibition, Anaheim, Calif., May 24, 1978.

Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1978, p 1181-1189. 6 refs.

A significantly different hub configuration solves the problem of producing a lightweight, easily manufactured composite hub. The new configuration is called the composite plate hub because it consists essentially of three composite plates which are readily fabricated by conventional manufacturing technology. The upper and lower plates are flat except for local reinforcements while the center, or pan, plate is essentially conical, blending to a horizontal flange at the center and horizontal lugs at the perimeter. The new helicopter rotor hub configuration is well suited to the anisotropic properties of fiber reinforced composites. The composite hub design weighs 24% less than the present titanium hub, and is projected to cost 52% less in production quantities. G R

A79-20879 Advanced composite fan frame for the Quiet Clean Short-Haul Experimental Engine /QCSEE/. C L Stotler (General Electric Co., Aircraft Engine Group, Evendale, Ohio). In Selective application of materials for products and energy, Proceedings of the Twenty-third National Symposium and Exhibition,

Anaheim, Calif , May 2-4, 1978
Society for the Advancement of Material and Process Engineering, 1978, p 1218-1229 7 refs

Azusa, Calif ,
Society for the Advancement of Material and Process Engineering, 1978, p 1218-1229 7 refs
(Author)

The design, fabrication and testing of the graphite/epoxy fan frame of the Quiet Clean Short Haul Experimental Engine (QCSEE) are discussed. Element testing to verify mechanical properties of the lay-up patterns employed in the frame was followed by subcomponent testing of all critical joint areas and by proof testing of the completed frame. Two frames were built and both have been successfully used in ground test engines.

A79-20880 * # Impact behavior of filament-wound graphite/epoxy fan blades K J Bowles (NASA, Lewis Research Center, Cleveland, Ohio) *Society for the Advancement of Material and Process Engineering, National Symposium and Exhibition, 23rd, Anaheim, Calif , May 2-4, 1978, Paper 18 p*

The fabrication and impact tests of graphite/epoxy filament wound fan blades are discussed. Blades which were spin tested at tip speeds up to 305 m/sec retained their structural integrity. Two blades were each impacted with a 454 g slice of a 908-g simulated bird at a tip speed of 263 deg and impact angles of 22 deg and 32 deg. The impact tests were recorded with high-speed movie film. The blade which was impacted at 22 deg sustained some root delamination but remained intact. The 32 deg impact separated the blade from the root. No local damage other than leading-edge debonding was observed for either blade. The results of a failure mode analysis are also discussed.

(Author)

A79-20884 # Manufacture of ring rolled components for gas turbine engines W Hansen (General Electric Co , Lynn, Mass) and N T Huuskonen (General Electric Co , Cincinnati, Ohio) *Society for the Advancement of Material and Process Engineering, National Symposium and Exhibition, 23rd, Anaheim, Calif , May 2-4, 1978, Paper 12 p*

The precision ring rolling process (patented in Dec 1976) is a new and cost effective alternative for manufacturing precision rings for gas turbine engines. The paper describes this process, noting several characteristics and capabilities as for example, that the contour can be maintained within 0.02 of an inch, the rings are expanded to a diametrical tolerance of + or - 0.10 inch and grain size is controlled by proper selection of annealing temperatures. Figures showing cost benefits for several production shapes are presented, indicating that the major cost savings are related to material utilization. Some specific nickel base alloys for which the process is used are mentioned.

A A

A79-20885 Trislander fatigue test progress R J Stowé (Britten-Norman /Bembridge/, Ltd, Bembridge Airport, Isle of Wight, England) *Aerospace (UK)*, vol 5, Nov 1978, p 22-24

Fatigue testing of the Trislander aircraft is reviewed, particularly data on the structural design of the wings and fuselage. Fatigue tests on the wing inter-spar box are discussed, noting that no cracks were found after any of the three simulated flight phases (133,300, 165,000, 161,000 flights) of the test specimen, and such tests will continue until cracks are initiated to explore then the propagation rate of the cracks until failure occurs. The investigations to date have shown that the Trislander structure has a good fatigue performance and a remarkable capacity for withstanding major accidents, though the records obtained from fatigue meters installed in the aircraft give a less optimistic picture of the Trislander's potential fatigue life than the generalized data.

A A

A79-20886 Airborne Early Warning Nimrod /Chadwick Memorial Lecture/ T A House (British Aerospace, Manchester, England) and A C Leacy (Marconi Avionics, Ltd, Borehamwood, Herts, England) *Aerospace (UK)*, vol 6, Jan 1979, p 21-26

The Nimrod (AEW) aircraft and its complex mission systems are described, and a brief review of the development and role of the

Airborne Early Warning (AEW) process is presented. Attention is given to the structure of Mission System Avionics, consisting of three groups of devices: (a) sensors, radar, IFF Interrogator, and ESM passive listening equipment, (b) the communication system, and (c) the data handling system, including the central processor and displays and the mission software. Also mentioned are some of the improvements on the configuration of the aircraft itself such as the sawing-off of the rear fuselage and its replacement with a new structure to ensure that the radome remains clear of the ground, and the accommodation of the ESM aerials in pods fitted to the wing tips to provide for an uninterrupted field of view.

A A

A79-21192 # ONERA wind tunnels (Souffleries de l'ONERA) J Morisset *Air et Cosmos*, vol 16, Jan 20, 1979, p 18-21. In French

The new pressurized subsonic wind tunnel at Fauga is described with attention given to calibration, testing of a Mirage 2000 model, and a comparison with the RAE pressurized wind tunnel. This is followed by an examination of the CERT transonic induction wind tunnel. Finally, consideration is given to a data acquisition and processing system developed for the Fauga wind tunnel.

B J

A79 21222 * # Ion chromatographic determination of sulfur in fuels C S Mizisin, D E Kuivinen, and D A Otterson (NASA, Lewis Research Center, Cleveland, Ohio) *U.S. Environmental Protection Agency, National Symposium on Ion Chromatographic Analysis of Environmental Pollutants and Other Analogous Compounds, 2nd, Research Triangle Park, N.C., Oct 11-13, 1978, Paper 15 p* 9 refs

A79-21278 # Projected aircraft systems development W T Hamilton (Boeing Commercial Airplane Co, Renton, Wash) *American Astronautical Society, Anniversary Conference, 25th, Houston, Tex, Oct 30-Nov 2, 1978, Paper 78-194* 11 p

Aircraft of the 21st century will resemble today's aircraft in that they will rely on wings to provide a high lift-to-drag ratio in cruising flight, thereby minimizing the thrust and fuel requirements. However, in other respects there will be major differences as a result of advances in all of the contributing technologies which will permit dramatic improvements in efficiency, speed, and configurations. Subsonic transports will continue to provide an increasing proportion of the world's transport requirements and they will need improved turbofan and turboprop propulsion systems with improved components efficiencies, lower maintenance, lower noise, and compatibility with new fuels. Efficient supersonic transports will come on by the next century for people transport and military actions. They will need high temperature components, variable-cycle engines, high speed combustion, and compatibility with new fuels. Specialized hypersonic aircraft and their engines are seen as the greatest challenge to the structural design engineers.

G R

A79-21295 * # NASA thermal barrier coatings - Summary and update F S Stepka (NASA, Lewis Research Center, Turbine Cooling Section, Cleveland, Ohio) *U.S. Navy and U.S. Air Force, Workshop on Cooling Problems in Aircraft Gas Turbines, Monterey, Calif, Sept 27, 28, 1978, Paper 22 p* 25 refs. Project SQUID

The work conducted at the NASA Lewis Research Center to evolve and evaluate a thermal-barrier coating system will be discussed. A durable, two-layer, plasma-sprayed coating consisting of a ceramic layer over a metallic layer was developed that has the potential of insulating hot engine parts and thereby reducing metal temperatures and coolant flow requirements and/or permitting use of less costly and complex cooling configurations and materials. The paper summarizes the results of analytical and experimental investigations of the coatings on flat metal specimens, turbine vanes and blades, and combustor liners. Discussed are results of investigations to determine coating adherence and durability, coating thermal, strength and fatigue properties, and chemical reactions of the coating.

with oxides and sulfates. Also presented are the effect of the coating on aerodynamic performance of a turbine vane, measured vane and combustor liner temperatures with and without the coating, and predicted turbine metal temperatures and coolant flow reductions potentially possible with the coating. Included also are summaries of some current research related to the coating and potential applications for the coating. (Author)

A79-21296 * # The NASA high pressure facility and turbine test rig. F. S. Stepka (NASA, Lewis Research Center, Turbine Cooling Section, Cleveland, Ohio) *U.S. Navy and U.S. Air Force, Workshop on Cooling Problems in Aircraft Gas Turbines, Monterey, Calif., Sept 27, 28, 1978, Paper 16 p* Project SQUID

NASA Lewis Research Center is presently constructing a test facility for developing turbine-cooling and combustor technology for future-generation aircraft gas-turbine engines. Prototype engine hardware will be investigated in this facility at gas-stream conditions up to 2480 K average turbine inlet temperature and 4.14 million N/sq m turbine inlet pressure. The facility will have the unique features of fully automated control and data acquisition through the use of an integrated system of minicomputers and programmable controllers, which will result in more effective use of operating time and operators and will provide a built-in self-protection safety system. The facility, turbine rig, and turbine-cooling test program are described. (Author)

A79-21347 * Hydrogen enrichment for low-emission jet combustion. R. M. Clayton (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.) In: *Evaporation combustion of fuels*. Washington, D.C., American Chemical Society (Advances in Chemistry Series, No. 166), 1978, p. 267-286. 19 refs. Contract No. NAS7-100

Simultaneous gaseous pollutant emission indexes (g pollutant/kg fuel) for a research combustor with inlet air at 120,900 N/sq m (11.9 atm) pressure and 727 K (849 F) temperature are as low as 1.0 for NO_x and CO and 0.5 for unburned HC. Emissions data are presented for hydrogen/jet fuel (JP-5) mixes and for jet fuel only for premixed equivalence ratios from lean blowout to 0.65. Minimized emissions were achieved at an equivalence ratio of 0.38 using 10-12 mass percent hydrogen in the total fuel to depress the lean blowout limit. They were not achievable with jet fuel alone because of the onset of lean blowout at an equivalence ratio too high to reduce the NO_x emission sufficiently. (Author)

A79-21350 Strategic satellite communications come of age. J. H. Gruetzmacher (USAF, Space and Missile Systems Organization, Los Angeles Air Force Station, Calif.) *Satellite Communications*, vol. 3, Jan 1979, p. 18-21

The Afsatcom (Air Force Satellite Communications) system is described, discussing the smooth transition from Afsatcom I, with initial operational capability attained in Spring of 1979, to SSS (Strategic Satellite System) or Afsatcom II in the late 1980's. The Afsatcom system is designed to direct the Single Integrated Operations Plan (SIOP) forces, composed of U.S. Air Force bombers, ICBMs, ALCMs, and the U.S. Navy SLBMs, and will be used in theater strike operations, including an array of U.S. Army weapon systems and the U.S. Air Force GLCMs. Afsatcom I consists of UHF Transponders on several DOD satellites, with global coverage on SDS and Fitsatcom system satellites provided by Afsatcom narrowband communication packages (twelve 5 kHz channels). SSS is projected to improve the satellite's resistance to jamming and physical attack, and provide end-to-end encryption for all communications links. The smooth transition from Afsatcom I to SSS will be effected through the integration of a dual function command post terminal. A. A.

A79-21417 Determination of the wave drag of an airfoil in a transonic flow by shear interferometry. V. D. Bokser, V. B. Dmitrieva, L. B. Nevskii, and I. M. Serebriiskii (Tsentral'nyi Aerogidrodinamicheskii Institut, Moscow, USSR) (*TsAGI, Uchenye*

Zapiski, vol. 6, no. 1, 1975, p. 103-107) *Fluid Mechanics - Soviet Research*, vol. 6, Nov-Dec 1977, p. 1-6. 6 refs. Translation

The wave drag of an airfoil profile in viscous near-sonic flow (free stream M of about 0.8-0.9) was measured interferometrically in a wind tunnel. The combination of interferometry with the theory of wave drag and a weighting method allows for a quantitative evaluation of the relative contributions of wave and vortex drag to the increment of profile drag in cases of supercritical flow. B. J.

A79-21418 Effect of the entropy layer on the hypersonic flow around aerodynamic control surfaces. V. Ia. Neiland and L. A. Sokolov (Tsentral'nyi Aerogidrodinamicheskii Institut, Moscow, USSR) (*TsAGI, Uchenye Zapiski*, vol. 6, no. 1, 1975, p. 89-92) *Fluid Mechanics - Soviet Research*, vol. 6, Nov-Dec 1977, p. 7-11. Translation

A simple method is presented for calculating pressure distribution on an inclined control surface in the case when the presence of an entropy layer does not allow use of formulas that relate the value of pressure to inclination of the surface. It is assumed that the Reynolds number, the temperature factor, the state of the boundary layer, etc., are such that the effects of viscosity and separation can be neglected. It is shown that pressure drop (induced by deflection of the control surface) with growth of the entropy layer, 'spreads over' a certain length, which can lead to reversal of the separation. B. J.

A79-21420 The flow at the inlet and in the throat region of a plane supersonic air intake. I. S. Simonov and S. A. Stefanov (Tsentral'nyi Aerogidrodinamicheskii Institut, Moscow, USSR) (*TsAGI, Uchenye Zapiski*, vol. 6, no. 1, 1975, p. 38-47) *Fluid Mechanics - Soviet Research*, vol. 6, Nov-Dec 1977, p. 82-91. Translation

In a study of flow in the inlet and throat regions of a planar supersonic air intake, data are obtained on shock wave patterns, discharge coefficients, the shape of the throttle characteristic and pressure distributions. It is suggested that the ratio of static pressures in throat and in the inlet plane be used as the criterion of intake startup. It is shown that in the Mach number range less than about 1.7-1.8 at the presurge point of the throttle characteristic, flow in the intake channel is subsonic. At Mach numbers greater than 1.8, there are regions of supersonic flow even at the presurge point of the throttle characteristic. B. J.

A79-21421 Distribution of the intermittency factor along the transition region between laminar and turbulent boundary-layers. V. M. Filippov (Tsentral'nyi Aerogidrodinamicheskii Institut, Moscow, USSR) (*TsAGI, Uchenye Zapiski*, vol. 7, no. 2, 1976, p. 52-57) *Fluid Mechanics - Soviet Research*, vol. 6, Nov-Dec 1977, p. 109-114. 10 refs. Translation

A79-21466 # Aircraft dropwindsonde system. J. H. Smalley (National Center for Atmospheric Research, Boulder, Colo.) *Atmospheric Technology*, Winter 1978-1979, p. 24-28. 6 refs.

The NCAR dropwindsonde system and some of its applications are described. Design and recent design improvements are considered. The system provides a hard copy of real-time computation of pressure, temperature, relative humidity, and zonal winds at one minute intervals. Additionally, the results plus all raw data are formatted and stored on magnetic tape cassettes. Use of dropwindsondes in GATE, Monex, and the Global Weather Experiment is discussed. M. L.

A79-21475 # A low-frequency aeroelastic element method and its application to the harmonic gust response analysis of a flexible airplane. H. U. Mai (Helsinki University of Technology, Esbo, Finland) *Acta Polytechnica Scandinavica, Mechanical Engineering Series*, no. 74, 1978, 46 p. 35 refs. Research sponsored by the Academy of Finland.

An aeroelastic element method for calculating the harmonic gust response of a flexible airplane has been developed. The unsteady aerodynamic influence coefficients are calculated using the low-frequency vortex panel method, otherwise the method is not restricted to low frequencies. The state of motion is given in terms of free-body normal modes and rigid-body modes. The method was programmed on a UNIVAC 1108 computer and applied to harmonic gust response calculations of a swept-wing bomber and a high performance glider. In the case of the bomber, the accuracy was found to be good up to the highest reduced frequency considered (0.343), except between the short-period frequency and the first wing bending mode resonance frequency. In this frequency range, the response amplitudes are a little too high due to a slight overestimation of the short-period frequency. This inaccuracy can probably be removed by including body and nacelle effects in the calculation. (Author)

A79-21520 * # Lifting-line theory of oblique wings in transonic flows. H. K. Cheng and S. Y. Meng (Southern California, University, Los Angeles, Calif.) *AIAA Journal*, vol 17, Jan 1979, p 121-124. 14 refs. Contracts No. N00014-75-C-0520, No NCR 730-501, No NCA2-OR-730-601.

Three-dimensional corrections to the nonlinear mixed flow admitted by a high-aspect-ratio swept wing of practical interest are analyzed by solving a perturbation problem and matching its solution to that of an outer flow. The latter is identified with a linear solution involving a lifting line, but the centerline of the planform is not required to be straight and unyawed. The existence of a similarity in the three-dimensional flow structure for a certain oblique-wing geometry is demonstrated, along with a solution to the reduced problem in a high-subcritical case. F. G. M.

A79-21521 # A calculation of rotor impedance for hovering articulated-rotor helicopters. K. Kato (Tokyo, University, Tokyo, Japan) and T. Yamane. *Journal of Aircraft*, vol 16, Jan 1979, p 15-22. 11 refs.

A procedure is presented to calculate the loads transferred from an articulated rotor to the fuselage when the rotor hub is forced to oscillate sinusoidally in hover. The blade is considered as a rotating elastic beam and the inertial load expressions are given for the case where the hub is in motion. Basic assumptions include (1) quasisteady aerodynamic loads, (2) integration with strip theory, and (3) neglect of the effects of preceding and returning wakes. Sample calculations reveal the manner in which the typical articulated rotor impedances are influenced by blade elastic deformations, inertial loads, aerodynamic loads, and hub frequencies. (Author)

A79-21523 # Improved wave drag predictions using modified linear theory. R. T. Stancil (Vought Corp., Dallas, Tex.) *Journal of Aircraft*, vol 16, 1979, p 41-46.

The combined effect of two simple modifications to supersonic linear theory has resulted in significantly improved local pressure and drag predictions. The two modifications are (1) use of the exact boundary condition, and (2) use of the local (perturbed) Mach number to calculate $\beta = \text{square root of Mach number squared}^{-1}$. Comparisons with exact theory and test data are shown for two-dimensional ramps, aircraft wings, cones, and other axisymmetric bodies. The modified linear theory agrees with the exact theory and test data much better than ordinary linear theory, particularly for the larger slopes and nonslender cases. Also, the modified theory predicts only finite perturbation velocities and eliminates the unrealistic peak drags at sonic edge conditions predicted by ordinary linear theory and slender-body theory. Computational aspects are discussed. Because of the good correlations obtained for both planar and axisymmetric cases, the method is now being developed for complete aircraft configuration calculations. (Author)

A79-21524 # Overtest results for the 7.3 m /24-ft/ diameter hybrid Kevlar-29/nylon ribbon parachute. W. B. Pepper (Sandia Laboratories, Albuquerque, N. Mex.) *Journal of Aircraft*, vol 16, Jan 1979, p 47-50. 5 refs. Research supported by the US Department of Energy.

The design of a 7.3-m diam hybrid Kevlar 29/nylon ribbon parachute is presented. The results of six Nike rocket-boosted overttests of the parachute are discussed. Four tests were successful with the parachute being deployed unreefed from the 345 kg test vehicle in free flight at a Mach number of about 1.5 and a dynamic pressure of about 125 kN/sq m. A peak deceleration of 240 g was measured. The use of Kevlar 29 in construction of the parachute has resulted in 2.25 times the drag area of a 5.2 m-diam all-nylon ribbon parachute with the same pack weight and volume. (Author)

A79-21525 * # Ground effects on USB configurations. C. E. Lan (Kansas, University, Lawrence, Kan.) *Journal of Aircraft*, vol 16, Jan 1979, p 62-64. 12 refs. Grant No. NSG-1139.

Recent investigations of ground effects on aerodynamic characteristics have been stimulated by the interest in powered lift STOL airplanes. The ground effects on upper surface blowing (USB) configurations may involve change in both the circulation forces and the jet reaction forces. In this note, a theoretical method is proposed for predicting these effects. It is shown that the predicted results agree well with available experimental data. In particular, the wing alone method is shown to be incapable of predicting the ground effects of USB configurations. S. D.

A79-21595 # Coaxial flow noise - Isothermal flow (Shum soosnykh strui - Izotermicheskie strui). V. M. Kuznetsov and A. G. Munin. *Akusticheski Zhurnal*, vol 24, Nov-Dec 1978, p 878-886. 10 refs. In Russian.

The paper presents a procedure for calculating coaxial flow noise from examination of the three basic regions of sound emission. Formulas are obtained for calculating the acoustic output for annular flows and coaxial flows for various conditions of flow velocity along the inner and outer surface. Observed and calculated profiles are compared. M. L.

A79-21634 Computer calculation of aerodynamic characteristics of aircraft at supersonic velocities. S. A. Poppytalov and V. V. Samsonov. (*Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza*, May-June 1978, p 96-102.) *Fluid Dynamics*, vol 13, no 3, Dec 1978, p 415-421. Translation.

In the method proposed for computing the aerodynamic characteristics of complex three-dimensional designs, the perturbed pressure is the basic unknown function. Using this method, the solution is obtained for the entire flight vehicle, making allowance for the influence of the thickness of the elements on the aerodynamic characteristics. With this method, the accuracy of the computations is improved by eliminating the need for numerical differentiation. V. P.

A79-21635 Influence of the transverse curvature of the lower surface on the conical supersonic flow field on a delta vehicle. A. P. Kosykh and A. N. Minalos. (*Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza*, May-June 1978, p 103-110.) *Fluid Dynamics*, vol 13, no 3, Dec 1978, p 421-427. 13 refs. Translation.

In the present paper, the inviscid flow past a delta wing, whose lower surface is formed as a circular cone and is an elliptical segment in cross section, is calculated in a nonlinear formulation. The analysis reveals a flow regime characterized by two separation lines and three spreading lines at the lower surface. The conditions for laminar-turbulent transitions are determined for the surface under consideration. V. P.

A79-21725 **Bibliography on the fatigue of materials, components and structures Volume 2 - 1951-1960** J Y Mann (Department of Supply, Aeronautical Research Laboratories, Melbourne, Australia) Oxford, Pergamon Press, Ltd, 1978 498 p 5902 refs \$75

This volume provides a comprehensive bibliography covering all aspects of the behavior and performance of materials, components, and structures under fatigue load conditions. The 5903 literature references listed have been extracted from over 1000 publication sources originating in 30 countries and covering 10 years of research and development. Detailed subject and author indexes supplement the bibliography. F G M

A79-21800 **Applied ECM Volume 1** L B Van Brunt Dunn Loring, Va, EW Engineering, Inc, 1978 1001 p 65 refs \$39.95

This book deals with electronic countermeasures (ECM), electronic counter-countermeasures (ECCM), and related areas of tactical radar-controlled weapons systems. Unclassified information about the ECM and ECCM aspects of tactical microwave radar-controlled weapons systems is provided, with emphasis on fundamentals and concepts, the theory of ECM and ECCM, and generic problems and their solutions. A glossary of ECM and ECCM language and technology is given, fundamentals of ECM are outlined, and an encyclopedia of ECM tactics and techniques is presented. Specific topics include ECM definitions and equations, ECM output systems, active ECM system signal-processing principles, active ECM system technology, passive ECM, reduction or variation of radar observation of targets, general jamming considerations, and electronic support measure considerations. The encyclopedia describes a multitude of unclassified ECM tactics and techniques that can be used against missiles or their detection, acquisition, tracking, and guidance subsystems. F G M

A79-21914 **Response and other characteristics of a flat bladed, dual pitch propeller anemometer** V R Turner (Department of the Environment, Atmospheric Environment Service, Toronto, Canada) In Symposium on Meteorological Observations and Instrumentation, 4th, Denver, Colo, April 10-14, 1978, Preprints Boston, Mass, American Meteorological Society, 1978, p 77-82

Propeller anemometers, when used in orthogonal pairs, can provide the vector components of wind speed and direction. A four bladed propeller anemometer, described by Champ (1972), is considered. The results are reported of further wind tunnel tests on this anemometer and a similar anemometer fabricated with glass-epoxy blades, looking specifically at the cosine response, calibration, turning factor, response length, and expected errors. The significance of the obtained data is evaluated. The nonlinearity of calibration of the glass epoxy propeller, which is observed at higher wind speeds for yaw angles greater than 15 deg, is believed to be caused by gradual flexing of the propeller blades under the increasing force of the wind as wind speed increases. G R

A79-21915 **An omnidirectional, tilt insensitive, wind speed threshold detector** A J Bedard, Jr (NOAA, Wave Propagation Laboratory, Boulder, Colo) and T T Fujita (Chicago, University, Chicago, Ill) In Symposium on Meteorological Observations and Instrumentation, 4th, Denver, Colo, April 10-14, 1978, Preprints Boston, Mass, American Meteorological Society, 1978, p 83-86 12 refs

The considered relatively simple wind speed threshold detector was designed in connection with requirements to develop surface sensors which could be used in the prevention of wind-shear related accidents at airports. It is pointed out that the detector indicates wind speed and not wind direction. Although in some instances wind vector information is necessary at a point, there is evidence that the most dangerous density currents will produce significant wind speed surges. A simple wind-speed sensor can, therefore, be used for the detection of thunderstorm gust fronts. A variety of other uses

considered for the sensor are related to down-slope wind studies, wind caution signs for roads and bridges, aspects of wind machine protection, and site surveys. G R

A79-21919 **The Dulles Airport pressure-sensor array for gust-front detection System design and preliminary results** A J Bedard, Jr and W H Hooke (NOAA, Wave Propagation Laboratory, Boulder, Colo) In Symposium on Meteorological Observations and Instrumentation, 4th, Denver, Colo, April 10-14, 1978, Preprints Boston, Mass, American Meteorological Society, 1978, p 115-124 17 refs. Research supported by the Federal Aviation Administration

Seven high-wind events monitored by the Dulles Airport gust-front detection system are examined. The detection system consists of two major elements - a hybrid acoustic-microwave radar system for providing a detailed height profile of the wind directly above the sensor, and a dense surface array of pressure jump detectors for detecting the development and motion of the more localized features. Advantages and disadvantages of the use of anemometers for gust-flow detection of thunderstorm outflows and of the use of pressure jump detectors for detection of thunderstorm outflow are described. Procedures for optimizing the configuration and density of airport warning arrays are considered. M L

A79-21920 **AV-AWOS and AUTOB - An update** J T Bradley, M Lefkowitz, and W Read (NOAA, National Weather Service, Sterling, Va) In Symposium on Meteorological Observations and Instrumentation, 4th, Denver, Colo, April 10-14, 1978, Preprints Boston, Mass, American Meteorological Society, 1978, p 125-130

Post-1976 test results and operational experience with two automated systems for observation of clouds and visibility are reported, and the planning of an operational test of AV-AWOS, one of the systems, is described. One system, AUTOB (AUTOMATED OBSERVATIONS) uses one ceilometer, one visibility sensor, and limited processing. AV-AWOS (AVIATION AUTOMATED WEATHER OBSERVATION SYSTEM) is intended primarily for airport terminals and uses three ceilometers and three visibility sensors. The studies indicate good agreement between continuously updated automated observations and the subjective judgment of a human observer. M L

A79-21960 **Cloud physics observations inside hailstorms with an armored aircraft data system** G N Johnson, J H Killinger, D J Musil, and P L Smith, Jr (South Dakota School of Mines and Technology, Rapid City, S Dak) In Symposium on Meteorological Observations and Instrumentation, 4th, Denver, Colo, April 10-14, 1978, Preprints Boston, Mass, American Meteorological Society, 1978, p 351-356 NSF Grant No C-760

The armored T-28 hail research aircraft was developed as the result of a project which had been initiated to develop a research vehicle capable of flying through hailstorms. The aircraft was to be used to gather meteorological data from the interior regions of such storms, which could lead to a clearer understanding of hail formation and possible hail suppression mechanisms. The modifications required to the standard T-28 included armoring all leading edges, strengthening wing and tail structures, and installing a larger engine and stronger propeller. A description is presented of the instruments carried aboard the T-28, taking into account the measurement of state variables, aircraft navigation and performance variables, and hydrometeor sensors. Attention is also given to the operational procedures, the data recording system, and the different types of data. G R

A79-21963 **A modular approach to airborne research instrumentation** C E Beck (National Center for Atmospheric Research, Boulder, Colo) In Symposium on Meteorological Observations and Instrumentation, 4th, Denver, Colo, April 10-14, 1978, Preprints Boston, Mass, American Meteorological Society, 1978, p 377-381

Most commercially available equipment has not been designed for the specific problems encountered on aircraft. The use of such equipment normally requires modifications to make it useable in the aircraft environment. An obvious step to accomplish the savings of space, weight, and power for electronic equipment to be installed on light aircraft is to design special equipment for the specific installation. The decision to take this step is not so great when consideration is given to the expense of buying the equipment and then making it fit the job. A major advantage of in-house design is that the end product need only meet the specifications of the user. The advantages of a modular approach are in this connection discussed, taking into account aspects of module design, module construction, flexibility, and serviceability. The involved principles are illustrated with the aid of examples involving modules which have been constructed by NCAR and been used in the light twin engine aircraft. G R

A79-21964 A new airborne data system for atmospheric research. R B Friesen and R Brown (National Center for Atmospheric Research, Boulder, Colo.) In Symposium on Meteorological Observations and Instrumentation, 4th, Denver, Colo., April 10-14, 1978, Preprints. Boston, Mass., American Meteorological Society, 1978, p 382-384

A fourth generation Airborne Research Instrumentation System (ARIS IV) has been designed and developed for use on three smaller aircraft. The purpose of the onboard data acquisition system is to record on magnetic tape the output of various instruments, while simultaneously computing and displaying in real time selected meteorological parameters. The need for a new generation data system for the aircraft became urgent as the shortcomings of the previous system, ARIS III, increased due to the proliferation of digital instrumentation and the demands for larger complements of instrumentation to meet the requirements of more complex projects. ARIS IV consists of a computer, display devices, magnetic tape drive, digital/analog subsystem, and specialized instrumentation interfaces. A general analog/digital input subsystem was designed to handle 39 analog channels and 24 digital channels. The majority of the ARIS IV software was written in standard FORTRAN IV with assembly language used only for the device interface handlers. The ARIS IV is flexible enough to provide support for airborne research in most areas of the atmospheric sciences. G R

A79-21965 Microprocessor control of aircraft DME. P K Govind (National Center for Atmospheric Research, Boulder, Colo.) In Symposium on Meteorological Observations and Instrumentation, 4th, Denver, Colo., April 10-14, 1978, Preprints. Boston, Mass., American Meteorological Society, 1978, p 385-390 7 refs

Distance Measuring Equipment (DME) standardized by the International Civil Aviation Organization is a pulse-ranging, line-of-sight system used for aircraft navigation. The system includes an airborne Receive/Transmit (RT) unit, a ground transponder, and an indicator aboard the aircraft which reads the distance between the aircraft and the ground transponder. With the exception of the NASA system, the cost and complexity of the multi-DME systems is beyond the reach of most general aviation applications. A description is presented of a cost effective design of a self scanning multi-DME system that employs a microprocessor to tune a single airborne DME to a multiple set of ground stations. The advantages of a microprocessor controlled DME are related to the ease of interfacing with aircraft digital data acquisition systems to record data, the availability of off-the-shelf programmable hardware, and the capability of software controlled system expansion. G R

A79-21967 Sodar and aircraft measurements of turbulence parameters within cooling tower plumes. R L Coulter and K H Underwood (Pennsylvania State University, University Park, Pa.) In Symposium on Meteorological Observations and Instrumentation, 4th, Denver, Colo., April 10-14, 1978, Preprints. Boston, Mass., American Meteorological Society, 1978, p 396-401 10 refs. Contract No E(11-1)-2463

A79-21968 Simultaneous measurements of turbulence in the lower atmosphere using sodar and aircraft. D W Thomson, R L Coulter, and Z Warhaft (Pennsylvania State University, University Park, Pa.) In Symposium on Meteorological Observations and Instrumentation, 4th, Denver, Colo., April 10-14, 1978, Preprints. Boston, Mass., American Meteorological Society, 1978, p 402-409 20 refs. US Environmental Protection Agency Grant No R 800397, Contract No E(11-1) 2463

Only recently has substantial effort been devoted to developing the science of quantitative sodar measurements of turbulence. The employed procedure involves the use of calibrated monostatic and bistatic sodars for observations of temperature and velocity fluctuation variance, and turbulent energy dissipation and temperature variance destruction rates. A description is presented of the results of such measurements. In addition to the calibrated Doppler sodar, simultaneous measurements of atmospheric turbulence were made using a research aircraft in the region probed by the sodar. The reported high frequency turbulence measurements made it possible to evaluate both velocity and temperature spectra extending to wave numbers within the dissipation range. The quality of the resulting spectra clearly validate use of the scattering theory based on application of the $-5/3$ inertial subrange law. G R

A79-21971 Research aircraft and their capabilities. C B Emmanuel (NOAA, Research Facilities Center, Miami, Fla.) In Symposium on Meteorological Observations and Instrumentation, 4th, Denver, Colo., April 10-14, 1978, Preprints. Boston, Mass., American Meteorological Society, 1978, p 422-425

An aircraft provides an excellent research platform for the in-situ measurement of atmospheric parameters. The Research Facilities Center of the National Oceanic and Atmospheric Administration operates currently three optimally instrumented aircraft for the conduction of a variety of investigations. The aircraft include one WC 130B Hercules and two WP-3D Orions. The aircraft can operate effectively from sea-level to about 30,000 ft, loiter at speeds between 180 and 220 knots, cruise at 325 knots and attain dash speeds in excess of 400 knots. In their present configuration, the aircraft support a multitude of sophisticated research systems capable of measuring a wide range of atmospheric and oceanic parameters. In addition to the full array of meteorological and cloud physics instrumentation, the aircraft carry radar systems, considered to be the world's most advanced, for severe weather research. G R

A79-21972 A small aircraft gust-probe system for studies of boundary layer convection and transport. R O Gilmer, R E McGavin, and R F Reinking (NOAA, Boundary Layer Dynamics Group, Boulder, Colo.) In Symposium on Meteorological Observations and Instrumentation, 4th, Denver, Colo., April 10-14, 1978, Preprints. Boston, Mass., American Meteorological Society, 1978, p 426-432 13 refs

The use of large multiengine aircraft for simpler or relatively local experiments is impractical. For such investigations, small aircraft are most cost-effective and mobile, and they may readily be equipped with only the limited instrumentation required for the specific experiment. An airborne gust probe system for measuring atmospheric eddy motions and corresponding fluxes of sensible heat, water vapor or latent heat, and momentum has been redesigned for use on a small aircraft. The sensors for the small aircraft system include a gust probe to measure the fluctuations in the three-dimensional wind, a refractometer to measure fluctuations in humidity, a small thermister to measure fluctuations in temperature, and a variety of pressure transducers, accelerometers, and gyros to correct for aircraft motion. In all, 15 parameters must be measured and recorded. The system is useful in accurately measuring the intensity and scales of turbulent mixing and associated diffusion and transports. G R

A79-21973 The status of air motion measurements on NCAR aircraft. D H Lenschow, C A Cullian, R B Friesen, and E N Brown (National Center for Atmospheric Research, Boulder, Colo.) In Symposium on Meteorological Observations and Instru-

mentation, 4th, Denver, Colo., April 10-14, 1978, Preprints
Boston, Mass., American Meteorological Society, 1978, p 433-438 7 refs

The National Center for Atmospheric Research (NCAR) operates currently four aircraft equipped with inertial navigation systems (INS) and gust probes for air motion measurements. These aircraft can be instrumented to measure both mean horizontal wind and turbulent fluctuations of the three air velocity components. These components are obtained by subtracting the velocity of the aircraft with respect to the earth measured by the INS from the velocity of the air with respect to the aircraft measured by the gust probe sensors. Since the gust probe measures in the aircraft frame of reference, these measurements are converted to the earth's frame of reference by using the three aircraft attitude angles measured by the INS. Attention is given to the gust probe sensors, INS measurements, the performance of the instrumentation, and future improvements.
G R

A79-21974 **The Cessna-207 aircraft turbulence and temperature measuring system** M Gamo, S Yamamoto, and O Yokoyama (Ministry of International Trade and Industry, National Research Institute for Pollution and Resources, Tokyo, Japan) In Symposium on Meteorological Observations and Instrumentation, 4th, Denver, Colo., April 10-14, 1978, Preprints
Boston, Mass., American Meteorological Society, 1978, p 439, 440 6 refs

The considered measuring system is used for the conduction of studies which have the objective to clarify the structure of the free or forced convective atmospheric boundary layer above flat terrain. The characteristics of the internal boundary layer which develops around the coastal area are also studied. Three-dimensional wind fluctuations are measured with the aid of a hot-wire anemometer, a sonic anemometer thermometer (SAT), and a horizontal vane. Mean temperature and humidity are measured by a thermister psychrometer, temperature fluctuations by a thermocouple thermometer and a SAT, and surface temperature by an infrared thermometer. Wing and temperature sensors are mounted on booms supported by the wing struts. The aircraft motion is detected by means of an inertial platform. Attention is given to the correction of vertical velocity fluctuations data, the correction of temperature fluctuation data, the calculation of the energy dissipation, and the computation of turbulent heat flux.
G R

A79-21989 * **An aircraft compatible laser induced fluorescence system - In situ and remote measurements of trace gases** D D Davis and D Philen (Georgia Institute of Technology, Atlanta, Ga.) In Symposium on Meteorological Observations and Instrumentation, 4th, Denver, Colo., April 10-14, 1978, Preprints
Boston, Mass., American Meteorological Society, 1978, p 518-523
Research supported by the Electric Power Research Institute, NSF Grant No. ATM-76-81487, Grant No. NsG-1075

The laser-induced fluorescence technique for obtaining direct measurements of atmospheric OH and other gases is described. A narrow-band UV laser is tuned to one or more of the electronic absorption bands of a specified molecule so as to cause fluorescence from a bonding excited electronic state. The monitored wavelength is longer than the laser wavelength. Equipment, specifics for OH detection, data processing, and interference are discussed, and application of the technique to the detection of NO, SO₂, and CH₂O is considered.
M L

A79-21991 **A comparison of temperatures and winds reported by the Concorde SST with data obtained from rawinsonde and satellite** R M McInturff (NOAA, National Meteorological Center, Washington, D C.) In Symposium on Meteorological Observations and Instrumentation, 4th, Denver, Colo., April 10-14, 1978, Preprints
Boston, Mass., American Meteorological Society, 1978, p 532-534

A preliminary evaluation of the aircraft integrated data system (AIDS) data for the lower stratosphere is presented. The evaluation is considered with reference to the possible role of the AIDS data in

meteorological operations and in the research program to be undertaken in connection with FGGE - the Global Weather Experiment. Data for temperature and winds are examined, and it is found that sets of AIDS temperatures obtained from Concorde flights are internally consistent, and that good agreement is found between these AIDS data and radiosonde reports.
M L

A79-21992 **Analysis of air motion measurements from aircraft** A Vaziri and J W Telford (Nevada, University, Reno, Nev.) In Symposium on Meteorological Observations and Instrumentation, 4th, Denver, Colo., April 10-14, 1978, Preprints
Boston, Mass., American Meteorological Society, 1978, p 535-541

Data processing techniques used with a certain system which provides air motion measurements from aircraft are considered. The Desert Research Institute system interfaces with LN15D inertial navigation system, and the reported data were obtained by Buffalo aircraft flights in 1969-1972. The measuring system, data unpacking, and air motion calibration are described. It is suggested that the data processing techniques permit air motion measurement with an accuracy of about 0.3 m/s. Attention is directed to the extreme sensitivity of the derived winds to changes in sensor calibrations and zero offsets. The inertial platform error is characterized.
M L

A79-21994 **Design of a flexible aircraft data acquisition system** M J Merritt (Meteorology Research, Inc., Altadena, Calif.) In Symposium on Meteorological Observations and Instrumentation, 4th, Denver, Colo., April 10-14, 1978, Preprints
Boston, Mass., American Meteorological Society, 1978, p 547-555

The use of a commercial microprocessor in an aircraft flexible data acquisition system is discussed. Advantages of this microprocessor in comparison with other commercial microprocessors are considered. The data system structure and characteristics are described, problems discovered during field experience are considered, and some comments concerning system fabrication are presented.
M L

A79-21997 **An alternative approach to the high aspect ratio wing with jet flap by matched asymptotic expansions** T Kida and Y Miyai (Osaka Prefecture, University, Sakai, Japan) *Aeronautical Quarterly*, vol 29, Nov 1978, p 227-250 13 refs

An alternative method is described for solving the problem of a three dimensional jet-flapped wing with a high aspect ratio. This method is similar to the lifting-line theory of Kerney (1971) or Tokuda (1971), but differs in that the method of matched asymptotic expansions is applied to an integral equation, derived from the lifting surface theory, rather than a partial differential equation. The advantage of the present method over those used previously is that the necessary outer solutions are obtained directly, it is not necessary to rely upon physical insight or considerable ingenuity. The final results are different from those obtained by the previous authors, it is shown that the present result is correct, by noting some errors in the earlier theories.
(Author)

A79-21998 **A surface source and vorticity panel method** J A H Petrie (British Aerospace, Aerodynamics Dept., Kingston-Brough, Bucks., Leeds University, Leeds, England) *Aeronautical Quarterly*, vol 29, Nov 1978, p 251-269 14 refs

A panel method for solving potential flow problems of arbitrary geometry is presented. It is very easy to apply and should be very quick to run. Unlike most other panel methods this one does not require a specification of the vorticity distribution in advance, but obtains it as part of the solution. The method is applied to three test cases chosen for their difficult and varied nature.
(Author)

A79-21999 **Some low speed experimental results on the effects of swirl and velocity distribution on an axis-symmetric jet** A D Young and K N Rao (Queen Mary College, London, England) *Aeronautical Quarterly*, vol 29, Nov 1978, p 270-284 5 refs

The flows resulting from a number of different methods for producing swirl in an axis symmetric jet have been investigated. These

methods include upstream vanes, tangential injection, a twisted plastic sheet and rotation of part of the jet pipe. Tests were also made with the first two types of swirl device in association with a radial distribution of axial velocity in the jet which had a minimum on the axis produced by a suitably graded wire grid or web inserted in the jet pipe. The measurements covered the mean (axial and swirl) velocity distributions as well as the main turbulence quantities at various stations downstream of the jet exit. It was found that the swirl considerably enhanced the rate of growth of the mixing region as previous workers have shown, but there was a significant reduction of this enhancement when the axial velocity increased from the centre outwards. This is in accordance with current concepts on the stability of curved turbulent shear flows. (Author)

A79-22000 Hypersonic flow over conical wing-body combinations R Hillier (Imperial College of Science and Technology, London, England) *Aeronautical Quarterly*, vol 29, Nov 1978, p 285-304 13 refs

This paper shows how thin shock layer theory may be applied to wing-body combinations and also to yawed wings of caret and diamond section. The common feature of these cases is the interaction of the crossflow with the body slope discontinuity and the manner in which the resulting disturbances propagate through the shock layer. Practical computation of surface pressures is straightforward and comparison with experiment appears to be fairly good for the limited results available. (Author)

A79-22161 Naval Air Development Center's unique environmental test facilities N Tait (US Naval Material Command, Naval Air Development Center, Warminster, Pa.) *Journal of Environmental Sciences*, vol 22, Jan-Feb 1979, p 13-16

Five environmental test facilities at the Naval Air Development Center in Warminster, Pennsylvania are described. The five facilities are a full-scale aircraft structural test facility, an open water facility, and ejection seat tower (man-rated), a vertical drop tower (man-rated), and a dynamic flight simulator (man-rated). Structures, functions, and capabilities of the facilities are discussed. M L

A79-22162 Quantification of the storage logistics thermal environment. H C Schafer (US Naval Weapons Center, China Lake, Calif.) *Journal of Environmental Sciences*, vol 22, Jan-Feb 1979, p 28-32 26 refs

Environmental criteria determination is discussed with reference to the 'real life' of military materiel exposed to thermal conditions typical of any given part of the world. While data for extreme exposure locations have been obtained, fewer data are available for temperate zones, the lack of these data biases 'worldwide probable chance of occurrence' displays toward the extreme. Processing the vast quantity of field-measured thermal data is simplified by noting that nature tends toward moderation even in the more extreme climatic zones of the earth. The necessity for being precise as to the specific environment encountered by a given kind of materiel is stressed, and skin temperature probability information for different forms of transport and storage is presented. Procedures for interpreting the information are considered. M L

A79-22324 The Sunship G Khoury (Imperial College of Science and Technology, London, England) and E Mowforth (Surrey, University, Guildford, England) *Sunworld*, vol 2, Nov 1978, p 92-94

Development of a solar-powered airship Sunship - is proposed for moving substantial payloads in areas where there is sufficient solar-energy intake. It is suggested that an airship with a conventional configuration and with an array of solar cells over the greater part of its skin area would be capable of carrying a working load of 3 to 5 tons. Geographic range of potential operation, present and future solar cell costs, and hull structure are considered. M L

A79 22327 # Experimental study on flow in a supersonic centrifugal impeller Y Senoo, H Hayami, Y Kinoshita (Kyushu University, Fukuoka, Japan), and H Yamasaki (*American Society of Mechanical Engineers, Gas Turbine Conference, London, England, Apr 9-13, 1978, Paper 78-GT-2*) *ASME, Transactions, Journal of Engineering for Power*, vol 101, Jan 1979, p 32-39, Discussion, p 39, 40, Authors' Closure, p 40, 41 14 refs

An impeller of a supersonic centrifugal compressor was tested in a casing without a diffuser so that the flow range was not limited by the diffuser. Regarding the impeller, emphasis was placed on critical conditions such as inducer stall and surge. Experimental data were examined based on a one-dimensional analysis and a quasi-three-dimensional analysis. Furthermore, the variation of shroud pressure with respect to time at many locations was utilized to guess the details of flow behavior between impeller blades near the shroud, and the contour of isobars was compared with that predicted by a quasi three-dimensional analysis. When the inlet relative velocity was supersonic, a detached shock wave and a shock wave in a blade channel were recognized, but the compressor operated efficiently, although such conditions existed only in a narrow flow range limited by surge and choke. (Author)

A79-22328 # Periodically unsteady flow in an imbedded stage of a multistage, axial-flow turbomachine J H Wagner, T H Okishi, and G J Holbrook (Iowa State University of Science and Technology, Ames, Iowa) (*American Society of Mechanical Engineers, Gas Turbine Conference, London, England, Apr 9-13, 1978, Paper 78-GT-6*) *ASME, Transactions, Journal of Engineering for Power*, vol 101, Jan 1979, p 42-51 12 refs Grant No AF AFOSR-76 2916

A periodic average flow measurement technique involving a hot wire sensor was used to measure the periodically unsteady velocity field in the first stage of a low-speed, multistage, axial-flow research compressor. In portions of the compressor annulus, the periodic average velocity patterns for imbedded rotor and stator exit flows showed appreciable sequential variation with the systematically changed data sampling position of the rotor blades. Representative examples of periodic average flow field variation with rotor blade sampling position in stop action sequence are shown for various locations in the compressor. A simple, first-order approximation physical description of blade wake flow transport and interaction based on experimental data interpretation is proposed to organize and thus help understand the data obtained. (Author)

A79-22329 # Experimental investigation of unsteady phenomena in vaneless radial diffusers A N Abdelhamid (Carleton University, Ottawa, Canada), W H Colwill, and J F Barrows (Carrier Corp., Syracuse, N Y) (*American Society of Mechanical Engineers, Gas Turbine Conference, London, England, Apr 9-13, 1978, Paper 78-GT-23*) *ASME, Transactions, Journal of Engineering for Power*, vol 101, Jan 1979, p 52-59, Discussion, p 59, Author's Closure, p 60 10 refs Research sponsored by the Elliott Co and Carrier Corp

Pressure fluctuations at various locations on the flow path of two centrifugal compressor stages have been recorded and analyzed in the time and frequency domains. Two distinct types of unsteady phenomena were measured: a rotating pressure pattern in the diffuser and compressor system surge. The rotating pressure pattern was generated at a much higher mass flow rate than the one leading to surge. At the onset of the diffuser instability, the pressure fluctuations were sinusoidal and lines of equal phase were radial. For the tests conducted in the present investigation, two nodal diameters existed in the pattern. Both amplitude and rotational speed of the pressure pattern gradually increased as the mass flow rate was gradually decreased. It is shown that the measured pressure fluctuations should not be attributed to rotating zones of separated boundary layers at the diffuser walls. This does not mean, however, that a stationary separation zone in the diffuser is not necessary to generate the measured diffuser instability. (Author)

A79-22330 # The effect of a transversely injected stream on the flow through turbine cascades III - Influence of aspect ratio B

A Aburwin and N R L Maccallum (Glasgow, University, Glasgow, Scotland) (*American Society of Mechanical Engineers, Gas Turbine Conference, London, England, Apr 9-13, 1978, Paper 78-GT-24*) ASME, Transactions, Journal of Engineering for Power, vol 101, Jan 1979, p 61-67 5 refs Research supported by the Science Research Council

An experimental investigation has been made of the effect of a transversely injected stream on the flow through turbine cascades similar to those in which previous studies had been made, but having aspect ratios of 1.5 and 1.0 compared to the previous value of 3.0. New instrumentation includes a five-hole probe. The average losses in stagnation pressure and the changes in flow capacity remain in agreement with one-dimensional theory. The exit vortex is moved towards the end-wall as aspect ratio is reduced. The strength of the vortex is diminished when the aspect ratio is reduced from 3.0 to 1.5, but there is little change for the further reduction of aspect ratio. (Author)

A79-22331 # Jet cooling at the rim of a rotating disk D E Metzger (Arizona State University, Tempe, Ariz), W J Mathis, and L D Grochowsky (*American Society of Mechanical Engineers, Gas Turbine Conference, London, England, Apr 9-13, 1978, Paper 78-GT-25*) ASME, Transactions, Journal of Engineering for Power, vol 101, Jan 1979, p 68-72 8 refs

Results are presented from an experimental study conducted to measure heat transfer rates at the rim of a rotating disk convectively cooled by impinging jets. The disk face contour radially inward from the rim is varied to simulate the geometric conditions found on gas turbine engine rotors. Heat transfer rates are found to be relatively unaffected by impingement for jet flowrates less than the order of one-tenth the disk pumping flow. Disk pumping flows are evaluated through the use of an analysis which accounts for the presence of the disk hub. At larger jet flowrates, heat transfer rates increase strongly with increasing jet flow, reaching two to three times the no-impingement values at jet flowrates approximately equal to the pumped flow. All the heat transfer results, both with and without jet impingement, are essentially unaffected by changes in the disk face contour. (Author)

A79-22332 # Dynamic response testing of gas turbines R V Cottingham and C B Pease (National Gas Turbine Establishment, Farnborough, Hants, England) (*American Society of Mechanical Engineers, Gas Turbine Conference, London, England, Apr 9-13, 1978, Paper 78-GT-31*) ASME, Transactions, Journal of Engineering for Power, vol 101, Jan 1979, p 95-100 7 refs

A knowledge of the dynamic behavior of a gas turbine has always been necessary for control system design and development. One of the chief problems is to measure this information from engine tests as comprehensively and accurately as possible in the minimum amount of time. A technique, based on an improved and generalized version of the pseudo-random binary noise (PRBN) method, is described which shows significant improvements compared to other methods of dynamic response testing. The technique involves the injection of a small PRBN or other random disturbance into the fuel flow or variable geometry actuator, the recording of the response of other engine parameters to that disturbance and the subsequent use of a computer to derive the frequency response. The requirements necessary for successful dynamic response testing are discussed and a comparison made between the improved PRBN technique and conventional sine wave testing from actual engine tests. A number of engines have been analyzed using the new method, some of the results from which are presented. (Author)

A79-22334 # Gas turbine combustor cooling by augmented backside convection D M Evans and M L Noble (Solar Turbines International, International Harvester Group, San Diego, Calif) (*American Society of Mechanical Engineers, Gas Turbine Conference, London, England, Apr 9-13, 1978, Paper 78-GT-33*) ASME, Transactions, Journal of Engineering for Power, vol 101, Jan 1979, p 109-115 20 refs

Traditionally, gas turbine combustor walls have been cooled by one or more of the various film cooling methods. The current motivation to control exhaust gas emission composition has led to the serious consideration of backside convection wall cooling, where the cooling air is introduced to the main gas stream not prior to the dilution zone. Due to the confined space and the severe nature of the wall cooling problem, it is essential to maximize the heat transfer/pumping power characteristic, which suggests an augmented convection technique. A particular heat transfer design of a combustor cooled by means of transverse rib turbulence promoters applied to the exterior wall of the annular spaces surrounding the primary and secondary zones is described. Analytical methods for designing such a cooling system are reviewed and a comparison between analytical and experimental results is presented. (Author)

A79-22335 # Propagation of inlet flow distortions through an axial compressor stage J Colpin (Institut von Karman de Dynamique des Fluides, Rhode Saint-Genèse, Belgium) (*American Society of Mechanical Engineers, Gas Turbine Conference, London, England, Apr 9-13, 1978, Paper 78-GT-34*) ASME, Transactions, Journal of Engineering for Power, vol 101, Jan 1979, p 116-124 10 refs Research supported by the Institut von Karman de Dynamique des Fluides and Institut pour L'Encouragement de La Recherche Scientifique dans L'Industrie et L'Agriculture

This contribution will present an original calculation method predicting the development of an inlet flow distortion through a compressor stage. A finite difference technique is used to treat the flow equations outside the blade rows. That flow is two-dimensional, compressible and nonviscous. The blade rows are modeled using a quasi-actuator disk approach, but include the unsteady transfer terms due to the rotor relative motion in a non-uniform inlet flow. A set of experimental data, measured on a one stage axial compressor, submitted to a rectangular inlet total pressure distortion will be discussed and will serve as basis for a comparison between theory and experiments. (Author)

A79-22336 # An integrated quasi-3D finite element calculation program for turbomachinery flows Ch Hirsch and G Warzee (Bruxelles, Université Libre, Brussels, Belgium) (*American Society of Mechanical Engineers, Gas Turbine Conference, London, England, Apr 9-13, 1978, Paper 78-GT-56*) ASME, Transactions, Journal of Engineering for Power, vol 101, Jan 1979, p 141-148 17 refs

A quasi-3D calculation program based on finite elements is presented in the spirit of Wu's approach. In this work, however, the flow along the S2 surface is replaced by the calculation of the exact mass averaged-pitch averaged flow in a meridional plane. Extra terms appear in this equation which result from the deviations from axisymmetry and which can be calculated from the knowledge of the blade-to-blade flows. Due to the mass-averaging, these terms represent the only interaction from blade-to-blade S1 surfaces to the meridional flow. The complete program is integrated in a single package requiring only ten percent more computer storage than each of the composing S1 or S2 codes taken alone. The various parts of the program are described as well as the interaction process and specific approximations. Example of calculations compared with experimental data are given, showing good agreement with experimental data. (Author)

A79-22337 # Marine spey - SM1A propulsion module K G Page (Rolls-Royce, Ltd, Industrial and Marine Div, Coventry, England) and C R Pack (Ministry of Defence/Procurement Executive, Bath, Somerset, England) (*American Society of Mechanical Engineers, Gas Turbine Conference, London, England, Apr 9-13, 1978, Paper 78-GT-58*) ASME, Transactions, Journal of Engineering for Power, vol 101, Jan 1979, p 149-154

The requirements for a high efficiency marine gas turbine of 10 to 12 MW output has been identified, particularly for Naval craft. The adaptation and development of a marine version of the Rolls-Royce Spey aero engine has been funded by the Ministry of

Defence to meet this requirement. The most suitable version of the aero engine was found to be the TF41 jointly developed by Rolls-Royce and DDA for the LTV Corsair. Redesign involved removal of the bypass portion of the LP compressor and the full length bypass duct. Changes to other engine components have also been made to meet the new requirements, together with material changes for improved corrosion resistance. A new two stage free power turbine has been designed to provide long installed life and is not removed with the engine change unit. Particular attention has been given to the mounting system to provide high shock resistance. A full service module is being designed suitable for naval craft, but alternative lightweight installations can be provided. (Author)

A79-22393 # Aerodynamics of slender bodies at high angles of attack. C E G Prziembel (Rutgers University, Piscataway, NJ) and D E Sherada (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio) *Journal of Spacecraft and Rockets*, vol 16, Jan Feb 1979, p 10-14. 14 refs. Grant No AF-AFOSR-77-3300

Some of the difficulties encountered in using wind tunnel data to predict actual aerodynamic characteristics of slender bodies at moderate to high angles of attack are quantitatively investigated. Very high Reynolds number wind tunnel tests on roughly one-tenth scale models were conducted to determine the effect of various parameters on side forces. The boundary layer approaching the separation line was turbulent, and therefore quite representative of full scale conditions. Although the data indicate that the maximum side force increases with increasing Reynolds number, they do not indicate the possibility of simple extrapolation to full scale. It does not appear that the maximum side force for a particular model would occur at the same roll angle for various values of angle of attack, freestream Mach number, and Reynolds number. P T H

A79-22437 # Theoretical study of simultaneous two-dimensional high-pressure and one-dimensional low-pressure flows of an ideal gas in ejector nozzles. (Teoreticheskoe issledovanie sovmen'nogo techeniia dvumernogo vysokonapornogo i odnomernogo nizkonapornogo potokov ideal'nogo gaza v ezhekortnykh soplakh) V M Puzryev and R K Tagirov *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza*, Nov-Dec 1978, p 110-116. 7 refs. In Russian

A method is proposed for calculating, within the framework of the ideal gas model, the interaction between primary and secondary flows in supersonic ejector nozzles. It is shown that the finite-difference equations which approximate the differential equations of the coaxial primary and secondary flows in an ejector nozzle, possess a singularity. Owing to the finiteness of the integration step, the position of the singularity differs, in the general case, from the position of the singularity of the differential flow equations. This discrepancy is inversely proportional to the value of the ejection factor. An experimental verification showed that by allowing for this singularity, the method proposed yields accurate values of the static pressure for any ejection factor. V P

A79-22439 # Numerical investigation of the gasdynamic characteristics of control nozzles. (Chislennoe issledovanie osobnostei gazodinamiki upravliaiushchikh sopel) V M Dvoretzki and V V Zelentsov *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza*, Nov-Dec 1978, p 126-133. 9 refs. In Russian

An attempt is made to analyze, in the ideal gas approximation, the distribution of the local and integrated characteristics of the asymmetric flow in a gimbaled nozzle and a splitline nozzle. The flow in the subsonic and transonic regions of a gimbaled nozzle is calculated on the basis of a three-dimensional version of Godunov's (1959) difference scheme, while the supersonic flow is calculated using a stationary analog of Godunov's scheme. The complex spiral flow with back currents, characteristic of a gimbaled nozzle, is analyzed. V P

A79-22474 Theoretical modeling of high-speed helicopter impulsive noise. F H Schmitz and Y H Yu (U.S. Army, Aerome-

chanics Laboratory, Moffett Field, Calif) (*European Rotorcraft and Powered Lift Aircraft Forum, 3rd, Aix-en-Provence, France, Sept. 7-9, 1977*) *American Helicopter Society, Journal*, vol 24, Jan 1979, p 10-19. 19 refs

The Ffowcs Williams-Hawkings (1969) theoretical formulation is used to develop a simple acoustic model of high-speed helicopter impulsive noise, where the model depends primarily on the large-scale features of the rotor's aerodynamic flow field. In this theoretical model, the number of singularities are kept to the minimum necessary to describe the physical event. But in addition to monopole and dipole sources for acoustic radiation near the rotor's tip path plane, quadrupole sources are shown to be involved in the basic formulation of the problem. The development of the present simple acoustic model allows an approximate numerical evaluation of the quadrupole phenomenon. Several methods of improving the correlation of theoretical predictions and experimental data are suggested. S D

A79-22475 * Parameter identification applied to analytic hingeless rotor modeling. D Banerjee (Hughes Helicopters, Culver City, Calif), S T Crews (U.S. Army, Systems Development and Qualification Div., St. Louis, Mo), and K H Hohenemser (Washington University, St. Louis, Mo) *American Helicopter Society, Journal*, vol 24, Jan 1979, p 26-32. 15 refs. Army-sponsored research, Contract No NAS2-7613

It is known that dynamic rotor inflow has a substantial effect on rotor dynamic loads. Despite the complexity of the unsteady flow problem, simple analytical models can be made useful by identifying their parameters from transient response tests without performing flow measurements. Two analytical inflow models are studied: the first is based on an equivalent blade Lock number, the second is based on a time delayed unsteady momentum inflow. In preparation for the experimental data analysis, identifications from simulated test data and an eigenvalue analysis are performed. The experimental results show that the first analytical inflow model is accurate for rotor advance ratios of 0.4 and above. For lower advance ratios, the second inflow model provides better accuracy. Prediction studies with experimental data not used for the identification are performed to determine the accuracy of the mathematical models. (Author)

A79-22578 # A five channel MSS for aircraft platform. G Joseph and D S Kamat (Indian Space Research Organization, Space Applications Centre, Ahmedabad, India) In *International Symposium on Remote Sensing of Environment*, 12th, Manila, Philippines, April 20-26, 1978, Proceedings Volume 2

Ann Arbor, Mich., Environmental Research Institute of Michigan, 1978, p 1219-1227

Application of remote sensing for earth resources survey is one of the major activities of the Space Applications Center of the Indian Space Research Organization (ISRO). ISRO has developed a five-channel multispectral scanner (MSS). The present MSS instrument has a capability to choose any four spectral bands between 0.5 to 1.1 micron and one channel in the 8 to 12 micron band. The MSS instrument has a field of view of 5 milliradian and a spatial resolution of 15 m when flown at a height of 3 km. The instrument has some unique features incorporated for operational needs. A checkout facility enables the operator to monitor the complete health of the MSS to give GO/NO-GO decision before the mission starts. The instrument is mounted on a Dakota DC-3 aircraft and is being used to collect data for various user agencies in India. The work in respect of data preprocessing and the final data product is also discussed. (Author)

A79-22620 # Infrared remote sensing on geothermal areas by helicopter. M Sekioka (Defense Academy, Yokosuka, Kanagawa, Japan) and K Yuhara (Kyushu University, Fukuoka, Japan) In *International Symposium on Remote Sensing of Environment*, 12th, Manila, Philippines, April 20-26, 1978, Proceedings Volume 3

Ann Arbor, Mich., Environmental Research Institute of Michigan, 1978, p 1679-1686. 7 refs

A technique is developed to determine surface temperature distributions by using a helicopter-borne infrared thermographic instrument giving thermal images of television type. Making a helicopter with an open hatch on its floor, through which thermal images are photographed, to hover over the target area, the temperature distributions with high resolution can be obtained in projection on a horizontal plane. Two experimental surveys were performed for several subregions of an active volcanic island. In the first survey, an attempt to print out digitally the ratio of areas between each adjacent isotherm on the isothermal image is carried out with an isothermal area processor. A method converting the isothermal pattern of geothermal fields to a distribution of heat discharge will be applied to such a ratio of areas of isothermal patterns thus obtained in the near future. In the second one, effects of atmospheric absorption and emission between the sensor of the thermocamera and the target area are evaluated using a newly developed helicopter-borne radiosonde system to correct the surface temperatures measured by the thermocamera (Author)

A79-22673 # U.S. Coast Guard utilization of remote sensing techniques for ocean surveillance J R White, D R Freezer, and R R Vollmers (U.S. Coast Guard, Washington, D.C.) In *International Symposium on Remote Sensing of Environment*, 12th, Manila, Philippines, April 20-26, 1978, Proceedings Volume 3, Ann Arbor, Mich., Environmental Research Institute of Michigan, 1978, p. 2307-2311

The missions normally performed by the Coast Guard include pollution surveillance (oil slick detection), search and rescue, ice reconnaissance, and enforcement of laws and treaties, requiring large-scale ocean surveillance. Evaluation of sensor systems of various type has shown that the Coast Guard missions can be performed effectively using sensor-equipped aircraft. Particularly convincing were the excellent results obtained with the Airborne Oil Surveillance systems, AOSS I and AOSS II. The airborne sensors discussed in the present paper include the side-looking airborne radar, the IR/UV line scanner, the aerial reconnaissance camera, the airborne data annotation system, and the control display and record console. V P

A79-22705 The future - ARTS III F M McDermott (*Annual Air Law Symposium, 12th, Dallas, Tex., Apr 20-22, 1978*) *Journal of Air Law and Commerce*, vol 44, no 2, 1978, p. 321-332, 43 refs

The function and performance of automated radar terminal systems (ARTS) are discussed. The relation of ARTS and the NAS Stage A computer system is considered with particular reference to weather data and accident reconstruction. The present system of automation is described, and aviation history leading to the development of automated systems is surveyed. The importance of maintaining tape recordings of data and communications is indicated. M L

A79-22710 The role of metallurgy in aircraft accident investigation and litigation A S Tetelman and H S Redmon, Jr (Phelps, Dunbar, Marks, Clauerie and Sims, New Orleans, La.) (*Annual Air Law Symposium, 12th, Dallas, Tex., Apr 20-22, 1978*) *Journal of Air Law and Commerce*, vol 44, no 2, 1978, p. 401-416

In this article on forensic metallurgy, a metallurgist and a lawyer speak in the roles of expert witness for the defense and lawyer for the defense. The imaginary case involves the imaginary crash of a light single engine aircraft on landing, and it is assumed that witnesses reported an uncontrolled bank to the left. Exhibits and analysis suggesting that cable failure resulted from separation of wing and fuselage rather than from overload fatigue are examined. M L

A79-22711 Availability and use of weather data C H Smith (*Annual Air Law Symposium, 12th, Dallas, Tex., Apr 20-22, 1978*) *Journal of Air Law and Commerce*, vol 44, no 2, 1978, p. 417-465, 120 refs

The influence of weather data on aviation is discussed, and it is suggested that weather tends to increase the likelihood of aviation

accidents rather than to be the primary cause. Aviation weather products are discussed with reference to surface weather observations, aviation weather reports, terminal forecasts, area forecasts, Sigmet and Airmet, winds aloft forecast, pilot reports, surface weather maps, and weather depiction charts. Availability and certification of weather data are considered. Weather data as evidence are discussed in terms of official records statutes. M L

A79-22772 Army outlook Flight control systems S C Stevens (U.S. Army, Aviation Research and Development Command, St. Louis, Mo.) *Vertiflite*, vol 25, Jan-Feb 1979, p. 10-15

Future concerns of Army Aviation referring to R&D community are discussed especially areas in which rotary wing control improvements may be made. Consideration is given to Nap-Of-The-Earth (NOE) Flight, All Weather Operation, Attack/Scout Mission, Target Hand Off, and Air To Air Self Defense projected tactics, concluding that a more complex design of flight control systems is needed. Attention is also given to the multi-redundant fly-by-wire/fly-by-light, external rotating controls, flight control interaction, and integrated controllers systems. Army Aviation efforts in conjunction with NASA for meeting several rotary wing stringent requirements are mentioned, as is the AVRADCOM RDT&E plan, which describes the overall flight control system program. A A

A79-22774 * Thermochemical characterization of some thermally stable thermoplastic and thermoset polymers D A Kourtides, W J Gilwee, Jr, and J A Parker (NASA, Ames Research Center, Moffett Field, Calif.) *Polymer Engineering and Science*, vol 19, Jan 1979, p. 24-29, 31 refs

The thermochemical and flammability properties of some thermally stable polymers considered for use in aircraft interiors are described. The properties studied include (1) thermomechanical properties such as glass transition and melt temperature, (2) dynamic thermogravimetric analysis in anaerobic environment, (3) flammability properties such as oxygen index, flame spread, and smoke evolution, and (4) selected physical properties. The thermoplastic polymers evaluated include polyphenylene sulfide, polyaryl sulfone, 9,9-bis(4-hydroxyphenyl)-fluorene, polycarbonate poly(dimethyl siloxane) and polyether sulfone. The thermoset polymers evaluated include epoxy, bismaleimide, a modified phenolic, and polyaromatic melamine resin. These resins were primarily used in the fabrication of glass-reinforced prepregs for the construction of experimental panels. Test results and relative rankings of some of the flammability parameters are presented, and the relationship of the molecular structure, char yield, and flammability properties of these polymers are discussed. (Author)

A79-22839 Sikorsky S-76 stresses performance R R Ropelewski (*Aviation Week and Space Technology*, vol 110, Feb 19, 1979, p. 61-63, 65-68)

Structure and performance of the S-76 helicopter, in service since February 1979, are described in detail, together with information on flight tests. The S-76 has a maximum gross weight of 10,000 lb, a fuel capacity of about 1,820 lb, and twin Allison 250-030 turboshaft engines producing 650 shp each at take off. 40% of the aircraft's surface area and most of the rear fuselage and tail are made of lightweight, corrosion-free composite materials. Maximum speed is estimated at 287 km/hr, and best rate of climb at 6.9 m/sec. The characteristics of the aircraft in terms of stability, performance, vibration and interior noise levels are discussed, noting taxiing, hover and forward flight capabilities. A A

A79-22921 * Development of noise and vibration ride comfort criteria T K Dempsey, J D Leatherwood, and S A Clevenson (NASA, Langley Research Center, Hampton, Va.) *Acoustical Society of America, Journal*, vol 65, Jan 1979, p. 124-132, 23 refs

A laboratory investigation was directed at the development of criteria for the prediction of ride quality in a noise/vibration environment. The stimuli for the study consisted of octave bands of

noise centered at 500 and 2000 Hz and vertical floor vibrations composed of either 5 Hz sinusoidal vibrations, or random vibrations centered at 5 Hz and with a 5 Hz bandwidth. Results indicated that the total subjective discomfort response could be divided into two subjective components. One component consisted of subjective discomfort to vibration and was found to be a linear function of vibration acceleration level. The other component consisted of discomfort due to noise which varied logarithmically with noise level (power relationship). A model of subjective discomfort that accounted for the interdependence of noise and vibration was developed. The model was then used to develop a set of criteria (constant discomfort) curves that illustrate the basic design tradeoffs available between noise and vibration. (Author)

A79-22946 Towards a realistic structural analysis/design system. P. Mason, D. Gregory, T. Balderes, and S. Iaccarino (Grumman Aerospace Corp., Bethpage, N.Y.) In *Trends in computerized structural analysis and synthesis*, Proceedings of the Symposium, Washington, D.C., October 30-November 1, 1978. Oxford and Elmsford, N.Y., Pergamon Press, 1978, p. 285-294. 19 refs.

A description is given of work which is concerned with the development of a practical and realistic structural analysis and design system. Key concepts behind a realistic structural analysis-design system include modularity, integration, interaction, versatility, realistic design criteria, graphical control, common geometric data base, automatic data retrieval systems (data banks) and multistrategy design schemes to account for different types of construction. Most of these concepts and capabilities already exist within two main engineering systems. Current efforts in structural analysis have the objective to add to the existing systems the required design capability and to unite the appropriate features of the two systems. G. R.

A79-22951 Adaptive approximations in finite element structural analysis. A. Peano (Milano, Politecnico, Milan, Italy), A. Pasini, R. Riccioni, and L. Sardella (Istituto Sperimentale Modelli e Strutture, Bergamo, Italy). In *Trends in computerized structural analysis and synthesis*, Proceedings of the Symposium, Washington, D.C., October 30-November 1, 1978. Oxford and Elmsford, N.Y., Pergamon Press, 1978, p. 333-342. 19 refs.

A finite element computer program is termed adaptive when it possesses a local a posteriori error estimation capability, along with a capability of assigning (automatically or with minimum user interaction) additional degrees of freedom to regions with particularly high accuracy requirements. The automated convergence process reduces the discretization error until the accuracy desired is obtained, thereby establishing confidence in the solution. The purpose of the present paper is to demonstrate, on the basis of two and three-dimensional applications, an adaptive computer program capable of obtaining improved solutions at minimum cost. The behavior of p-convergent approximations at crack tip singularities is studied, and the implementation of adaptive finite element techniques into second generation large-scale computer programs is discussed. V. P.

A79-23241 # A functional evaluation of a thrust carrying cylindrical roller bearing design. F. R. Morrison, J. Pirvics, and W. J. Crecelius (SKF Industries, Inc., King of Prussia, Pa.) *American Society of Mechanical Engineers and American Society of Lubrication Engineers, Joint Lubrication Conference, Minneapolis, Minn., Oct. 24-26, 1978, ASME Paper 78-Lub-28*. 6 p. 13 refs. Members, \$1.50, nonmembers, \$3.00. Army sponsored research.

A first generation bearing is designed to be used as a replacement for the pair of bearings currently located at one end of the spiral bevel input pinion in the transmission of a U.S. Army Blackhawk size helicopter. The design effort and the preliminary experimental evaluation of this prototype bearing are described. Functional evaluation concerns a special 60 mm bore cylindrical roller bearing designed to support the radial and thrust loads

developed by the spiral bevel input. Two prototype bearings are fabricated and laboratory tested. Lubrication is supplied through synthetic-lubricant circulation. Visual and SEM examination of the bearing surfaces after accumulated 32-hr operation show no abnormal deterioration of the load-supporting contact surfaces. The condition of the load-supporting contact surfaces after predominant thrust loading is found to be quite satisfactory. S. D.

A79-23246 * # Filtration effects on ball bearing life and condition in a contaminated lubricant. S. H. Loewenthal (NASA, Lewis Research Center, Cleveland, Ohio) and D. W. Moyer (Tribon Bearing Co., Cleveland, Ohio). *American Society of Mechanical Engineers and American Society of Lubrication Engineers, Joint Lubrication Conference, Minneapolis, Minn., Oct. 24-26, 1978, ASME Paper 78-Lub-34*. 6 p. 20 refs. Members, \$1.50, nonmembers, \$3.00.

Ball bearings were fatigue tested with a noncontaminated MIL-L 23699 lubricant and with a contaminated MIL-L 23699 lubricant under four levels of filtration. The test filters had absolute particle removal ratings of 3, 30, 49, and 105 microns. Aircraft turbine engine contaminants were injected into the filter's supply line at a constant rate of 125 milligrams per bearing hour. Bearing life and running track condition generally improved with finer filtration. The experimental lives of 3- and 30-micron filter bearings were statistically equivalent, approaching those obtained with the noncontaminated lubricant bearings. Compared to these bearings, the lives of the 49-micron bearings were statistically lower. The 105-micron bearings experienced gross wear. The degree of surface distress, weight loss, and probable failure mode were dependent on filtration level, with finer filtration being clearly beneficial. (Author)

A79-23250 An airborne microcomputer for radio navigation. J. L. Houle (Ecole Polytechnique, Montreal, Canada) and M. Lavoie (Canadian Marconi Co., Montreal, Canada). *International Journal of Mini and Microcomputers*, vol. 1, no. 1, 1978, p. 25-34. 14 refs.

The purpose of this paper is to present the architecture and the tasks of a microcomputer dedicated to airborne radio navigation. The system consists of a three frequency Omega signal receiver coupled to a microprocessor. Some of the features of the overall system are original enough to be of interest to engineers and scientists involved with microprocessor applications. The computer is interfaced with A/D, D/A, digital output, digital input as well as a rudimentary buffered modem between the control and display unit of the CMA-734 and the computer itself. The paper briefly covers the principles and development of hyperbolic radio navigation. The microprocessor is examined, with attention given to some interesting special features of the interfaces. Finally, the software is described along with the equations and algorithms necessary to command the automatic flight control system of the aircraft, point the directional antenna, monitor the status of the input/output of the system, and to detect malfunctions of its own memory and other modules. (Author)

A79-23377 # Determination of friction losses in a turbine blade boundary layer (Determinarea pierderilor prin frecare in stratul limita pe paleta de turbina). V. Pimsner and N. Baran (Bucuresti, Institutul Politehnic, Bucharest, Rumania). *Studii si Cercetari de Mecanica Aplicata*, vol. 37, July-Aug. 1978, p. 527-534. 6 refs. In Rumanian.

A method of calculating the characteristics of the boundary layer of a turbine blade in a cascade is proposed. The boundary layer equations are solved by the finite difference method. Formulas are given which are valid for the determination of the friction losses in the boundary layer as a function of the boundary layer parameters. P. T. H.

A79-23509 * # Effect of lip and centerbody geometry on aerodynamic performance of inlets for tilting-nacelle VTOL aircraft

R R Burley (NASA Lewis Research Center, Cleveland, Ohio) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La, Jan 15-17, 1979, Paper 79 0381* 25 p 8 refs

Inlets for tilt nacelle VTOL aircraft must operate over a wide range of incidence angles and engine weight flows without internal flow separation. Wind tunnel tests of scale model inlets were conducted to evaluate the effectiveness of three geometric variables to provide this capability. Increasing the lip contraction ratio increased the separation angle at all engine weight flows. The optimum axial location of the centerbody occurred when its leading edge was located just downstream of the inlet lip. Compared with a short centerbody, the optimum location of the centerbody resulted in an increase in separation angle at all engine weight flows. Decreasing the lip major to minor-axis ratio increased the separation angle at the lower engine weight flows. (Author)

A79-23510 * # Aerodynamic performance of scarf inlets J M Abbott (NASA, Lewis Research Center, Cleveland, Ohio) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La, Jan 15-17, 1979, Paper 79 0380* 21 p

A scarf inlet is characterized by having a longer lower lip than upper lip leading to both aerodynamic and acoustic advantages. Aerodynamically, a scarf inlet has higher angle of attack capability and is less likely to ingest foreign objects while the aircraft is on the ground. Acoustically, a scarf inlet provides for reduced inlet radiated noise levels below the engine as a result of upward reflection and refraction of inlet radiated noise. Results of a wind tunnel test program are presented which illustrate the aerodynamic performance of two different scarf inlet designs. Based on these results, scarf inlet performance is summarized in a way to illustrate the advantages and limitations of a scarf inlet compared to an axisymmetric inlet. (Author)

A79-23512 * # Effect of forward velocity and crosswind on the reverse-thrust performance of a variable-pitch fan engine D C Reemsnyder and D A Sagerser (NASA, Lewis Research Center, Cleveland, Ohio) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La, Jan 15-17, 1979, Paper 79-0105* 20 p 12 refs

Variable-pitch-fan engines may be attractive for future short-haul aircraft if sufficient reverse thrust is available for aircraft deceleration after touchdown. Thrust reversal is obtained in these engines by changing fan blade pitch about 90 deg, which causes the fan airflow to enter the fan duct nozzle and exhaust through the fan inlet. This capability would eliminate the heavy and costly thrust reverser system required for current fixed pitch turbofan engines. NASA has, therefore, supported the development of advanced technology for a quiet, clean, high-bypass ratio turbofan engine for future short-haul aircraft. In connection with this program, tests were conducted to determine the effect of forward velocity and angle of attack on steady state reverse-thrust performance. Other objectives of the tests were related to the determination of the effect of forward velocity on forward to reverse thrust transient performance and the determination of the effectiveness of an overshoot blade angle technique to establish reverse thrust during a transient. The results of the tests are discussed. G R

A79-23513 * # Preliminary flight and wind tunnel comparisons of the inlet/airframe interaction of the F-15 airplane L D Webb, S A Whitmore, and R L Janssen (NASA, Flight Research Center, Edwards, Calif) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La, Jan 15-17, 1979, Paper 79-0102* 18 p 8 refs

Preliminary flight and wind tunnel comparison data are presented for the F-15 inlet/airframe interactions program. Test conditions and instrumentation for both the model and the aircraft are described. Flight and wind tunnel inlet drag data (for a 0-deg

angle of attack and Mach numbers of 0.6, 0.9, and 1.2), derived by using nearly identical pressure integration equations, are compared. The effects of a movable cowl, movable ramps, and other system components on pressure flow fields along the airframe are discussed. Excellent agreement between wind tunnel and flight pressure-integrated drags is found at all three Mach numbers. The wind tunnel data show good agreement for pressure integrated and force-balance-measured inlet drag, except at Mach 0.6. Flight-measured pressure-integrated inlet lift is lower than that measured in the wind tunnel. S D

A79-23515 * # Computational aerodynamics development and outlook /Dryden Lecture in Research for 1979/ D R Chapman (NASA, Ames Research Center, Moffett Field, Calif) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La, Jan 15-17, 1979, Paper 79-0129* 30 p 150 refs

Some past developments and current examples of computational aerodynamics are briefly reviewed. An assessment is made of the requirements on future computer memory and speed imposed by advanced numerical simulations, giving emphasis to the Reynolds-averaged Navier-Stokes equations and to turbulent eddy simulations. Experimental scales of turbulence structure are used to determine the mesh spacings required to adequately resolve turbulent energy and shear. Assessment also is made of the changing market environment for developing future large computers, and of the projections of micro-electronics memory and logic technology that affect future computer capability. From the two assessments, estimates are formed of the future time scale in which various advanced types of aerodynamic flow simulations could become feasible. Areas of research judged especially relevant to future developments are noted. (Author)

A79-23517 * # Computation of supersonic viscous flows over ogive-cylinders at angle of attack J V Rakich, Y C Vigneron, and R Agarwal (NASA, Ames Research Center, Moffett Field, Calif) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La, Jan 15-17, 1979, Paper 79 0131* 10 p 19 refs. Grant No NGR 16-002 038

The parabolic Navier-Stokes (PNS) marching finite difference method is applied to 3-D viscous flow over pointed ogive-cylinders, and to turbulent flow over a cone. Ogive computations were performed using the new technique recently reported by Vigneron, Rakich, and Tannehill. Comparison is made with experiment and inviscid computations. The present results show that this method, which neglects part of the pressure gradient in the x-momentum equation, is nevertheless valid for flows with a strong favorable pressure gradient. In addition, turbulent separated flow over a cone has been computed using the older PNS code due to Lubard and Helliwell. It is found that one must freeze the turbulent eddy viscosity model upstream of 3-D separation to get agreement with experiment. (Author)

A79-23526 * - Computational optimization and wind tunnel test of transonic wing designs H P Haney, R R Johnson (Vought Corp., Dallas, Tex.), and R M Hicks (NASA, Ames Research Center, Aerodynamics Research Branch, Moffett Field, Calif) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La, Jan 15-17, 1979, Paper 79-0080* 12 p 7 refs

A practical procedure for the optimum design of transonic wings is demonstrated. The procedure uses an optimization program based on the method of feasible directions coupled with an aerodynamic analysis program which solves the three-dimensional potential equation for subsonic through transonic flow. Two new wings for the A-7 aircraft were designed by using the optimization procedure to achieve specified surface pressure distributions. The new wings, along with the existing A-7 wing, were tested in the Ames 11-foot transonic wind tunnel. The experimental data show that all of the performance goals were met. (Author)

A79-23531 # Propulsion integration of a supersonic cruise strike-fighter W W Hinz and E H Miller (Grumman Aerospace Corp., Bethpage, N Y) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La, Jan 15-17, 1979, Paper 79-0100* 11 p 10 refs

Requirements for efficient supersonic cruise in future strike-fighter aircraft place increased emphasis on the integration of the propulsion system. The current paper reviews the propulsion considerations that contributed to an attractive aircraft design, and reports the results of a wind tunnel test program that examined a matrix of inlet, nacelle, and exhaust nozzle configurations. These propulsion components were incorporated into a complete aircraft model, insuring proper geometric simulation of aircraft/propulsion interference effects, and tested at Mach 1.5 and 2.0. Included in the propulsion package were rectangular and semi-circular inlet configurations. Nozzles examined included the wedge, ALBEN, 2-D C-D, and current and advanced axisymmetric configurations. The external drag data acquired during these tests and supporting inlet/nozzle internal performance and weight data were subsequently combined to determine the overall propulsion system impact on mission and aircraft takeoff gross weight. (Author)

A79-23532 * # Performance characteristics of nonaxisymmetric nozzles installed on the F-18 aircraft F J Capone (NASA, Langley Research Center, High Speed Aerodynamics Div., Hampton, Va.), N S Gowadia (Northrop Corp., Hawthorne, Calif.), and W H Wooten (General Electric Co., Cincinnati, Ohio) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La, Jan 15-17, 1979, Paper 79-0101* 31 p 19 refs

The Langley Research Center has conducted an experimental program on a model of the F-18 airplane to determine the performance of nonaxisymmetric nozzles relative to the aircraft's baseline axisymmetric nozzle. The performance of a single expansion ramp (ADEN) and two-dimensional convergent-divergent (2-D C-D) nozzle were compared to the baseline axisymmetric nozzles. The effects of vectoring and reversing were also studied. Performance of a modified YF-17 airplane with the ADEN nozzle was also estimated. The results of this investigation indicate that nonaxisymmetric nozzles can be installed on a twin engine fighter airplane with equal or better performance than axisymmetric nozzles. The nonaxisymmetric nozzles also offer potential for innovative and improved aircraft maneuver through thrust vectoring and reversing. The YF-17/ADEN flown as a technology demonstrator would have reduced performance compared to an unmodified YF-17. However, on an equal aircraft weight basis, performance would essentially be equivalent. This study also showed that the YF-17 can serve as a testbed to validate nonaxisymmetric nozzle technology. (Author)

A79-23534 # Advanced weapons carriage concepts through integrated design M N Gough, Jr (Grumman Aerospace Corp., Bethpage, N Y) and D R Carlson (Hughes Aircraft Co., Missile Systems Group, Canoga Park, Calif.) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La, Jan 15-17, 1979, Paper 79-0092* 13 p

In the past, weapons and air vehicles were designed independently of each other with subsequent weapon integration, resulting in unacceptable integration penalties. In the present paper, the joint Grumman/Hughes Advanced Weapon Carriage Configured Vehicle study is described which addresses this problem. The weapon system concepts derived to illustrate the value of early weapon and carrier integration are discussed with particular reference to the top-translating carriage concept. V P

A79 23541 * # Effects of turbulence model selection on the prediction of complex aerodynamic flows T J Coakley and M Y Bergmann (NASA, Ames Research Center, Moffett Field, Calif.) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La, Jan 15-17, 1979, Paper 79-0070* 20 p 18 refs

Numerical simulations of viscous transonic flow over a circular-arc airfoil and in a diffuser are described. The simulations are made with a new computer program designed to serve as a tool in the development of improved turbulence models for complex flows. The program incorporates zero-, one-, and two-equation eddy viscosity models and includes a variety of subsonic and supersonic boundary conditions. The airfoil flow contains a shock separated boundary layer interaction that has resisted previous attempts at simulation. The diffuser flow also contains a shock boundary-layer interaction, which has not been simulated previously. Calculations using standard turbulence models, developed originally for incompressible unseparated flows, are described. Results indicate that although there are interesting differences in predictions between the various models, none of them predict the flows accurately. Suggestions for improved turbulence models are discussed. (Author)

A79-23542 * # On turbulence modeling for unsteady transonic flows J G Marvin, L L Levy, Jr., and H L Seegmiller (NASA, Ames Research Center, Moffett Field, Calif.) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La, Jan 15-17, 1979, Paper 79-0071* 16 p 18 refs

A detailed examination of the turbulent field in an unsteady transonic flow undergoing shock-induced separation is conducted. Ensemble-averaged mean and fluctuating velocities, obtained from conditionally sampled laser velocimeter data, are described and analyzed to assess the applicability of modeling concepts usually employed in steady-flow problems. Some comparisons with computations employing the Reynolds averaged Navier-Stokes equations with a mixing length turbulence model are then presented to illustrate the status of current predictive capabilities. The results appear to imply that turbulence models developed for steady flows apply and that the model need not reflect all the fine details of the turbulent structure but rather account in an approximate way for the production and destruction of the turbulence. G R

A79-23549 # A model of external burning propulsion D W Harvey (McDonnell Douglas Astronautics Co., Huntington Beach, Calif.) and I Catton (California, University, Los Angeles, Calif.) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La, Jan 15-17, 1979, Paper 79-0358* 13 p 15 refs USAF-supported research

A computer model of external burning propulsion of axisymmetric, supersonic vehicles is described. Reactive gaseous injectant issues from individual nozzles around the vehicle periphery, near the base. At the base these individual jets merge into an annulus of injectant surrounding the base cavity. Detailed individual jet calculations in the region upstream of the base are made by an existing analysis developed for fuel-rich jet interaction. The injectant annulus is calculated assuming an adjustable fraction of the flow at equilibrium and the remainder frozen; mass and momentum are conserved, and the transverse pressure gradients are assumed negligible. Results and trends are presented for parameters including Mach number, altitude, vehicle geometry and injectant mass and momentum flux and composition. (Author)

A79 23550 # Some features of the unsteady pressure field in transonic airfoil buffeting F W Roos (McDonnell Douglas Research Laboratories, St. Louis, Mo.) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La, Jan 15-17, 1979, Paper 79-0351* 11 p 17 refs

Comparisons are made between the unsteady transonic flow fields of two airfoils: a Whitcomb supercritical airfoil and a conventional NACA 0012 section. Wind tunnel experiments on these airfoils included penetration into buffeting as a result of high section lift coefficient and/or high freestream Mach number. Fluctuating surface pressure, lift, and shock location were measured on both airfoils. Two point pressure cross correlations were used to determine coherence and propagation direction of pressure fluctuation patterns on the upper surface of each airfoil. Between the upper surface shock

and the trailing edge, pressure disturbances propagated upstream in attached flow, but traveled downstream when extensive separation existed. In the latter case, convection velocities were found to be frequency dependent. Another cross correlation, relating surface pressure fluctuations to unsteady lift, was employed to establish which regions of the pressure fields were of primary importance in producing buffeting forces. The supercritical airfoil exhibited less periodicity in its cross-correlation. This result was attributed to the flat topped, aft cambered shape of the supercritical airfoil section, which reduced the coupling between shock oscillations and lift fluctuations (Author)

A79-23551 # Investigation of cross flow shocks on delta wings in supersonic flow M J Siclari (Grumman Aerospace Corp., Bethpage, N Y) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La., Jan 15-17, 1979, Paper 79-0345* 17 p 17 refs Contract No F33615-77 C 3126

In the study described, a finite difference approach to solving the rotational Euler equations, explicitly fitting shocks as a boundary, is applied to a variety of geometrical shapes in the lower supersonic Mach number regime. It is shown how special techniques based on the physics of the flow can be used to circumvent a variety of numerical difficulties encountered with the conical flow problem that are primarily associated with the initial value characteristics of the hyperbolic scheme, causing embedded shock induced entropy and cross flow layers to develop on the body surface. V P

A79-23552 # Computational transonic design procedure for three-dimensional wings and wing-body combinations V Shankar, N D Malmuth (Rockwell International Science Center, Thousand Oaks, Calif), and J D Cole (California University, Los Angeles, Calif) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La., Jan 15-17, 1979, Paper 79-0344* 15 p 17 refs Contract No F44620-76-C 0044

A computational transonic design procedure for three-dimensional wings in which shapes are determined supporting prescribed pressure distributions, is presented. The method uses an existing three-dimensional modified small disturbance theory analysis code to include the design procedure. A consistent analysis design differencing procedure at the wing slit is implemented. Design results are presented for aft and forward swept wings in isolation as well as in the presence of a fuselage. Performance of the designed wing at off-design Mach number and in the presence of solid and free jet wind tunnel walls is also reported (Author)

A79-23553 # Some basic test results of V/STOL jet induced lift effects in hover F A Wohlbe and D Migdal (Grumman Aerospace Corp., Bethpage, N Y) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La., Jan 15-17, 1979, Paper 79-0339* 7 p 6 refs

Jet induced effects usually manifest themselves on a V/STOL aircraft as additional forces and moments caused by the presence of propulsive jets. Configuration parameters are known to determine both the magnitude and direction of induced forces in-ground effect. These forces are significant in determining aircraft takeoff weight or useful load. Small-scale hover test results are presented for aircraft models having two jets with a high wing, low canard arrangement, as well as a low-wing, tee tail arrangement. Configuration test parameters include fuselage contour, jet splay angle, canard size, and strake effects. Results indicate that either fuselage shaping or fuselage strakes can be very effective in creating positive lift on hovering aircraft (Author)

A79-23555 # Experimental techniques used to evaluate propulsion system interference effects on the cruise configuration of the Boeing C-14 D N Hunt (Boeing Aerospace Co., Seattle, Wash) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La., Jan 15-17, 1979, Paper 79-0335* 9 p 5 refs

For upper surface blowing (USB) configurations the determination of jet interference effects is an important part of cruise drag prediction. Accurate determination of jet interference in the wind tunnel is a problem requiring great attention to the details of thrust-drag bookkeeping, model design details, and thrust calibration techniques. The manner in which these problems were approached for the C-14 program is discussed and typical results are shown. The quality of the final results is discussed in terms of wind tunnel data repeatability. Comparison of the final drag results to flight test data is shown (Author)

A79-23556 # Jet-induced aerodynamics of V/STOL aircraft over a moving deck J H Kamman, C L Hall (McDonnell Aircraft Co., St Louis, Mo), and M M Walters (U S Naval Materiel Command, Naval Air Development Center, Warminster, Pa) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La., Jan 15-17, 1979, Paper 79-0337* 12 p

The propulsive lift system induced aerodynamics of representative V/STOL aircraft were assessed over a three degree of freedom ship deck motion simulator. The primary objective of the investigation, conducted by McDonnell Aircraft Company under contract to the Naval Air Development Center, was to determine the effects of a variety of deck motions on the jet induced aerodynamics of V/STOL aircraft during landing and take off operations from seaborne platforms. The dynamic data were compared to predicted induced force and moment variations based on data obtained with fixed deck positions. The comparisons indicate that the data acquired with deck motion can differ significantly from the predictions. Several configuration related effects were also evaluated, including the effects of model contouring and lift improvement devices. These results indicate that accurate simulation of the fuselage lower surfaces can be very important and that lift in ground effect can be improved significantly by simple fences even at high deck roll angles (Author)

A79-23557 # Powered wind tunnel testing of the AV-8B - A straightforward approach pays off T R Lacey, D B Johnson, and J J Voda (McDonnell Aircraft Co., St Louis, Mo) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La., Jan 15-17, 1979, Paper 79-0333* 8 p

The general approach to powered V/STOL testing used in the AV-8B development program is presented. Alternate approaches are discussed and the rationale for the approach which was selected is given. A description of the power system and its checkout procedure is included. Aerodynamic force and moment data comparisons between scale model tests using cold jet simulation and full scale tests using the Pegasus 11 engine are included (Author)

A79-23558 # Low speed testing techniques for V/STOL aircraft in the Princeton dynamic model track W F Putman, H C Curtiss, Jr (Princeton University, Princeton, N J), and M Lapins (Grumman Aerospace Corp., Bethpage, N Y) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La., Jan 15-17, 1979, Paper 79-0334* 17 p 12 refs

Experimental techniques are discussed that permit evaluation of V/STOL aircraft aerodynamics in and near hovering flight. The unique apparatus employed utilizes a moving model and allows precise control of model velocities from hover through the transition flight regime. Quasi steady testing results are presented and discussed regarding their value in test productivity, examination of hysteresis phenomena, and elimination of recirculation effects due to the testing enclosure. The suitability of Froude scale modeling is examined and the capability of complete flight dynamics simulation is reviewed. Particular attention is devoted to the capability for testing powered models both in and out of ground effect as well as for simulating the dynamics of ground effect. A current Navy/NASA sponsored test program utilizing a Grumman Aerospace Corporation twin turbofan V/STOL aircraft model is discussed (Author)

A79-23562 * = Recent advances in the solution of three-dimensional flow over wings with leading edge vortex separation F

T Johnson, E N Tinoco (Boeing Aerospace Co, Seattle, Wash), P Lu, and M A Epton (Boeing Computer Services, Inc, Seattle, Wash) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La, Jan 15-17, 1979, Paper 79-0282* 15 p 26 refs Contracts No NAS1-15169, No NAS1 15275

Recent advances in a panel method for the solution of three-dimensional flow about wing and wing-body combinations with leading-edge vortex separation are presented These advances were achieved as part of an ultimately successful assault on two shortcomings of the method, namely convergence failures in seemingly random cases, and overprediction of lift coefficient for high aspect ratio wings Advances include the implementation of improved panel numerics for the purpose of eliminating the highly non-linear effects of ring vortices around doublet panel edges, and the development of a least squares procedure for damping vortex sheet geometry update instabilities A variety of cases generated by the computer program implementing the method are presented These cases are of two types The first type consists of numerical studies, which verify the underlying mathematical assumptions of the method and moreover show that the results are strongly invariant with respect to such user dependent input as wing panel layout, initial sheet shape, sheet rollup, etc The second type consists of cases run for the purpose of comparing computed results with experimental data, and these comparisons verify the underlying physical assumptions made by the method (Author)

A79-23563 * # On the stability of the boundary layer on a transonic swept wing L M Mack (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La, Jan 15 17, 1979, Paper 79 0264* 17 p 17 refs Contract No NAS7-100

Both incompressible and compressible linear stability theory are applied to the three-dimensional compressible boundary layer on a particular transonic sweptback wing of infinite span A spatial stability theory is used which identifies the growth direction with the real part of the complex angle of the group velocity It is found that in the forward, but not the rear, crossflow instability region, the maximum amplification rates of the steady disturbances may be calculated to within about 10% by the incompressible stability theory There is little difference between the sixth and eighth order compressible theories The maximum amplification rate of the steady disturbances at any chordwise station is closely related to the maximum crossflow at that station independent of the Reynolds number For other than crossflow instability, there can be large differences between the incompressible and compressible theories, both as to the amplification rate and the angle of the wavenumber vector for maximum instability Amplitude ratios of individual wave components are obtained by integrating the spatial amplification rate along the growth direction subject to the constraint that the wavenumber vector is irrotational This procedure yields steady disturbances aligned with the local potential flow direction whose wave lengths are nearly independent of downstream distance (Author)

A79-23564 # Amplification factors at transition on an unswept wing in free flight and on a swept wing in wind tunnel L J Runyan and D George Falvy (Boeing Commercial Airplane Co, Seattle, Wash) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La, Jan 15 17, 1979, Paper 79-0267* 18 p 10 refs

Theoretically predicted amplification characteristics of Tollmien-Schlichting and crossflow disturbances are correlated with experimental data on transition location A modified version of the MACK linear stability program was used to analyze two specific cases an unswept sailplane wing of high quality surface finish in free flight at low Reynolds number, and a swept wing section in a low turbulence wind tunnel For the sailplane wing, where transition was caused by Tollmien-Schlichting type instability, the amplification factor corresponding to transition was found to be about e to the

15th power For the swept wing model, where transition was caused by crossflow instability, the amplification factor corresponding to transition was about e to the 12th power (Author)

A79-23568 # Introducing cost effectiveness into the tactical airplane design cycle in a cost effective manner P G Osterbeck, R C Sutton, and L D Hawkins (Boeing Aerospace Co, Seattle, Wash) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La, Jan 15-17, 1979, Paper 79-0235* 7 p

A description is presented of an aircraft design approach which employs multilayered regressions for problem simplification The approach employs existing computer routines for surface fit regressions and optimizations It has been found that the new approach provides adequate accuracy during the conceptual design process with a factor of ten (or greater) reduction in man hour and computer costs A scheme is involved that is extremely compatible with the computer graphics aided conceptual design process, giving the designer the benefit of years of specialty engineer experience in his decision making The employed combination of multilayered regressions and multivariable data management techniques makes it possible to conduct an adequate study of the considered problem within budgetary and calendar time constraint realisms G R

A79-23570 # Impact of cruise speed on productivity of supersonic transports E Q Bond, B R Wright (Lockheed-California Co, Burbank, Calif), R A Flume (Branniff International, Dallas, Tex), and E A Carroll *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La, Jan 15-17, 1979, Paper 79-0231* 12 p

A comparison of airplane productivity and utilization levels derived from commercial airline type schedules based on 1995 passenger demand forecasts was made between two subsonic and four supersonic cruise speed aircraft The cruise speed component is the only difference between the schedules Productivity-to-speed relationships were determined for three discrete route systems, North Atlantic, transpacific, and North-South America All three route systems show airplane productivity practically doubling between cruise speeds of Mach 0.82 and 2.0 Above Mach 2.0, further productivity gains are a function of the particular route system The route systems with longer cruise distances are able to take advantage of cruise speeds higher than Mach 2.0 A weighted average of all three route systems shows only an additional 10 percent increase in productivity of the Mach 2.7 aircraft over the Mach 2.0 aircraft (Author)

A79 23571 * # Free oscillations of a large drop in space N Jacobi, R P Tagg, J M Kendall, D D Elleman, and T G Wang (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La, Jan 15-17, 1979, Paper 79-0225* 11 p 13 refs Contract No NAS7 100

In preparation for forthcoming studies on materials processing in space, techniques and equipment are being developed for the deployment and control of large globules of liquid in a zero-g environment This paper first presents a theoretical analysis of the intense sound field within an enclosure by which positioning forces, torques, and temporal perturbations may be applied to a sample Procedures for digital analysis of photographic records of the sample motion are described Results on the mean and oscillatory motion of a 2.5 cm diameter water drop during the flight of a SPAR rocket are given In particular, spectral analysis shows that the drop oscillates at several frequencies Identification with theoretically expected modes is made for some of the spectral lines (Author)

A79-23577 # F-16 high-alpha flight control characteristics and control system concept J K Buckner, J E Walker, and C K Clark (General Dynamics Corp, Fort Worth, Tex) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La, Jan 15-17, 1979, Paper 79-0403* 9 p

A description is presented of the concept and design of the high angle of attack features of the F 16 flight control system. The F 16 is the culmination of the lightweight fighter prototype flyoff competition held in 1974. This program was conceived by the Air Force to explore the advantages of emerging technologies as applied to fighter aircraft to achieve exceptional maneuverability in the air combat arena, with low cost to be held as a primary objective. The performance and design goals for the F-16 placed significant pressure on the development of the flight control system. Attention is given to the basic flight control system, departure prevention features, normal load factor/angle-of-attack limiting, roll-rate limiting, rudder limiting, automatic spin prevention, and a flight demonstration of control system features. G R

A79-23578 # Influence of fundamental parameters on the supersonic base flow problem in presence of an exhaust jet B Wägner (Dornier GmbH, Friedrichshafen, West Germany) and R A White (Illinois, University, Urbana, Ill.) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La, Jan 15-17, 1979, Paper 79-0133* 10 p 29 refs Bundesministerium der Verteidigung Contract No T/RF 42/70016/71415

For the axisymmetric base flow problem in presence of a jet a systematic study is carried out taking into account all essential physical parameters. Using the method of characteristics for the inviscid outer flow and the method of Korst for the turbulent shear layers, the influence of the approaching boundary layer is introduced by the concepts of equivalent bleed and origin shift, and the ONERA angular criterion is used for the recompression process. A modification of the ONERA-criterion for the two stream recompression is proposed. The results are thoroughly discussed and compared with experiments, and estimations of the Reynolds number influence are presented. (Author)

A79-23581 * Dynamic simulation studies of fuel conservation procedures used in terminal areas P J O'Brien (FAA, National Aviation Facilities Experimental Center, Atlantic City, NJ), L Tobias, and E A Palmer (NASA, Ames Research Center, Moffett Field, Calif.) In *Air Traffic Control Association, Annual Fall Conference, 23rd, Fort Worth, Tex, October 2-5, 1978, Proceedings* Washington, D C, Air Traffic Control Association, Inc, 1978, p 9-15

A simulation program was devised to study the effects of fuel conservation procedures on ATC and terminal area operations. The FAA National Aviation Facilities Experimental Center and the Ames Research Center have interconnected ATC and piloted simulation facilities at both centers. A unique national simulation facility for the study of pilot/controller/system interactions was established. The present paper describes the simulation facilities and outlines aircraft operational procedures evaluated in the experiments. Two experiments studied are discussed: the first involves two types of landing approaches, while the second involves both landing approaches and profile descents. B J

A79-23582 ATC operations in first decade of en route automation A J Kulikowski (Air Route Traffic Control Center, Memphis, Tenn.) In *Air Traffic Control Association, Annual Fall Conference, 23rd, Fort Worth, Tex, October 2-5, 1978, Proceedings* Washington, D C, Air Traffic Control Association, Inc, 1978, p 16-24

It is noted that automation and especially radar data processing have given the en route controller a superb tool which allows him a great degree of flexibility while increasing his capacity to handle traffic. It is found that the performance of air traffic controllers was quite good in the first decade of automation in en route ATC. B J

A79-23583 Integrated ATC development - The next decade. The controller's viewpoint P C Sweers, III (Los Angeles Air Route Traffic Control Center, Palmdale, Calif.) In *Air Traffic Control Association, Annual Fall Conference, 23rd, Fort Worth,*

Tex, October 2-5, 1978, Proceedings Washington, D C, Air Traffic Control Association, Inc, 1978, p 38-42

It is suggested that the most significant factor affecting the controller and the user in the next decade will be the increase in aircraft operations handled. This increase will necessitate a review of current procedures, equipment, staffing, and training. An attempt is made to describe possible changes in the area of procedures and equipment, the manner in which the FAA should cope with these changes, and the impact on the user and controller. B J

A79-23585 A look at the near future S Wugalter (FAA, ATC Systems Command Center) In *Air Traffic Control Association, Annual Fall Conference, 23rd, Fort Worth, Tex, October 2-5, 1978, Proceedings* Washington, D C, Air Traffic Control Association, Inc, 1978, p 80-85

The directions which integrated ATC development may take in the next decade are considered. It is concluded that flow management will be a more active and dynamic part of the NAS, and the FAA will be better equipped to handle the challenges of the national air traffic flow patterns. B J

A79-23586 ATC delays - The number one problem in the next decade A F Pitas (Air Transport Association, Washington, D C) In *Air Traffic Control Association, Annual Fall Conference, 23rd, Fort Worth, Tex, October 2-5, 1978, Proceedings* Washington, D C, Air Traffic Control Association, Inc, 1978, p 92-98

Ways of improving ATC system capacity and reducing delays are discussed. Attention is given to such possible solutions as new airports, new runways, reducing runway occupancy time, improved airport surface traffic control and guidance, decrease of longitudinal spacing between aircraft, improved ILS monitoring, improved main power productivity, and improved flow management. B J

A79-23587 Integrated ATC development - The next decade. A Safety Board viewpoint F H McAdams (National Transportation Safety Board, Washington, D C) In *Air Traffic Control Association, Annual Fall Conference, 23rd, Fort Worth, Tex, October 2-5, 1978, Proceedings* Washington, D C, Air Traffic Control Association, Inc, 1978, p 112-118

ATC related aspects of safety are discussed with attention given to the prediction of hazardous weather conditions, and the development and implementation of improved equipment. It is found that the primary safety problems in the airway system are the constant surveillance of aircraft to ensure adequate separation and the need to reduce the effects of information-transfer misunderstanding or misperception. B J

A79-23588 * NASA plans new programs in support of integrated ATC development J J Kramer (NASA, Washington, D C) In *Air Traffic Control Association, Annual Fall Conference, 23rd, Fort Worth, Tex, October 2-5, 1978, Proceedings* Washington, D C, Air Traffic Control Association, Inc, 1978, p 120-130

Consideration is given to the following areas in which NASA may contribute to the technology of an advanced national aviation system: (1) quiet safe, fuel-efficient aircraft, (2) low-cost, reliable, digital avionics, (3) integrated controls technology, (4) human factors in civil and general aviation, (5) aircraft system technology validation and demonstration, and (6) satellite systems technology applications. Such specific projects as the Terminal Configured Vehicle, the Global Positioning System, and the Search and Rescue Satellite System are described. B J

A79-23589 DERD-MC - The new ATC system in the FRG H-J Batzer (Bundesanstalt für Flugsicherung, Frankfurt am Main, West Germany) In *Air Traffic Control Association, Annual Fall Conference, 23rd, Fort Worth, Tex, October 2-5, 1978, Proceedings* Washington, D C, Air Traffic Control Association, Inc, 1978, p 134-145

The ATC situation in the Federal Republic of Germany is reviewed with attention given to operational requirements, the tasks of the flight plan coordinator, and the flow control unit. Consideration is then given to the new radar processing and display system for ATC in the FRG: the DERD MC (Display of Extracted Radar Data Mini Computer). The chief functions and the design of DERD-MC are briefly described. B J

A79-23590 Touch entry device for air traffic control R Bearsto, A Hastbacka, and J Cawley (Sanders Associates, Inc., Nashua, NH) In Air Traffic Control Association, Annual Fall Conference, 23rd, Fort Worth, Tex., October 2-5, 1978, Proceedings Washington, D C., Air Traffic Control Association, Inc., 1978, p 156-166

A touch data entry device (TDED) for ATC has been designed on the basis of an approach where the spherical surface of a CRT display is approximated by two flat-plane LED assemblies in both vertical and horizontal planes, angled so that the CRT display surface is quartered. This TDED is mechanically simple and well suited to meeting the goals established for the system. A handheld remote data entry device (RDED) has also been designed to solve the problem of having to return to the display for a simple handoff to the local controller or to terminate a flight. B J

A79-23591 A Modular C3 concept for air traffic control E H Riley (Hughes Aircraft Co., Culver City, Calif.) In Air Traffic Control Association, Annual Fall Conference, 23rd, Fort Worth, Tex., October 2-5, 1978, Proceedings Washington, D C., Air Traffic Control Association, Inc., 1978, p 168-173

The Modular Command/Control/Communications (Modular CCC) concept is described in relation to its relevance to ATC. Consideration is given to the advantages of this concept for ATC automation and to how the concept could be applied to ATC automation. The concept seems to be particularly well-suited to ATC automation because of its intrinsic ease of expansion and functional growth, fail safe/fail soft features, the ease with which it can keep pace with constantly advancing technology, and significant life cycle cost advantages. B J

A79-23592 Joint aircraft ground systems automation Real time data transmission requirements D F Babcock (SRI International, Menlo Park, Calif.) In Air Traffic Control Association, Annual Fall Conference, 23rd, Fort Worth, Tex., October 2-5, 1978, Proceedings Washington, D C., Air Traffic Control Association, Inc., 1978, p 174-186 16 refs

One problem that must be considered in any attempt to optimize runway capacity by using more precise control is the dynamic wind field the aircraft may experience on its final approach. When the changes are large and sudden they may lead to go-arounds and accidents. In rare cases these wind changes are beyond the performance capability of the aircraft. In these cases the goal of the system designer is to provide the pilot with a reliable and timely warning. More frequently the wind field is negotiable if accurate and timely information is available to the pilot so that he may employ suitable control strategies. The present paper examines the requirements on wind data timeliness in the context of a hypothetical system. This system measures the wind field along the approach path from the ground and transmits the data automatically to the aircraft flight control system. B J

A79-23594 En route minimum safe altitude warning /E-MSAW/ R W Spalding (Computer Sciences Corp., Pomona, N.J.) In Air Traffic Control Association, Annual Fall Conference, 23rd, Fort Worth, Tex., October 2-5, 1978, Proceedings Washington, D C., Air Traffic Control Association, Inc., 1978, p 200-204

The E-MSAW concept has been designed to minimize use of available NAS resources such as central processor time and core storage. Capabilities have also been included to minimize presentation of nuisance alerts. The automated detection of en route low-

altitude situations is a desirable addition to the NAS system, it will enhance safety within the system by backing up the controller in early detection of these situations. Workload will be eased, allowing greater time to meet the ever increasing demands of the future in maintaining safety within the En Route Air Traffic Control System. B J

A79-23597 Evolution of a TRACON F A Liebe (FAA, New York, N.Y.) In Air Traffic Control Association, Annual Fall Conference, 23rd, Fort Worth, Tex., October 2-5, 1978, Proceedings Washington, D C., Air Traffic Control Association, Inc., 1978, p A-2 to A-6

The NY TRACON currently in the installation phase in Hempstead, Long Island will provide an up-to-date replacement for the NYCIFRR. It will provide standard FAA equipments such as the ARTS-III A which will be used at most major terminal facilities. This change will eliminate the training, logistics, and staff support difficulties of the NYCIFRR. The NY TRACON will meet the immediate New York ATC needs now and through the 1980s. It will also afford the broader automation base required for the addition of automation enhancements necessary to meet future requirements. B J

A79-23628 The logistics of life cycle cost J R Peronnet (Grumman Aerospace Corp., Bethpage, N.Y.) (*Society of Reliability Engineers, Canadian Reliability Symposium, 5th, Ottawa, Canada, Oct 19, 20, 1978*) *Microelectronics and Reliability*, vol 19, no 1, 2, 1979, p 23-30

Key aspects of life cycle cost (LCC) methodology synthesis are reviewed and the ease of program application and integration is illustrated on such programs as the Canadian New Fighter Aircraft concept. Consideration is also given to the interrelationship between hardware design, ILS resource requirements, and program cost impacts of prime support postures as well as alternate support plan concepts. It is concluded that by selectively blending and tailoring the available logistic analysis tools such as LSA and Pareto analysis within an interactive phased program analysis approach and applying the discipline inherent in the systems engineering process, an orderly consistent and expanding data base can be developed on a program upon which alternate support concepts can be realistically projected and tested. B J

A79-23629 Reliability and maintainability growth of a modern, high performance aircraft, the F-14A G Bigel and J Winsten (Grumman Aerospace Corp., Bethpage, N.Y.) (*Society of Reliability Engineers, Canadian Reliability Symposium, 5th, Ottawa, Canada, Oct 19, 20, 1978*) *Microelectronics and Reliability*, vol 19, no 1, 2, 1979, p 31-38

This paper presents an historical overview of the F-14A Reliability and Maintainability growth with the concurrent impact on the logistic support posture. The design is traced from the RDT&E phase, where for the first time, comprehensive R&M parameters were established as requirements rather than goals. During the initial aircraft design, careful attention was given to the Reliability, Maintainability, and Serviceability requirements resulting in the incorporation of new test, servicing, handling and interchangeability features. Through the incorporation of these features in the basic design, the Maintenance Manhours per Flight Hour, Mean Time to Repair, and Mission Success values were successfully achieved and demonstrated. Improvements in reliability and maintainability have resulted in significant improvements in Elapsed Maintenance Time per Maintenance Action, loading of shop test equipment (2nd line Maintenance) and aircraft component removals. (Author)

A79-23631 Reliability based quality /RBQ/ technique for evaluating the degradation of reliability during manufacturing L Neri, V Allen (U.S. Army, Army Aviation Research and Development Command, St. Louis, Mo.), and R Anderson (IIT Research Institute, Chicago, Ill.) (*Society of Reliability Engineers, Canadian Reliability Symposium, 5th, Ottawa, Canada, Oct 19, 20, 1978*)

Microelectronics and Reliability, vol 19, no 1 2 1979 p 117-126

A reliability based quality (RBQ) program is being developed by AVRADCOM in order to assure that helicopter systems and components are reliable and cost effective. The RBQ growth process involves consideration of hardware test, failure, correction and retest activities. It is an iterative test fail correct process involving early assessment of process induced defects, the identification of reliability critical processes, and the implementation of improved processes or better tests. The present paper addresses the use of the RBQ approach in the production phase and discusses how to assess and control the reliability of a helicopter system or component as it leaves production by performing reliability and quality control analyses. B J

A79-23632 CP-140 aircraft reliability program - A 'tailored' management approach R F Steiner (*Society of Reliability Engineers, Canadian Reliability Symposium, 5th, Ottawa, Canada, Oct 19, 20, 1978*) *Microelectronics and Reliability*, vol 19 no 1 2, 1979, p 133-139

The reliability program conducted during the Canadian CP-140 aircraft development and production phases is described. Such program constraints as low cost, small production run, and large mix of off-the-shelf, modified and newly developed avionics equipment dictated the use of innovative and practical approaches in the reliability management aspect of the program. Particular consideration is given to tailoring the reliability program to meet the above constraints while improving the reliability effectiveness over prior aircraft development programs. B J

A79-23643 Estimation of reliability from multiple independent grouped censored samples with failure times known J E Bilikam (FMC Corp., San Jose, Calif) and A H Moore (USAF, Institute of Technology, Wright Patterson AFB, Ohio) *IEEE Transactions on Reliability*, vol R-27, Dec 1978, p 329-331

Failure times of one type aircraft engine component were recorded. In addition, life times are periodically recorded for unfailed engine components. The data are considered as multiple s-independent grouped censored samples with failure times known. The assumed failure model is the 2-parameter Weibull distribution. Maximum likelihood estimates are derived. The exponential model is used for comparison. Monte Carlo simulation is used to derive s-bias and mean square error of the estimates. The asymptotic covariance matrix was computed for the sampling conditions studied. The maximum likelihood estimates of the reliability were obtained as a function of component operating time since overhaul. (Author)

A79-23741 Measurement and analysis of airport emissions P S Daley (USAF, Armament Development and Test Center, Tyndall AFB, Fla) and D F Naugle (North Carolina, University, Chapel Hill, N C) *Air Pollution Control Association, Journal*, vol 29, Feb 1979, p 113-116 9 refs

This paper is of interest to those involved in regulation and analysis of aircraft related air pollution problems. USAF efforts to measure and model airport pollution are summarized. Efforts include (1) a joint EPA study at Williams AFB, AZ which involves both modeling and measurement, (2) photographic studies to track plume rise, (3) theoretical modeling studies to analyze airport pollution. It is concluded that the Williams study, soon to be completed, will greatly aid in determining the accuracy of airport air pollution dispersion models, that air quality modeling studies have shown that state of the art Air Force engines cannot be cost effectively modified to reduce pollution except possibly in the hydrocarbon area and that, at present, unpredictable thermal plume rise of aircraft exhausts renders model ineffective at locations close (less than 1 km) to the source. (Author)

A79-23742 Atmospheric dispersion modeling F Pasquill *Air Pollution Control Association, Journal*, vol 29 Feb 1979, p 117-119 17 refs

Recent recommendations for modification of the P-G (Pasquill-Gifford) system used for point-source plume modeling are discussed.

Special aspects of modeling the dispersion of pollution from airport sources are examined. Recent approaches to point-source plume modeling are surveyed. P-G estimates of plume dispersion parameters in an idealized atmosphere boundary are considered. M L

A79-23743 Emissions of oxides of nitrogen from aircraft B C Jordan (US Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, N C) and A J Broderick (FAA, Office of Environment and Energy, Washington, D C) *Air Pollution Control Association, Journal*, vol 29, Feb 1979, p 119-124 8 refs

The effect on air quality of NO₂ release from commercial aircraft is discussed. Topics considered include aircraft emissions and emission densities, the analytical basis for existing NO_x standards, and the oxidation of NO to NO₂. Information on the validation of models and the monitoring of NO₂ is presented with attention to short term NO₂ air quality. It is noted that no definitive procedure has yet been developed for relating aircraft NO_x emissions to NO₂ air quality. M L

A79-23744 Reducing air pollutant emissions at airports by controlling aircraft ground operations C G Gelinas (Pacific Environmental Services, Inc., Santa Monica, Calif) and H S L Fan (Peat, Marwick, Mitchell and Co., San Francisco, Calif) *Air Pollution Control Association, Journal*, vol 29, Feb 1979, p 125-128 6 refs

Research sponsored by the California Air Resources Board.

Potential reductions in air pollutant emissions were determined for four strategies to control aircraft ground operations at two case study airports, Los Angeles and San Francisco International Airports. Safety, cost, and fuel savings associated with strategy implementation were examined. Two strategies, aircraft towing and shutdown of one engine during taxi operations, provided significant emission reductions. However, there are a number of safety problems associated with aircraft towing. The shutdown of one engine while taxiing was found to be the most viable strategy because of substantial emission reductions, cost benefits resulting from fuel savings, and no apparent safety problems. (Author)

A79-23745 Updated model assessment of pollution at major US airports R J Yamartino and D M Rote (Argonne National Laboratory, Argonne, Ill) *Air Pollution Control Association, Journal*, vol 29, Feb 1979, p 128-132 12 refs

FAA sponsored research.

The air quality impact of aircraft at and around Los Angeles International Airport (LAX) is simulated for hours of peak aircraft operation and 'worst case' pollutant dispersion conditions. An updated version of the Argonne Airport Vicinity Air Pollution (AVAP) model is used in the simulation, model refinements reflect new theoretical formulations and data from field programs at LAX, O'Hare, and John F Kennedy International Airports. Maximum carbon monoxide concentrations at LAX are found to be low relative to the NAAQS. Relatively high, widespread hydrocarbon levels indicate that aircraft emissions may aggravate oxidant problems near the airport. Concentrations of oxides of nitrogen are high enough relative to proposed standards to warrant further study. Similar modeling is underway for the O'Hare and JFK airports. (Author)

A79-23796 Discrete time slice simulation of replacement requirements L L George (Texas A & M University, College Station Tex) In *Modeling and simulation* Volume 9 Proceedings of the Ninth Annual Pittsburgh Conference Pittsburgh, Pa., April 27, 28, 1978 Part 4 Pittsburgh, Pa., Instrument Society of America 1978, p 1297-1303 Grant No AF-AFOSR 78-3501

The actuarial method computes the expected number of engine removals required to fly a specified number of hours. A time slice simulation based on the actuarial method generates a random sample of engine removals. The distribution function of the number of engine removals can be estimated from the simulated sample.

Consequently, moments and percentiles can be estimated in addition to the mean computed by the actuarial method. This paper proposes a refinement which increases simulation accuracy or reduces run time required to achieve desired accuracy. The refinement is to generate a piecewise exponential lifetime within the actuarial age interval where an engine dies instead of assigning the death time to the end point of the interval. This almost eliminates the bias present in the actuarial method and the time slice simulation. (Author)

A79-23797 * A sensitivity analysis for the F100 turbofan engine using the multivariable Nyquist array. G. G. Leininger and M. L. Borysiak (Toledo, University, Toledo, Ohio). In *Modeling and simulation*. Volume 9. Proceedings of the Ninth Annual Pittsburgh Conference, Pittsburgh, Pa., April 27, 28, 1978. Part 4. Pittsburgh, Pa., Instrument Society of America, 1978, p. 1327-1333. 9 refs. Grants No. NsG 3171, No. NsG 3084.

In the feedback control design of multivariable systems, closed loop performance evaluations must include the dynamic behavior of variables unavailable to the feedback controller. For the multivariable Nyquist array method, a set of sensitivity functions are proposed to simplify the adjustment of compensator parameters when the dynamic response of the unmeasurable output variables is unacceptable. A sensitivity study to improve thrust and turbine temperature responses for the Pratt Whitney F100 turbofan engine demonstrates the utility of the proposed method. (Author)

A79-23850 Real-time simulation in air traffic control. V. D. Hopkin. *The Controller*, vol. 17, Dec 1978, p. 8, 10.

A real-time simulation technique in the United Kingdom of air traffic control is reviewed with emphasis on the limitations of the technique when used for evaluation while controllers are fulfilling their normal roles. Difficulties posed to real-time simulation by artificial boundaries and by traffic samples which constitute inputs to the system, the discrepancies between real-time air traffic control simulations and real-life systems, the acceptability to the controller of whatever is being investigated in real-time simulation are discussed. The limitations of the technique in evaluating stress and workload are analyzed and consideration is given to the value of linking real-time simulation more closely to such techniques as modeling and fast-time simulation. Basic uses of real-time simulation like aiding procedural training and familiarization, and allowing procedures and skills to be rehearsed and perfected are mentioned. A. A.

A79-23858 Separation and collision risk in air traffic control. M. Mizumachi (Tokyo, University, Tokyo, Japan) and T. Ohmura (Mitsubishi Electric Corp., Ltd., Kamakura, Japan). *Electronics and Communications in Japan*, vol. 60, Nov 1977, p. 86-93. 8 refs. Translation.

In the existing air traffic control (ATC) system, collision risk is defined in terms of the minimum allowable separation between two aircraft flying on the same route. The allowable separation is evaluated on the basis of human experience. In this paper the collision risk is defined anew using a stochastic model with the observation of the aircraft motion and prediction taken into account. The relation between the collision risk and separation is clarified. The relation between the collision risk and parameters such as the accuracy in the measurement of the aircraft position and velocity and the prediction time of the aircraft motion is discussed. An effective automatic ATC system which will be applicable for the future radar ATC is proposed. (Author)

A79-23895 Some engineering property comparisons for 7050 and AZ 74 61 die forgings. R. J. H. Wanhill, L. Schra, and H. P. Van Leeuwen (Nationaal Lucht- en Ruimtevaartlaboratorium, Amsterdam, Netherlands). *Engineering Fracture Mechanics*, vol. 11, no. 3, 1979, p. 507-513, 515-524. 33 refs. Research supported by the Royal Netherlands Air Force and Nederlands Instituut voor Vliegtuigontwikkeling en Ruimtevaart.

A comparison of some of the engineering properties of 7050 T736 and AZ 74 61 die forgings is made. The properties

investigated were strength, fracture toughness, stress corrosion resistance and fatigue life and crack propagation resistance. Some of the properties of these alloys are also compared with those of 7079 and DTD 5024 die forgings. It is concluded that 7050 possessed a superior combination of properties. However, the susceptibility of 7050 to general corrosion warrants extra consideration of corrosion protection systems applied to this alloy. (Author)

A79-23975 Winglets give USAF KC-135 new look in life. *Aviation Engineering and Maintenance*, vol. 3, Jan 1979, p. 24-26.

The function of the winglets, projected to be installed at the end of the KC-135 wings, and currently under testing at the Air Force Flight Development Laboratory, is described, together with a presentation of some technical aspects involving the installment. The use of the winglets is expected to improve range and fuel consumption by about 6% and enhance the overall operational capabilities of the aircraft. Tests have shown though that the winglets have a torquing effect on the aircraft wing, requiring thus modifications on the wing. The final series of flight tests will take place in the early 1980's. A. A.

A79-24073 Vibration and flutter investigations of aircraft with special nonlinear structural properties (Schwingungs- und Flatteranalyse von Flugzeugen mit besonderen nichtlinearen Struktureigenschaften). O. Sensburg and B. Schoen (Messerschmitt Bolkow-Blohm GmbH, Ottobrunn, West Germany). *Zeitschrift für Flugwissenschaften und Weltraumforschung*, vol. 2, Nov-Dec 1978, p. 395-404. 11 refs. In German.

This paper describes an analytical procedure to treat the influence of nonlinear structural properties - especially in the support mechanism of heavy wing loads - on the vibration and flutter behavior of modern combat aircraft. To get an approximation of the different kinds of vibration behavior of nonlinear structures, parameter variations using linearized limit values for the nonlinear elements are used to perform vibration and flutter calculations. A more accurate analysis method is developed in conjunction with a test model using a simplified mathematical model with nonlinear properties by applying the treatment of harmonic linearization. (Author)

A79-24077 The effects of lightning and nuclear electromagnetic pulse on the composite aircraft. R. Carr (Grumman Aerospace Corp., Bethpage, N.Y.). In *Materials synergisms*, Proceedings of the Tenth National Technical Conference, Kiamesha Lake, N.Y., October 17-19, 1978. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1978, p. 1-13. 9 refs. Contract No. F33615-77-C-5169.

The application of composite materials to aircraft fuselage and wing structures which contain the bulk of the subsystems, electronic components, critical cabling etc. presents potential problems to the electromagnetic compatibility design engineer. This paper presents the results obtained for lightning strike attachment tests to a model aircraft fabricated in part from graphite/epoxy materials, and the numerical results of external and internal coupling for nuclear and lightning EMP mathematical model studies. In addition, basic conductivity data for the graphite/epoxy material and its shielding effectiveness with and without protection systems is also presented. (Author)

A79-24078 Composite wing/fuselage integral concept. M. A. Nadler and A. Musicman (Rockwell International Corp., Los Angeles, Calif.). In *Materials synergisms*, Proceedings of the Tenth National Technical Conference, Kiamesha Lake, N.Y., October 17-19, 1978. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1978, p. 14-29.

It was found in a number of investigations that a composite construction of the wing/fuselage area would be vital for the implementation of performance objectives with respect to future Mach 2 class fighter aircraft. Cost projections also showed that

technically, highly ambitious, single-cure integral manufacturing approaches for the lower cover/substructure portion of the wing/fuselage interface area will provide substantial savings over conventional composite construction, in which cover and substructure members are separately cured and both covers mechanically attached. A concept overview is provided. The tooling approach for low-cost fabrication of integral structure consists primarily of thin-rubber bladder molds combined with stiffening diaphragms. Attention is given to program elements, subcomponent cost data, economic projections, and future plans. G R

A79-24079 **Advanced composite cover to substructure attachment technology** C Ramsey (USAF, Flight Dynamics Laboratory, Wright Patterson AFB, Ohio) and H Forsch (Grumman Aerospace Corp., Bethpage, N Y) In Materials synergisms, Proceedings of the Tenth National Technical Conference, Kiamasha Lake, N Y, October 17-19, 1978. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1978, p 30-37. USAF-supported research.

Integral composite wing skin substructure concepts were developed and evaluated in this program funded by the Air Force Flight Dynamics Laboratory, Structural Development Branch. Technologies addressed included bonded unreinforced joints and joints reinforced by various Translaminar Reinforcement (TLR) concepts. Flatwise tension strengths were obtained at 67 F, room temperature and 270 F for dry specimens. These test data were correlated with an analytical prediction of the failure mode and load. (Author)

A79-24080 **Multidimensional advanced composites for improved impact resistance** J W Herrick (Fiber Materials, Inc., Biddeford, Me) In Materials synergisms, Proceedings of the Tenth National Technical Conference, Kiamasha Lake, N Y, October 17-19, 1978. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1978, p 38-50. Contract No N00019 77 C 0430.

Graphite fiber composites often exhibit inadequate impact strength under certain types of loading conditions. Multidimensional (3D) composites have been explored as a possible solution to this problem. The impact behavior of various types of these specially woven and molded laminates was evaluated and compared to more conventional 2-dimensional laminates. The data indicate that selected 3D composites possess superior resistance to low velocity impact. (Author)

A79-24081 **Present and future developments in aerospace materials and structures** C A Paez (Grumman Aerospace Corp., Bethpage, N Y) In Materials synergisms, Proceedings of the Tenth National Technical Conference, Kiamasha Lake, N Y, October 17-19, 1978. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1978, p 51-62.

A survey shows that subsonic and low-supersonic aircraft are still being built primarily from aluminum alloys, and secondarily from steel and fiberglass. A sharp increase in titanium utilization did occur in the late 1960's, however, for high-load-intensity and high-temperature applications for the F-14 and F 15 fighters and the B-1 bomber. The high adiabatic wall temperatures characteristic of flight in the high-supersonic regime dictated that airframes designed for aircraft such as the SR-71 and MIG-25 be made primarily from titanium and steel. Titanium processing is one area in which significant improvement seems imminent. Primary Adhesive Bonded Structures (PABST) appear well suited for transport and low supersonic speed aircraft. Most aerospace companies have already designed advanced composite structures for in-plane loading applications. Critical areas of current development are related to the advanced composite wing-to fuselage component. Attention is also given to aspects of selective reinforcement and aircraft stealth requirements. G R

A79-24082 **Superplastic forming/diffusion bonding technology in the USAF/McDonnell BLATS program** J F Schier, D J

Dorr (McDonnell Aircraft Co., St Louis, Mo), J R Williamson, and M L Griffith (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio) In Materials synergisms, Proceedings of the Tenth National Technical Conference, Kiamasha Lake, N Y, October 17-19, 1978. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1978, p 63-72.

The Built-up Low cost Advanced Titanium Structures (BLATS) program has the objective to demonstrate the cost and weight advantages to be achieved in using advanced titanium fabrication technology in the design and manufacture of aircraft structures. The considered BLATS program is concerned with the demonstration of the cost and weight reductions of the new titanium technologies in a redesign of the F-15 Eagle aft fuselage structure. The production structure is nearly all titanium. It represents an effective performance-optimized use of titanium using current state-of-the-art in a production application. A summary is presented of major design and fabrication studies being conducted in the first two phases of the seven-phase BLATS program. A description is provided of developments in an Air Force program concerned with a Superplastic Forming/Diffusion Bonded Aircraft Structure. G R

A79-24083 **The PABST program - A validation of bonding primary structure** E W Thrall, Jr (McDonnell Aircraft Co., Long Beach, Calif) In Materials synergisms, Proceedings of the Tenth National Technical Conference, Kiamasha Lake, N Y, October 17-19, 1978. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1978, p 73-81. 8 refs. USAF sponsored research.

The Primary Adhesively Bonded Structure Technology (PABST) program has the objective to obtain experience regarding an employment of adhesive bonding in aircraft construction. In the PABST program, chromic acid anodize and phosphoric acid anodize were evaluated against the sulfuric acid, sodium dichromate etch which was to act as a baseline control treatment. The primary test for bond surface treatment durability was the wedge crack propagation test. From the results of comparative tests, phosphoric acid anodize was selected because no adhesive failures occurred within the full range of the test matrix. The PABST program design phase started with an all out search for fuselage structural arrangements that would be most amenable to bonding. Attention is also given to manufacturing studies and inspection methods. G R

A79-24084 **Cast aluminum structures technology** D D Goehler (Boeing Commercial Airplane Co., Seattle, Wash) In Materials synergisms, Proceedings of the Tenth National Technical Conference, Kiamasha Lake, N Y, October 17-19, 1978. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1978, p 82-90. Contract No F33615-76 C 3111.

The objective of CAST is to establish necessary structural and manufacturing technologies and to demonstrate and validate the integrity, producibility, and reliability of cast aluminum primary airframe structures. The goal of the program is to demonstrate a minimum of 30% acquisition cost savings with no weight penalty. Attention is given to the design activities of the CAST program, the manufacturing methods, the fabrication of hardware, and full-scale primary structural castings can be designed and produced at a substantial cost savings and at a weight competitive with built-up sheet metal and forged components. G R

A79-24085 **Lowercost structure by substituting AF1410 steel for titanium** G V Bennett (Rockwell International Corp., Los Angeles, Calif) In Materials synergisms, Proceedings of the Tenth National Technical Conference, Kiamasha Lake, N Y, October 17-19, 1978. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1978, p 91-99. USAF-supported research.

A new high-strength, high-toughness steel has been developed by the Air Force as a low-cost substitute for annealed Ti-6Al-4V structures. To validate the structural integrity of an AF1410 airframe component, a structural integrity program was conducted. A typical 175-pound titanium airframe component was selected for study, and a 158-pound AF1410 steel fitting was designed to replace the titanium component. Extensive mechanical property tests were conducted on three heats of material to establish design allowables. Machinability and heat-treatment studies were conducted to maximize the cost-saving potential. An AF1410 die forging with a 3:7 buy/fly ratio was produced, machined, heat treated, and subjected to full-scale spectrum load fatigue testing. Projected savings of this 158-pound AF1410 substitute for Ti-6Al-4V is 30-33 percent, in addition to a slight weight saving. (Author)

A79-24086 The comparative evaluation of prebond surface treatments for titanium. M. J. Felsen (Lockheed-California Co., Burbank, Calif.) In *Materials synergisms, Proceedings of the Tenth National Technical Conference, Kiamesha Lake, N.Y., October 17-19, 1978*. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1978, p. 100-107. 8 refs.

In certain military aircraft applications, adhesively bonded titanium joints on occasion have exhibited relatively poor environmental resistance. Several recently developed candidate surface treatments have performed better than the prior treatments in selected laboratory testing, but there is a lack of consensus regarding the relative ranking among the various methods of surface preparation. A comparative evaluation is made of the performance of four surface treatments, two of which were applied as part of production processing. Factors which may contribute to a lack of correlation among test data from laboratory to laboratory are considered, including adhesive/surface treatment compatibility. (Author)

A79-24087 Moisture/temperature effects upon mean strength of composite-to-metal adhesively bonded joint elements. R. V. Wolff (General Dynamics Corp., Materials Engineering Group, Fort Worth, Tex.) In *Materials synergisms, Proceedings of the Tenth National Technical Conference, Kiamesha Lake, N.Y., October 17-19, 1978*. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1978, p. 108-123.

The effect of accelerated moisture exposures on the mean static strength of laminate-to-metal adhesively bonded joint elements was investigated at several temperatures. Elements were designed to represent the materials and processes used in certain bonded assemblies for the full-scale development version of General Dynamics' F-16 Air Combat Fighter. The test matrix for this study was composed of four laminate moisture levels (each obtained under constant temperature and humidity conditions), three element bonded lap lengths, and six test temperatures (over the range of -75 F to +270 F). Results are presented in terms of joint strength as a function of overlap and temperature (at constant temperature). (Author)

A79-24089 A cyclic load test for environmental durability evaluation of bonded honeycomb structure. K. M. Harriman and M. C. Locke (Boeing Co., Seattle, Wash.) In *Materials synergisms, Proceedings of the Tenth National Technical Conference, Kiamesha Lake, N.Y., October 17-19, 1978*. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1978, p. 138-148.

A cyclic load test was developed to evaluate environmental durability of bonded square-edge honeycomb structure. Various adhesive bonding technologies relative to surface preparation methods, adhesive systems, core materials, and edge sealing were investigated. Comparative long-term durability of different bonding systems was determined under a cyclic load in a harsh environment such as 140 F/condensing humidity, and simulated flight cycling environment (GAG). Results to date have shown the test technique to be discriminating in differentiating old bonding technology versus new, improved bonding materials and processes. (Author)

A79-24090 Tooling and assembly procedures, serviceability program elements. M. A. Nadler and L. J. Costanza (Rockwell International Corp., Los Angeles, Calif.) In *Materials synergisms, Proceedings of the Tenth National Technical Conference, Kiamesha Lake, N.Y., October 17-19, 1978*. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1978, p. 149-165. Contract No. F33615-76-C-5344.

Rockwell's Advanced Composites Serviceability program is designed to determine critical effects of defects and to develop and verify rational accept/reject criteria. Four types of elements representing typical primary aircraft structures are being fabricated in a production environment to assess the validity of the analytical and quality assurance methods under development. The paper discusses a number of tooling and assembly features of general interest used in fabricating these elements. (Author)

A79-24091 Radome design/fabrication criteria for supersonic EW aircraft. C. A. Paez (Grumman Aerospace Corp., Bethpage, N.Y.) In *Materials synergisms, Proceedings of the Tenth National Technical Conference, Kiamesha Lake, N.Y., October 17-19, 1978*. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1978, p. 166-186.

The EF-111A Tactical Jamming System (TJS) is the latest U.S. Air Force tactical aircraft to be dedicated specifically to electronic warfare (EW). The supersonic EF-111A is capable of flying with, and providing, protective jamming coverage for the tactical strike force throughout its entire mission profile. The main purpose of this aircraft is to detect, identify, and nullify enemy radars across a wide frequency range. The functional purpose of the radome is to protect the avionics system antenna from damage in a flight environment and at the same time provide adequate structural strength and surface contour for the flight dynamics of the aircraft. Attention is given to radome design structural considerations, weapons bay radome design, fin-fairing radome design, and electrical testing. G. R.

A79-24093 Pressure-controlled thermal expansion molding of advanced composite RPV wing structure. J. J. Grosko (Lockheed-Georgia Co., Marietta, Ga.) In *Materials synergisms, Proceedings of the Tenth National Technical Conference, Kiamesha Lake, N.Y., October 17-19, 1978*. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1978, p. 194-210. Contract No. F33657-76-C-0713.

The development of integral tool heating and of gas-filled pressure-control cavities in elastomeric mandrels used to form integral structure in one cure cycle is discussed. The structure addressed by this development is the outboard pylon-to-tip segment of the Teledyne Ryan BGM-34C Remotely Piloted Vehicle (RPV) wing. Tying this structure to the manufacturing technology development, a preliminary design of the wing structure was performed and used to define process development test articles. Pay-off potential of the application of this technology in terms of cost and weight savings versus this metal wing baseline is reviewed. This program was due for completion in October 1978. (Author)

A79-24099 Application of the isothermal square bend process to F14 wing beams. A. G. Metcalfe and E. C. Thorsrud (Solar Turbines International, San Diego, Calif.) In *Materials synergisms, Proceedings of the Tenth National Technical Conference, Kiamesha Lake, N.Y., October 17-19, 1978*. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1978, p. 275-281.

The Square Bend process grew out of application of isothermal rolling to sheet metal fabrication. It was applied to titanium alloy sheet where large radius bends formed by press brake forming were ironed down onto tooling with rolls. The rolls, workpiece, and tooling are heated by passage of electrical current so that the workpiece is at the desired working temperature while the rolls and tooling are hot enough to eliminate chilling of the workpiece. The process has been demonstrated in laboratory type samples of Z-beams and channels and is ready to be applied to aircraft and engine

hardware The Square Bend process is discussed and a description is presented of plans for applying the process to the F14 wing beam

G R

A79-24100 Experience with net-shape processes for titanium alloys R H Witt (Grumman Aerospace Corp, Bethpage, N Y) and W T Highberger (U S Naval Air Systems Command, Washington, D C) In Materials synergisms, Proceedings of the Tenth National Technical Conference, Kiamesha Lake, N Y, October 17-19, 1978 Azusa, Calif, Society for the Advancement of Material and Process Engineering, 1978, p 282-305 6 refs Navy Contract No 5018-002 4, Contracts No N00019 70-C-0598, No N00019-74-C-0301, No N00019-76-C-0143

The feasibility of producing complex, deep-pocketed titanium alloy shapes typical of airframe structural components by hot isostatic pressing (HIP) prealloyed powders to near net-shapes in one operation was demonstrated Results of studies on powders, net-shape-making capabilities, parameter control, NDI acceptance, flight qualification and cost evaluations are presented As a result of this program, a HIP'd F 14A fuselage brace has been installed for flight (Author)

A79-24103 Hot isostatic pressing structural materials for ramjet applications F L Banta (United Technologies Corp, Chemical Systems Div, Sunnyvale, Calif) In Materials synergisms, Proceedings of the Tenth National Technical Conference, Kiamesha Lake, N Y, October 17 19, 1978 Azusa, Calif, Society for the Advancement of Material and Process Engineering, 1978, p 330-338

Complex ramjet inlet turn and dump configurations were cast by the investment process from 17-4 pH stainless steel and treated by a secondary operation (hot isostatic pressing) to enhance mechanical and fracture toughness properties The effects of this treatment were evaluated by microstructural examination, tensile tests, and fracture toughness properties determinations in benign (K1c) and hostile (K1sc) environments Mechanical properties tests were made on weldments produced by the gas tungsten arc process, which was used to assemble these castings into a ramjet combustion chamber (Author)

A79-24106 Oxide morphologies on aluminum prepared for adhesive bonded aircraft structures J D Venables, D K McNamara, J M Chen, T S Sun (Martin Marietta Laboratories, Baltimore, Md), and R Hopping (Martin Marietta Aerospace, Baltimore, Md) In Materials synergisms, Proceedings of the Tenth National Technical Conference, Kiamesha Lake, N Y, October 17-19, 1978 Azusa, Calif, Society for the Advancement of Material and Process Engineering, 1978, p 362-376 23 refs

The high resolution capabilities of a scanning transmission electron microscope (STEM) operated in the SEM mode have been used to examine the morphology of oxides on Al surfaces prepared for adhesive bonding by three commercial processes used in the aircraft industry High resolution (about 30 A) stereo micrographs obtained in this manner provide striking visual evidence for fine oxide protrusions which apparently interlock with the adhesive to enhance bond strength (Author)

A79-24107 An automated system for phosphoric acid anodizing of aluminum alloys G Carrillo (Rohr Industries, Inc, Riverside, Calif) In Materials synergisms, Proceedings of the Tenth National Technical Conference, Kiamesha Lake, N Y, October 17-19, 1978 Azusa, Calif, Society for the Advancement of Material and Process Engineering, 1978, p 377 396

The described automated system for phosphoric acid etching of aluminum alloys can process aluminum alloys through either an FPL cycle or a phosphoric acid anodize cycle, separately or in alternate cycles without interruption Three seven-step procedures are characterized Attention is directed to cycle selection, rack design, and the A-line layout and construction M L

A79-24111 Structural design, tooling and manufacturing of a composite YF-16 forward fuselage F Spelce (General Dynamics Corp, Fort Worth, Tex) In Materials synergisms, Proceedings of the Tenth National Technical Conference, Kiamesha Lake, N Y, October 17 19, 1978 Azusa, Calif, Society for the Advancement of Material and Process Engineering, 1978, p 441-451

A composite forward fuselage for the YF-16 aircraft was fabricated with the goal of demonstrating the advantages of advanced composite materials in an aircraft structure Stiffened sheet construction was used as the basic structural configuration A unique method of manufacturing large graphite/epoxy shell type curing molds was developed Methods will be described by which large fiberglass/epoxy curing molds may be used in such a manner that the differential of thermal expansion will not affect the size and fit of the graphite/epoxy panels being cured Silicone rubber mandrels were used for forming hat stiffened fuselage side panels, bulkheads and removable doors Mechanical fastening methods were used to fasten the composite panels and components to other metal parts of the fuselage assembly Weight and cost savings were realized through the use of composite materials, innovative tooling and the ability to reduce the parts count in a composite structure In conclusion, this paper discusses (1) the purpose for building an advanced composite forward fuselage, (2) data on the fuselage component, and (3) the results of tests on the fuselage (Author)

A79-24122 Material and process control - Aircraft integral fuel tanks L H Tasker and P G Steinweg (USAF, Sacramento Air Logistics Center, McClellan AFB, Calif) In Materials synergisms, Proceedings of the Tenth National Technical Conference, Kiamesha Lake, N Y, October 17 19, 1978 Azusa, Calif, Society for the Advancement of Material and Process Engineering, 1978, p 561-574

The F 111 aircraft is built with integral fuel tanks in order to meet range requirements An integral fuel tank is formed when the aircraft structure is sealed at the joints to allow fuel storage Two types of fuel tank sealants are used (1) polyester is used in the faying surfaces and for structural voids, and (2) polysulfide is used for fillet sealing The fuel tanks also contain bonded structures joined with nitrile/phenolic and epoxy based adhesives A special desalant and an effective detergent cleanser are also used Attention is focused on principles and techniques to be applied during construction and repair in order to obtain reliable low maintenance integral fuel tanks Adherence to the identified principles will lead to a leak-free system, whereas violation of any of them can result in a leak-prone system S D

A79-24123 Adhesive sealing - A fuel leak deterrent W M Scardino (USAF, Materials Laboratory, Wright Patterson AFB Ohio), D Strickland, and J Stiver (USAF, Acquisition Logistics Div, Wright Patterson AFB, Ohio) In Materials synergisms, Proceedings of the Tenth National Technical Conference, Kiamesha Lake, N Y, October 17-19, 1978 Azusa, Calif, Society for the Advancement of Material and Process Engineering, 1978, p 575 586

The Air Force has been experiencing integral fuel tank leak problems with many of its aircraft types Examination of fuel tank leak maintenance costs reveals that the aircraft types with the best integral fuel tank leak performance over the past 20 yr experience are the F 102 and F 106, which have used a structural thermosetting adhesive in the faying surfaces of the fuel tanks The sealing procedure and tests used for F 102 and F 106 are applied during the assembly of a C 130 aircraft wing The background of the original sealing process and the C 130 adhesive development are described The aircraft is now undergoing successful flight testing S D

A79-24124 Development and flight test evaluation of fuel tank sealants for Mach 3+ aircraft M F George, Jr and R V Burton, Jr (Lockheed California Co, Advanced Development Projects Div, Burbank, Calif) In Materials synergisms Proceedings of

the Tenth National Technical Conference, Kiamesha Lake, N Y , October 17-19, 1978 Azusa, Calif , Society for the Advancement of Material and Process Engineering, 1978, p 587-597

The contribution of the Lockheed SR 71 Mach 3+ aircraft in fluoroelastomer integral fuel tank sealant development is discussed including evaluation techniques, required material properties and developmental problems To provide continuity, a brief historical evolution of material systems is presented beginning with the single component systems and later, the two component compositions, which finally resulted in the present materials The SR-71 development and testing continues with improved materials such as fluoro silicones, fluorocarbon-fluorosilicone hybrids (FCS 210) and other new classes of fluorinated polymers presently in development

(Author)

A79-24125 Dynamic laboratory evaluation of integral fuel-tank sealants W R Mallory, E V Harbert, Jr (Systems Research Laboratories, Inc , Dayton, Ohio), and W F Anspach (USAF, Materials Laboratory, Wright-Patterson AFB, Ohio) In *Materials synergisms, Proceedings of the Tenth National Technical Conference*, Kiamesha Lake, N Y , October 17-19, 1978 Azusa, Calif , Society for the Advancement of Material and Process Engineering, 1978, p 598-609 Contract No F33615-76 C 5253

The paper describes the design features and capabilities of a bench-scale fuel-tank-sealant test apparatus that subjects the sealant material in the laboratory to mechanical forces, pressures, temperatures, and fuel exposure conditions closely simulating those experienced in aircraft integral fuel tanks during flight The test apparatus consists of two chambers which simulate the outside and inside of the fuel tank The system can simulate a complete flight profile including fuel loading, take off, cruise and high speed flight, landing, and shutdown More importantly, the equipment allows automatic evaluation of elastomeric sealants using a variety of joint configurations, and provides a cost effective reliable selection of the optimum sealant and/or sealing system for the aircraft

S D

A79-24131 Temperature/humidity criteria for advanced composite structures B Wollner (Northrop Corp , Aircraft Group, Hawthorne, Calif) In *Materials synergisms, Proceedings of the Tenth National Technical Conference*, Kiamesha Lake, N Y , October 17-19, 1978 Azusa, Calif , Society for the Advancement of Material and Process Engineering, 1978, p 672-683 5 refs

Temperature and humidity criteria for design of advanced composite structures are developed for an advanced tactical aircraft configuration Application of these parameters to determine the moisture content and distribution within fiber reinforced composite elements under conditions simulating the design service life is described Results indicate that the moisture content characteristics will depend upon the complete environmental history experienced during the service life, when advanced composite materials are utilized

(Author)

A79-24134 Repair of directionally solidified airfoil components J W Lee, R P Schaefer, and C A Voehringer (United Technologies Corp , Government Products Div , West Palm Beach, Fla) In *Materials synergisms, Proceedings of the Tenth National Technical Conference*, Kiamesha Lake, N Y , October 17 19, 1978 Azusa, Calif , Society for the Advancement of Material and Process Engineering, 1978, p 733-745 Contracts No F33615-76 C 5151, No F33615 75-C-5114

Repair procedures have been established by the aircraft company for directionally solidified jet engine turbine vane components These procedures were established through the application of advanced joining (TLP bonding) technology, improved local fusion weld repairs, and recoating techniques These components will be repaired, using the established procedures, by a repair vendor Engine testing will follow to qualify both the procedures and the vendor

(Author)

A79-24142 A helicopter fuselage design concept R W Pinckney and T W Griffith (Boeing Vertol Co , Philadelphia, Pa) In *Materials synergisms, Proceedings of the Tenth National Technical Conference*, Kiamesha Lake, N Y , October 17-19, 1978

Azusa, Calif , Society for the Advancement of Material and Process Engineering, 1978, p 889-897

A series of advanced technology components for use in a large (148,000-pound gross weight) tandem rotor helicopter were developed and tested by a US aerospace company These systems were incorporated into a flightworthy prototype airframe, the XCH-62 heavy-lift helicopter Two basic structural concepts were considered for the prototype airframe, including conventional skin and stringer designs and adhesively bonded honeycomb panel structure The sandwich panel concept was selected for the primary fuselage structure, and a flightworthy fuselage was constructed The results of the design trade study are discussed along with the tooling used to produce the large structural honeycomb panels, and the materials and processes which will be used to insure long and maintenance free production airframe performance

G R

A79-24144 Turbine airfoil repair W R Young (General Electric Co , Cincinnati, Ohio) In *Materials synergisms, Proceedings of the Tenth National Technical Conference*, Kiamesha Lake, N Y , October 17 19, 1978 Azusa, Calif , Society for the Advancement of Material and Process Engineering, 1978, p 924-938

Gas turbine airfoils which are exposed to high temperature, oxidizing, gas environment sometimes require repair and refurbishment to extend operating life Repair developments which incorporate removal of oxides from thermal fatigue cracks by fluoride ion cleaning are described, including process parameters and surface interactions with R'80 nickel base superalloy Results of crack repair by a novel braze diffusion process known as Activated Diffusion Healing (ADH) are presented including ADH joint mechanical properties and microstructure

(Author)

A79-24177 # Laboratory fire testing of cabin materials used in commercial aircraft C P Sarkos, J C Spurgeon, and E B Nicholas (FAA National Aviation Facilities Experimental Center, Atlantic City, N J) *Journal of Aircraft*, vol 16, Feb 1979, p 78-89 22 refs

The purpose of this paper is to familiarize individuals with the kinds of materials currently used in the cabin interior of a commercial airliner, to describe some of the more important fire tests used to evaluate these materials, and to summarize the behavior of these cabin materials when subjected to each of the fire test methods Specifically, a detailed description is presented of the following respective test methods for flammability, smoke, and toxic gas emissions vertical Bunsen burner test, National Bureau of Standards (NBS) smoke chamber, and a combustion tube furnace test Fire test data on 75 cabin materials are summarized for burn length, flame-out time, specific optical density (D(s)) of smoke, and yields of hydrogen cyanide (HCN) and carbon monoxide (CO)

(Author)

A79-24178 # Total pressure recovery of flared fan nozzles used as inlets T G Keith, Jr , T N Obee (Toledo, University, Toledo, Ohio), and D A Dietrich (Texas A & M University, College Station, Tex) *Journal of Aircraft*, vol 16, Feb 1979, p 110-115 7 refs

A simple expression has been developed which accurately represents the total pressure recovery of a flared exhaust nozzle when it is used as an inlet Physically such a situation can arise during the reverse-thrust operation of a variable pitch fan jet The formula is written in terms of the freestream and duct Mach numbers and contains two empirical coefficients One coefficient is associated with internal flow losses in the nozzle and can be found from a static engine test The other coefficient is associated with flow losses in the external field of the nozzle and can be approximated from existing cone drag data The developed expression produces an excellent fit

of measured total pressure recoveries, differences between calculated and experimental values were generally less than 0.5% (Author)

A79-24179 * # Calculated hovering helicopter flight dynamics with a circulation-controlled rotor W Johnson (NASA, Ames Research Center, U.S. Army, Aeromechanics Laboratory, Moffett Field, Calif.) and I Chopra (NASA, Ames Research Center, Moffett Field, Calif.) *Journal of Aircraft*, vol 16, Feb 1979, p 124-128 5 refs

The flight dynamics of a hovering helicopter with a circulation-controlled rotor are analyzed. The influence of the rotor blowing coefficient on the calculated eigenvalues of the helicopter motion is 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. The handling qualities of a helicopter with negative speed stability are probably unacceptable without a stability augmentation system (Author)

A79-24183 Longhorns into service M Hirst and J Marsden *Flight International*, vol 115, Feb 10, 1979, p 401-405

The new Learjet 28/29 Longhorn, in service since March 1979, is discussed including structure and performance capabilities. The span, length, height, and wing area are 13.35 m, 14.51 m, 3.73 m, and 24.57 sq m respectively, with the maximum cruising speed estimated at 464 kt at 12,500 m. The use of the winglets minimizes the drag increase occurring at the cruising speeds and altitudes envisaged for Longhorn by spreading the rotational energy in each vortex. From a 13,500 lb take off the aircraft can reach 51,000 ft without a break in less than 35 min while using about 1,200 lb of fuel, with cabin pressurization system operating at a differential of 9.4 lb/sq in and providing an 8,000 ft equivalent pressure altitude at the maximum cruising height. A A

A79-24194 # Longitudinal motion of an aircraft in unsteady flow (Podélný pohyb letounu s uvázením nestacionárnosti proudění) V Pokorný *Zpravodaj VZLU*, no 5, 1978, p 217-224 6 refs In Czech

Formulas are derived for the frequency characteristics of the longitudinal motion of an aircraft in turbulence. The inputs are the harmonic changes of vertical gusts and elevator and aileron deflections imposed to avoid undesirable aircraft responses. Aircraft deformations and compressibility effects are neglected. Attention is focused on deriving simple expressions for the effect of unsteadiness of the flow. Expressions of different degrees of approximation are obtained and are applied to the calculation of the frequency characteristics of a small transport aircraft. The results show the importance of taking unsteady flow effects into account. P T H

A79-24195 # Applicability of certain plastics in aviation industry from viewpoint of toxicology (Použitelnost některých plastů v letectví z toxikologického hlediska) J Luxa *Zpravodaj VZLU*, no 5, 1978, p 225-234 15 refs In Czech

The degradation behavior of a number of commonly used plastics in the aviation industry are reviewed, and results of thermogravimetric and gas chromatography studies of the stability of several plastics are presented and discussed in terms of their toxicological implications. It is shown that in the industry one must not merely take into account the temperature limits of application of a plastic as dictated by mechanical reasons, but rather temperature norms should be considered that are based on possible toxic effects. P T H

A79-24196 # Method for design and manufacture of the stage of a radial compressor (Metoda návrhu a výroby stupně radialeho kompresoru) V Vanek and O Matoušek *Zpravodaj VZLU*, no 6, 1978, p 257-269 In Czech

The paper describes a method for the thermodynamic design of the flow section of a radial compressor rotor. Special tools and cutting techniques used in constructing a radial compressor stage are mentioned. An algorithm for geometric design of the flow region of a bladeless and semibladeless diffuser is given. Milling procedure for a duct type diffuser is described. P T H

A79-24214 # Effects of periodic changes in free stream velocity on flows over airfoils near static stall L S Saxena, A A Fejer, and M V Morkovin (Illinois Institute of Technology, Chicago, Ill.) In *Nonsteady fluid dynamics, Proceedings of the Winter Annual Meeting, San Francisco, Calif., December 10-15, 1978* New York, American Society of Mechanical Engineers, 1978, p 111-116 6 refs Grant No DAHC04 75 G 0142

This investigation aims at the understanding of unsteady flows over lifting surfaces. It is a study of sinusoidally oscillating flows over stationary NACA 0012 airfoils set at angles of attack close to the angle of stall, which is the same in the oscillating flows as in steady flow. At the moderate amplitudes of these tests (18% of the mean velocity) the flow over the airfoil is quasi-steady provided the frequency of oscillations is low. At high frequencies and angles below stall angle, the unsteadiness alters some of the details of the flow but globally the flow is again quasi-steady. However above stall angle, and at high frequencies the quasi-steady character of the flow disappears completely, the average normal force exceeds the steady flow value by 60% and exhibits large periodic excursions from the mean. These drastic changes seem to imply that modeling the dynamic stall of helicopter blade profiles in wind tunnels requires simultaneous oscillations of the free stream and of the angle of attack. Comparison with flows incorporating boundary layer trips revealed Reynolds number independence. (Author)

A79-24215 # Engineering analysis of dynamic stall L E Ericsson and J P Reding (Lockheed Missiles and Space Co., Inc., Sunnyvale, Calif.) In *Nonsteady fluid dynamics, Proceedings of the Winter Annual Meeting, San Francisco, Calif., December 10-15, 1978* New York, American Society of Mechanical Engineers, 1978, p 117-123 23 refs

An earlier developed quasi-steady analytic method has been shown to give predictions that are in good agreement with experimental dynamic stall results as long as the oscillation amplitude and frequency are of moderate magnitudes. In the present paper this quasi-steady method is extended to include the transient effect of the 'spilled' leading edge vortex, thereby providing simple analytic means for prediction of dynamic stall characteristics at high frequencies and large amplitudes. The veracity of the method is demonstrated by critical comparisons with the extensive experiments performed by Carr, et al. (Author)

A79-24216 # Numerical predictions of the unsteady lift development on airfoils in a viscous fluid R B Kinney (Arizona, University, Tucson, Ariz.) In *Nonsteady fluid dynamics, Proceedings of the Winter Annual Meeting, San Francisco, Calif., December 10-15, 1978* New York, American Society of Mechanical Engineers, 1978, p 125-134 17 refs Research supported by the Alexander von Humboldt Stiftung

The unsteady two-dimensional viscous flow about an airfoil is predicted using numerical solutions to the Navier-Stokes equations. The airfoil is taken to be fixed, and the fluid streams past it in a prescribed manner. The forces acting on the airfoil are determined as a function of time. Results are presented for a 9% thick Joukowski airfoil which is symmetrical about the chord. The speed of the onset flow is assumed to change impulsively from zero to some constant value. The instantaneous direction of the onset flow is a prescribed function of time. Calculations are performed for Reynolds numbers of 1000 and 10,000. At the lower Reynolds number, the lift variation with time is determined for prescribed constant flow angles of 5, 10, and 15 deg, as measured from the chord. At the higher Reynolds number, the flow angle varies with time, starting from 0 deg and reaching a maximum of 5 deg. Results are also presented at

the higher Reynolds number for a periodically varying flow angle
(Author)

A79-24217 # Drag on an oscillating airfoil in a fluctuating free stream S B R Kottapalli and G A Pierce (Georgia Institute of Technology, Atlanta, Ga) In *Nonsteady fluid dynamics, Proceedings of the Winter Annual Meeting, San Francisco, Calif., December 10-15, 1978* New York, American Society of Mechanical Engineers, 1978, p 135-145 33 refs

An analytical study is presented regarding the unsteady skin friction drag of an oscillating airfoil exposed to a fluctuating free stream speed Both laminar and turbulent conditions are covered in the analysis The unsteady potential flow pressure and velocity distributions required for the subsequent boundary layer analysis are obtained by an approximate development The time-dependent boundary layer is solved by a finite difference scheme It was found that depending on the values of the phase difference between free stream fluctuations and airfoil oscillations, reduced frequency, and amplitude of free stream fluctuations, the drag can either lead or lag the free stream
(Author)

A79-24218 # Wake induced time-variant aerodynamics including rotor-stator axial spacing effects. S Fleeter, R L Jay, and W A Bennett (General Motors Corp., Detroit Diesel Allison Div., Indianapolis, Ind) In *Nonsteady fluid dynamics, Proceedings of the Winter Annual Meeting, San Francisco, Calif., December 10-15, 1978* New York, American Society of Mechanical Engineers, 1978, p 147-163 18 refs Contract No F49620-77-C-0024

A serious design consideration in the gas turbine industry is related to the possible failure of rotor and stator airfoils as a result of aerodynamic excitations A description is presented of an experimental research program which had the overall objective to obtain fundamental unsteady forced response aerodynamic data necessary to quantify the effect of rotor-stator axial spacing This is accomplished by measuring the aerodynamically induced fluctuation pressure distribution in a downstream vane row of realistic geometry, with the primary source of excitation being the wakes from the upstream rotor blading Two rotor-stator axial spacing ratios, representative of those found in advanced design compressors, are investigated over a wide range of reduced frequency values and compressor steady-state operating conditions
G R

A79-24219 # Effect of compressor geometry on the unsteady regimes of a low speed compressor J. Fabri and Y Le Bot (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France) In *Nonsteady fluid dynamics, Proceedings of the Winter Annual Meeting, San Francisco, Calif., December 10-15, 1978* New York, American Society of Mechanical Engineers, 1978, p 165-173 8 refs Research supported by the Société Nationale d'Etude et de Construction de Moteurs d'Aviation (ONERA TP no 1978-68)

A systematic investigation of the effect of blade geometry on the off-design performance and unsteady regimes of a two-stage, low speed axial compressor is presented The experimental results show that the performance and stall limit of each rotor as well as the nature of the after-stall regime, rotating stall or flow separation from the casing wall, is the same for the multistage compressor and the isolated rotor However, if both rotors do not have the same blade geometry, rotating stall affects the whole compressor only if the first stage initiates it, and in the case of wall separation, this phenomenon is restricted to the stage in which it is initiated
(Author)

A79-24220 # A fundamental criterion for the application of rotor casing treatment E M Greitzer (MIT, Cambridge, Mass.), J P Nikkanen, D E Haddad, R S Mazzawy (United Technologies Corp., Pratt and Whitney Aircraft Group, East Hartford, Conn.), and J D Joslyn (United Technologies Research Center, East Hartford, Conn) In *Nonsteady fluid dynamics, Proceedings of the Winter Annual Meeting, San Francisco, Calif., December 10-15, 1978*

New York, American Society of Mechanical Engineers, 1978, p 175-184 12 refs.

An experimental investigation has been carried out on the influence of grooved casing treatment on the stall margin of a compressor rotor Tests were conducted with two rotor builds having different solidities (but all other parameters identical) so that one of the rotors exhibited a wall, or casing, type of stall, while the other showed a blade stall It was found that the casing treatment, when compared to the solid casing, was very effective in increasing the stall margin of the wall stall configuration, whereas there was little or no change in the stall point of the blade stall configuration Detailed relative frame measurements of the rotor exit flow field were also taken as part of the program. These showed that in a wall stall situation, the use of casing treatment produced a substantial decrease in the relative total pressure defect, compared with the solid casing, while this was not true for the blade stall type of blading The results of the experiments, both in overall measurements and in the detailed relative frame traverses, support the hypothesis that casing treatment is effective only in a situation in which a wall stall exists
(Author)

A79-24221 # An experimental study of pulsating flow in a three stage axial flow compressor R E Peacock and D K Das (Cranfield Institute of Technology, Cranfield, Beds., England) In *Nonsteady fluid dynamics, Proceedings of the Winter Annual Meeting, San Francisco, Calif., December 10-15, 1978*

New York, American Society of Mechanical Engineers, 1978, p 185-191 8 refs Research sponsored by the Ministry of Defence (Procurement Executive)

A description is given of a series of experiments involving a three-stage version of an aircraft type compressor whose inlet flow was disturbed by a time-dependent axial pulsation of approximately sine-wave form The effect of pulsation on compressor performance was a sharp reduction in mass flow The compressor pressure ratio was increased above that in steady-state operation, irrespective of pulsation frequency The pulsations produced by the discrete frequency generator were attenuated through the compressor The waveforms produced over the frequency range considered in the test suggest that, as a means of producing sine-wave type pulsations, a discrete frequency generator of the type used may have a useful operating band bounded at low frequency by the geometry of the generator and at high frequency by edge effects from the generator spokes
G R

A79-24235 Failure analysis of aerospace components T W Heaslip (Transport Canada, Aviation Safety Bureau, Ottawa, Canada) In *Metallography in failure analysis, Proceedings of the Symposium, Houston, Tex., July 17, 18, 1977* New York, Plenum Press, 1978, p 141-165

The techniques employed by the Aviation Safety Engineering Facility in Canada include Scanning Electron Microscopy (SEM), X-ray energy dispersive techniques, and metallographical studies The SEM capability is unique in that the Engineering Facility has one of the few real time 3-dimensional image generation systems used in failure analysis in the world This technique takes out the guesswork on topography analysis which is required when using 2 dimensional projection The technologically current X-ray spectrometric analysis capability makes it possible to conduct the qualitative and semiquantitative chemical analysis of bulk materials, specific zones of parts, grains, phases, and residue on fracture faces and adjacent surfaces A description is given of two case histories to demonstrate the use of these tools and the essential nature of the techniques in comprehensive failure analysis
G R

A79-24236 # Air Force Space Laser Communications G Derossi (USAF, Space and Missile Systems Organization, Los Angeles Air Force Station, Calif) In *Holography A view of the future, Proceedings of the Joint Symposium, Los Angeles, Calif., January 20, 1979* Symposium sponsored by the American Institute of Aeronautics and Astronautics and World Future Society Los Angeles, Calif, American Institute of Aeronautics and Astronautics, Inc., 1979, p 38-43

The Air Force Laser Communications (LASERCOM) Program started with system concept and component design in the early 1970s. By 1973 the system that had evolved demonstrated data rates of up to one gigabit per second with a bit error rate of 0.00001 for 40,000 km simulated links. System capabilities were demonstrated starting with 1975 to demonstrate an engineering feasibility model of a gigabit-per-second space qualifiable transmitter and a brassboard receiver. The next phase of demonstration started in 1977 when the LASERCOM system began operation at the White Sands Missile Range. These demonstrations include ground to ground links of up to 20 km and aircraft-to-ground links of up to 50 km, dynamic far-field acquisition, tracking, and two-way communications are demonstrated. B J

A79-24254 Stress-peen straightening of complex machined aircraft parts R D Skinner (Lockheed-California Co., Burbank, Calif.) In Formability topics: Metallic materials, Proceedings of the Symposium, Toronto, Canada, May 4, 1977. Philadelphia, Pa., American Society for Testing and Materials, 1978, p 100 121 6 refs

A new technique (the stress-peen forming process) for the forming and straightening of complex machined aircraft parts has been developed which uses shot peening of the part while the latter is restrained to a predetermined, elastic tensile stress. The process demonstrates excellent predictability by balancing the stress profile across the cross section and provides ideal compressive stresses on all surfaces. The development of the process from the initial theory to preliminary straightening tests is reviewed. Emphasis is placed on the development of a mathematical model which (1) determines the initial stress in a complex forged part after it has been restored to its straightened position and (2) predicts the amount of elastic prestress and permits the determination of the selected peening process parameters required for balance stress equilibrium across the section. B J

A79-24291 # Heat transfer investigation of laminated turbine airfoils G P Liang (United Technologies Corp., Pratt and Whitney Aircraft Group, West Palm Beach, Fla.) and J W Fairbanks (U.S. Department of Energy, Div. of Power Systems, Washington D.C.) In Gas turbine heat transfer 1978, Proceedings of the Winter Annual Meeting, San Francisco, Calif., December 10-15, 1978. New York, American Society of Mechanical Engineers, 1978 p 21-30 7 refs Contract No. EY 76 C 05 5035

Cascade rig testing was used to determine the heat transfer characteristics of two laminated wafer airfoil cooling configurations: (1) a chordwise laminated airfoil yielding increased internal convection area and coolant flow flexibility and (2) a radially laminated airfoil incorporating a simple all convectively cooled scheme. Chordwise bonded wafer airfoils have potential application as stationary turbine components (vaness), while radially constructed airfoils (blades) will maintain structural integrity in a rotating environment. It was found that high levels of cooling effectiveness are attainable in air-cooled airfoils through the use of laminated wafer techniques. B J

A79-24295 # Aerodynamics and heat transfer of transonic turbine blades at off-design angles of incidence F G Hajar, O M Amana (GE Corporate Research and Development Center, Schenectady, N.Y.), and J F Louis (MIT, Cambridge, Mass.) In Gas turbine heat transfer 1978, Proceedings of the Winter Annual Meeting, San Francisco, Calif., December 10-15, 1978.

New York, American Society of Mechanical Engineers 1978, p 61-70 8 refs Contract No. N00014 76 C 0253

The effects of varying the angle of incidence between plus and minus 15 deg on the aerodynamic and heat transfer performance of a transonic blade cascade were investigated in a hot blowdown facility. Results show that the positive angles of incidence within the range investigated have little effect on the pressure and heat transfer distribution around the blade but that negative angles of incidence have significant effects on the pressure distribution. The effect of the

negative angles arises from the acceleration of the flow to a higher Mach number on the suction side before the trailing edge shock interaction. A NASA computer program using integral methods was employed to predict the Nusselt number distributions around the blade from the pressure distribution. B J

A79-24304 # Suction fuel supply systems for turbine powered general aviation aircraft D Petro (Avco Corp., Avco Lycoming Div., Stratford, Conn.) In Polyphase flow in turbomachinery. Proceedings of the Winter Annual Meeting, San Francisco, Calif., December 10-15, 1978. New York, American Society of Mechanical Engineers, 1978 p 223-242

The paper describes a self-contained, engine driven suction fuel supply system that will operate continuously with a two phase fuel flow while employing current state of the art technology. This concept removes unreliable tank mounted, electrical fuel boost pumps and eliminates airframe pressurized fuel handling equipment in order to improve system reliability, reduce weight and cost penalties, simplify maintenance tasks, and reduce aircraft vulnerability to fire hazards. Attention is given to suction fuel pump design considerations, the fuel pump configuration, and certification testing. B J

A79-24349 Flight test control by means of a microprocessor I (Flugversuchssteuerung durch einen Mikroprozessor I) H Gunther *Elektronik* vol 28 Jan 25, 1979, p 42-46 In German

Flight tests at the airport of Hannover in West Germany were conducted in order to study the suitability of the unconventional approach profiles used in simulator investigations. The tests are to verify the employed simulation concept on the basis of a direct comparison with a real aircraft. The nature of the tests make it necessary to perform control operations directly on board of the aircraft. It was, therefore, necessary to provide a suitable computing device. It is intended to use this device as basis for a flight control computer which can be employed in flight tests for other investigations. A study of computing device performance formed, therefore, a significant part of the entire flight test. It was decided to use a microprocessor in the computing device. The design of the computing system is discussed, taking into account also the program which is stored on PROM. G R

STAR ENTRIES

N79-15902*# National Aeronautics and Space Administration Langley Research Center Hampton, Va
A STUDY OF CANARD-WING INTERFERENCE USING EXPERIMENTAL PRESSURE DATA AT TRANSONIC SPEEDS

Blair B Gloss and Karen E Washburn Jan 1979 71 p refs (NASA-TP-1355, L-12491) Avail NTIS HC A04/MF A01 CSCL 01A

The canard had an exposed area of 28.0 percent of the wing reference area and was located in the chord plane of the wing or in a position 18.5 percent of the wing mean geometric chord above or below the wing chord plane. The canard leading edge sweep was 51.7 deg and the wing leading-edge sweep was 60 deg. The results indicated that the direct canard downwash effects on the wing loading are limited to the forward half of the wing directly behind the canard. The wing leading-edge vortex is located farther forward for the wing in the presence of the canard than for the wing-alone configuration. The wake, from the canard located below the wing chord plane, physically interacts with the wing inboard surface and produces a substantial loss of wing lift. For the Mach number 0.70 case, the presence of the wing increased the loading on the canard for the higher angles of attack. However, at Mach numbers of 0.95 and 1.20, the presence of the wing had the unexpected result of unloading the canard. Author

N79-15903*# National Aeronautics and Space Administration Langley Research Center Hampton Va
A THEORETICAL INVESTIGATION OF FOREBODY SHAPES DESIGNED FOR NATURAL LAMINAR BOUNDARY-LAYER FLOW

Raymond L Barger Jan 1979 18 p refs (NASA-TP-1375, L-12550) Avail NTIS HC A02/MF A01 CSCL 01A

The design of forebody shapes for natural laminar flow is discussed. For subsonic flow, computed results for three shapes of different fineness ratios indicate that laminar flow can be attained under conditions that approximate those on the forebody of a cruise missile flying at a low altitude at a high subsonic Mach number. For supersonic (Mach 2.00) design, a one-parameter family of hyperbolic arcs was used to generate forebody shapes having a favorable pressure gradient over the forebody length. Computed results for these shapes indicated laminar and transitional flow over the range of Reynolds numbers considered. Author

N79-15904*# General Dynamics/Convair San Diego Calif
CALCULATION OF THE PLANAR SUPERCRITICAL FLOW OVER A NASA SUPERCRITICAL PROFILE

H Yoshihara and R Magnus 18 Sep 1970 11 p refs (Contract NAS1-9308) (NASA-CR-111888) Avail NTIS HC A02/MF A01 CSCL 01A

An unsteady finite difference procedure was used to calculate the steady inviscid flow over an 11% thickness ratio NASA supercritical profile of LWP 505 at $M_{\infty} = 0.80$ and $\alpha = 0$. An attempt is made to include the viscous effects using a modified form of Head's entrainment method to calculate the turbulent boundary layer. The attempt to predict the viscous effects using the compressible form of Head's integral method with a modified auxiliary equation for the form factors was unsatisfactory. Though a reasonably separation bubble was established on the lower surface, a grossly exaggerated displacement effect resulted downstream of the shock on the upper

surface. There clearly is substantial further effort required to evolve a satisfactory boundary layer procedure which must then be coupled in a still unproven manner with the inviscid procedure. G Y

N79-15905# Tokyo Univ (Japan) Dept of Aeronautics
A NUMERICAL PREDICTION OF TYPICAL ARTICULATED ROTOR IMPEDANCE

Kanichiro Kato and Takashi Yamane 18 Oct 1978 20 p refs Backup document for AIAA Synoptic scheduled for publication in Journal of Aircraft in May 1979 Avail NTIS HC A02/MF A01

Numerical analyses were conducted for an articulated rotor blade in practical use in order to grasp the typical articulated rotor impedances. Results included the effects on impedances of the variations in trim velocity, collective pitch setting, and blade linear twist. Author

N79-15909# Royal Aircraft Establishment Farnborough (England) Aerodynamics Dept
THE ESTIMATION OF LATERAL-DIRECTIONAL AERODYNAMIC DERIVATIVES AT SUBSONIC SPEEDS

H H B M Thomas /In Von Karman Inst for Fluid Dyn Aerodyn Inputs for Probl in Aircraft Dyn Vol 1 1977 77 p refs

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A brief account is given of the theoretical and semi-empirical methods at present available for estimating the aerodynamic derivatives needed in linearized dynamic studies of airplanes. To bring forth the shortcomings of these methods and the types of problems posed in any attempt to improve upon the present position, various theoretical results are compared and experimental evidence is offered. Comparisons are made between estimated and measured derivatives for two types of airplanes. G G

N79-15910# Hawker Siddeley Aviation Ltd Hatfield (England)
A REVIEW OF METHODS FOR OBTAINING SUBSONIC LONGITUDINAL AERODYNAMIC DERIVATIVES

A B Young /In Von Karman Inst for Fluid Dyn Aerodyn Inputs for Probl in Aircraft Dyn Vol 1 1977 46 p refs

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The prediction and use of longitudinal aerodynamic derivatives is reviewed with particular emphasis on the practical problems of civil transport aircraft design. It is shown that the depth to which these aerodynamic data are required varies with the design stage of project as do the available methods for deriving the information. The body of data contained in the standard data sheet systems is examined and the deficiencies listed. The technique of wind tunnel testing for obtaining derivatives is also discussed together with the information to be obtained from rig test and flight testing. Finally, a review of future trends in the prediction of subsonic longitudinal derivatives is made. Author

N79-15911# Societe Nationale Industrielle Aerospaciale, Toulouse (France)
TRANSONIC/SUPERSONIC LONGITUDINAL AERODYNAMIC DERIVATIVES

E Khaski /In Von Karman Inst for Fluid Dyn Aerodyn Inputs for Probl in Aircraft Dyn Vol 1 1977 33 p refs Copyright Avail NTIS HC A16/MF A01

Some methods of predicting longitudinal aerodynamic derivatives are depicted, stressing two conventional calculation methods: one in subcritical subsonic regime (Muthopp Collocation method) and the other in supersonic regime (based on the Evard method). The influence of flexibility is discussed and the aerodynamic derivatives of some aircraft are obtained in different ways (theory, wind tunnel testing, or in flight). G G

N79-15912# Von Karman Inst for Fluid Dynamics Rhode-Saint-Genese (Belgium)

LATERAL-LONGITUDINAL CROSS-COUPLING EFFECTS
 J Sandford /In its Aerodyn Inputs for Probl in Aircraft Dyn Vol 1 1977 29 p refs

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The conditions under which the equations of motion for an aircraft can be separated into lateral and longitudinal groups are first established. The various ways in which these conditions can be violated are then discussed with particular reference to those which are aerodynamic in origin. G G

N79-15913# British Aircraft Corp Preston (England)
TRANSONIC/SUPERSONIC LATERAL AERODYNAMIC DERIVATIVES

B R A Burns and K Carr *In* Von Karman Inst for Fluid Dyn Aerodyn Inputs for Probl in Aircraft Dyn Vol 1 1977 102 p refs

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Estimates of the derivatives due to sideslip due to rate of roll and yaw and due to lateral controls are presented and compared with wind tunnel results and flight data at transonic and supersonic speeds. Some shortcomings and deficiencies in the data sheet methods are identified. Where discrepancies between estimates and measurements are evident explanations are offered. In most cases these are due to interference effects between adjacent stabilizing and lifting surfaces which are not accounted for in the based theories. The more important effects of aeroelastic distortion are described briefly and methods of application are illustrated. G G

N79-15914# Von Karman Inst for Fluid Dynamics Rhode-Saint-Genese (Belgium)

AERODYNAMIC INPUTS FOR PROBLEMS IN AIRCRAFT DYNAMICS, VOLUME 2

1977 389 p refs Proc of lectures held on 25-29 Apr 1977 2 Vol

(VKI-LS-99-Vol-2) Avail NTIS HC A17/MF A01

A series of lectures are presented on ways of analyzing and utilizing aerodynamic characteristics for solving problems related to aircraft stability.

N79-15915# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt Goettingen (West Germany)

PREDICTION OF UNSTEADY AERODYNAMIC FORCES IN HIGH FREQUENCY OSCILLATORY FLOW

H Foersching *In* Von Karman Inst for Fluid Dyn Aerodyn Inputs for Probl in Aircraft Dyn Vol 2 1977 80 p refs

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A review is made of current advances in the development of analytical methods and related computation techniques for the prediction of the motion-induced unsteady aerodynamic inputs for problems in high-frequency aircraft dynamics. The practical applicability and reliability of the various methods is demonstrated and some topics for further research work are indicated. Author

N79-15916# National Aerospace Lab Amsterdam (Netherlands)
THE USE OF PANEL METHODS WITH A VIEW TO PROBLEMS IN AIRCRAFT DYNAMICS

T E Labrujere R Roos and L J J Erkelens *In* Von Karman Inst for Fluid Dyn Aerodyn Inputs for Probl in Aircraft Dyn Vol 2 1977 140 p refs

(NLR-MP-77009-U) Copyright Avail NTIS HC A17/MF A01

A survey is given of the basic principles of the panel methods. The most frequently used methods steady as well as unsteady are described in some detail. Recent developments aiming at improvement and extension of the range of applicability are reviewed. The use of panel methods for the determination of stability derivatives is discussed. Results of some applications are shown illustrating the capability of the panel methods. Author

N79-15917*# National Aeronautics and Space Administration Langley Research Center Hampton Va
AERODYNAMIC CHARACTERISTICS AT HIGH ANGLES OF ATTACK

J R Chambers *In* Von Karman Inst for Fluid Dyn Aerodyn Inputs for Probl in Aircraft Dyn Vol 2 1977 39 p refs

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An overview is presented of the aerodynamic inputs required for analysis of flight dynamics in the high-angle-of-attack regime wherein large-disturbance nonlinear effects predominate. An outline of the presentation is presented. The discussion includes (1) some important fundamental phenomena which determine to a large extent the aerodynamic characteristics of airplanes at high angles of attack (2) static and dynamic aerodynamic characteristics near the stall (3) aerodynamics of the spin (4) test techniques used in stall/spin studies (5) applications of aerodynamic data to problems in flight dynamics in the stall/spin area and (6) the outlook for future research in the area. L S

N79-15919# Royal Aircraft Establishment Farnborough (England) Aerodynamics Dept

ON THE APPLICATION OF CERTAIN STATISTICAL METHODS TO WIND-TUNNEL TESTING

J McKie London Aeron Res Council 1978 57 p refs Supersedes RAE TR-75018 ARC-36049

(ARC-CP-1390 BR63387 RAE-TR-75018 ARC-36049) Avail NTIS HC A04/MF A01, HMSO £ 3 PHI

The use of some standard statistical techniques in wind-tunnel testing is illustrated. The results of non-linear regression analysis are applied to the particular problem of comparing the data from experiments in two different tunnels on the same model. Residual variance was used as a measure of the repeatability of results and standard tests were applied to look for significant differences between the two tunnels. The accuracy of a measured aerodynamic coefficient was put in terms of confidence limits for a given probability level. A method is given for determining the minimum detectable effect of a model geometry change and also for finding the number of data points needed to measure a coefficient to a prescribed accuracy. G G

N79-15920# Royal Aircraft Establishment Farnborough (England) Aerodynamics Dept

NON-CONICAL FLOW PAST SLENDER WINGS WITH LEADING EDGE VORTEX SHEETS

R W Clark London Aeron Res Council 1978 55 p refs Supersedes RAE-TR-76037 ARC-36863

(ARC-R/M-3814 RAE-TR-76037, ARC-36863 BR64192) Avail NTIS HC A04/MF A01 HMSO £ 5 PHI

The vortex sheet model of leading edge separation which has been successfully applied to slender delta wings of conical shape is extended to nonconical wings which have thin uncambered cross sections. Calculations of the shape and strength of the vortex sheet are presented for examples of a plane wing with a curved leading edge and of a delta wing with lengthwise camber. In each case it is found that the sign of the circulation shed from the leading edge changes as the calculation proceeds downstream but the consequences are very different in the two cases. An experimental investigation to clarify the behavior of the cambered wing is described. J M S

N79-15921# Engineering Sciences Data Unit, London (England)
ANALYSIS OF THE ZERO-LIFT WAVE DRAG MEASURED ON DELTA WINGS

J Weber and C King London Aeron Res Council 1978 79 p refs Supersedes RAE-TR-76072, ARC-37297 Prepared for RAE Sponsored by Min of Defence

(ARC-R/M-3818 BR63386, RAE-TR-76072 ARC-37297) Copyright Avail NTIS HC A05/MF A01 HMSO £ 6 PHI

Lift and drag were measured by strain gage balance at Mach numbers between 1.4 and 2.8. On some of the wings' surface pressure distributions were also measured. The zero-lift wave drag was examined, as well as skin friction drag and lift-dependent drag. The wave drag was obtained by integrating the pressure distribution. Values of the wave drag were also derived from the measured total drag by subtracting estimated values for the skin friction drag and for the effect of the sting support. The experimental values were compared with one another and with the theoretical estimates derived by supersonic area rule. The different experimental values are shown to be self-consistent and to lie up to 30% below the theoretical estimates. J A M

N79-15922# Royal Aircraft Establishment, Farnborough (England) Aerodynamics Dept
ON THE EVALUATION OF WALL INTERFERENCE IN TWO-DIMENSIONAL VENTILATED WIND TUNNELS BY SUBSONIC LINEAR THEORY

D Catherall London Aeron Res Council 1978 49 p refs
 Supersedes RAE-TR-76134, ARC-37409
 (ARC-R/M-3819 BR63623, RAE-TR-76134, ARC-37409)
 Avail NTIS HC A03/MF A01, HMSO £ 5, PHI

The interference potentials for lift solid blockage and wake blockage were previously presented in the form of integral expressions The expression for wake blockage is corrected and the integral expressions are converted into power series The motivation was to provide far-field boundary conditions, especially at large distances downstream for computations of transonic flows within wind tunnels Additionally, these power series facilitate the calculation of the interference in the neighborhood of the model The effects of parametric variations of wall porosity and slot geometry are demonstrated Lift and blockage interference velocities, their streamwise gradients and wall conditions for zero solid blockage are presented in both tabular and graphical form G G

N79-15925# National Transportation Safety Board Washington, D C

ANNUAL REVIEW OF AIRCRAFT ACCIDENT DATA US GENERAL AVIATION, CALENDAR YEAR 1977

16 Nov 1978 215 p
 Avail NTIS HC A10/MF A01

This record of aircraft accidents which occurred in US general aviation operations includes an analysis of accident data relating to an overview, types of accidents accident causal factors, kinds of flying, and conclusions A statistical compilation of accident information is presented in the form of accident and rate tables, analytic tables, injury tables and cause/factor tables These statistical data are divided into sections pertaining to all operations, small fixed-wing aircraft, large fixed-wing aircraft, rotorcraft, gliders and collisions between aircraft In 1977, there were 4 286 total general aviation accidents, 702 of which were fatal Included in the total number of accidents are 51 collisions between aircraft By coding each aircraft involved in collisions, an additional 51 records were produced, which brought the total number of accident records to 4,337 This figure reflects the actual number of pilots and aircraft involved in the accidents

Author

N79-15926# National Transportation Safety Board, Washington, D C

AIRCRAFT ACCIDENT REPORTS BRIEF FORMAT US CIVIL AVIATION ISSUE NUMBER 5 - 1976 ACCIDENTS

18 Oct 1977 329 p
 (NTSB-BA-77-3) Avail NTIS HC A15/MF A01

Selected aircraft accident reports, occurring in US civil aviation operations during calendar year 1976, are presented The 533 general aviation accidents and 6 air carrier accidents contained in this publication represent a random selection The brief format presents the facts, conditions, circumstances, and probable cause(s) for each accident Additional statistical information is tabulated by type of accident, phase of operation, kind of flying injury index, aircraft damage, conditions of flight, pilot certificate, injuries, and causal factors G G

N79-15927# Gellman Research Associates, Inc., Jenkintown, Pa

LARGE CARGO AIRCRAFT: A TECHNOLOGY ASSESSMENT, VOLUME 1 Final Report

Jan 1978 349 p refs 2 Vol
 (Contract NSF C-2062, Grant NSF ERS-76-80328)
 (PB-286896/6, NSF/RA-780240) Avail NTIS
 HC A15/MF A01 CSCL 01C

A preliminary comprehensive technology assessment of a future transportation technology, a large cargo aircraft described as having the same capacity as two dedicated Boeing 747 freighters is presented The methodology and the basic assumptions employed in the conduct of the study and the theoretical basis for the causal model are presented The differences between

the effects which emanate from the operation of the large cargo aircraft and from its function, are indicated The future state of the world economy is examined The causal model and the generic effects are presented Tables, figures, and matrices are included to illustrate areas of impact GRA

N79-15928# Gellman Research Associates, Inc., Jenkintown, Pa

LARGE CARGO AIRCRAFT A TECHNOLOGY ASSESSMENT, VOLUME 2 Final Report

Jan 1978 298 p refs 2 Vol
 (Contract NSF C-1061 Grant NSF ERS-76-80328)
 (PB-286897/4, NSF/RA-780241) Avail NTIS
 HC A09/MF A01 CSCL 01C

A principal result of operating a large cargo aircraft (LCA) fleet is stated to be the opening of new channels for international trade Primary impacts are likely to affect the export sectors of the economies of United States trading partners, particularly among the developing nations The possible effects of the LCA are analyzed by reviewing the current patterns of international trade and, then, the potential trade patterns of the future Since the impact of the LCA is expected to be greater in the lesser developed countries, at least one country was selected as a case study from each major region of developing nations following established criteria GRA

N79-15930# Royal Aircraft Establishment, Farnborough (England) Radio and Navigation Dept

OMEGA AND VLF AIRCRAFT INSTALLATIONS

H G Hill, J Kilvington, and N J Carter Feb 1978 44 p refs

(RAE-TM-RAD-NAV-66, BR62457) Avail NTIS
 HC A03/MF A01

The successful operation of OMEGA and VLF installations in aircraft is considered Included is a list of interference field strengths found in various RAE aircraft, the considerations to be taken into account in the choice of aerial type and site, and installation problems and their relation to receiver design G G

N79-15936# General Accounting Office Washington, D C Procurement and Systems Acquisition Div

STATUS OF THE FEDERAL AVIATION ADMINISTRATION'S MICROWAVE LANDING SYSTEM

19 Oct 1978 53 p
 (PB-287275/2, PSAD-78-149) Avail NTIS HC A04/MF A01
 CSCL 17G

The Federal Aviation Administration's new common civil/military microwave landing system is about 5 years behind schedule and research and development will cost between \$182 to \$192 million--approximately \$90 to \$100 million more than originally estimated Large amounts of money are still being invested for ground equipment for the existing system Recognizing these continued investments along with the probable extension to 1995 of instrument landing systems at international airports existing instrument landing systems at US domestic airports should be continued in accordance with a mutually agreeable microwave landing system implementation plan GRA

N79-15937 Kansas Univ Lawrence

DESIGN AND DEVELOPMENT OF A SYSTEM TO MEASURE THE MODE SHAPES OF A VIBRATING, ROTATING HELICOPTER BLADE IN A VACUUM Ph D Thesis

Frank John Fronczak 1978 423 p
 Avail Univ Microfilms Order No 7924860

A photographic technique and equipment are described Two camera systems are described One uses cylindrical lenses and a baffling arrangement to take photographs of a line on an object The other camera uses conventional spherical lenses to photograph the rotor blade These photographs provide data which is reduced to yield the components of vibration of a full size helicopter blade vibrating at resonance The rotor test stand which rotates and excites the blade vibration is described The mode shapes were measured in a vacuum in order to eliminate aerodynamic forces Blade deflection data is tabulated and plotted for several rotational speeds and frequencies Dissert Abstr

N79-15938*# National Aeronautics and Space Administration
Langley Research Center Hampton Va
**EXPERIMENTAL INVESTIGATION OF EFFECTS OF BLADE
TIP GEOMETRY ON LOADS AND PERFORMANCE FOR AN
ARTICULATED ROTOR SYSTEM**

William H Weller (Army Aviation Research and Development
Command, St Louis Mo) Jan 1979 79 p refs
(DA Proj 1L2-62209-AH-76)
(NASA-TP-1303 L-12153 AVRADCOM-TR-78-53) Avail
NTIS HC A05/MF A01 CSCL 01C

Wind-tunnel tests of an aeroelastically designed helicopter rotor model were carried out to determine the effects on dynamic response and aerodynamic performance of varying the design of the outboard 8 percent of the blade lengths Four different blade tip geometries or shapes having different amounts of planform sweep, thickness and chordwise taper and anhedral angle were studied Each configuration was tested at several shaft angles of attack for advance ratios of 0.20 0.30 0.35 and 0.40 For each combination of shaft angle and advance ratio rotor lift was varied over a wide range to include high lift conditions

Author

N79-15939*# Lockheed-California Co Burbank
**CONFIGURATION DEVELOPMENT STUDY OF THE X-24C
HYPERSONIC RESEARCH AIRPLANE, PHASE 1 Contractor
Report, Nov 1975 - Mar 1976**

Henry G Combs et al Dec 1976 368 p refs
(Contract NAS1-14222)
(NASA-CR-145032 SP-4499) Avail NTIS HC A16/MF A01
CSCL 01C

Four hypersonic research airplane configurations found to be the most cost effective were selected for further refinement The selection was based on a systematic analysis and evaluation of realistic designs involving nine different configurations evolving from three different structural/thermal concepts coupled with existing rocket and sustainer engines All configurations were constrained by the mission profiles research requirements aerodynamic envelope and maximum launch weight established by NASA

J A M

N79-15940*# Lockheed-California Co Burbank Advanced
Development Projects
**CONFIGURATION DEVELOPMENT STUDY OF THE X-24C
HYPERSONIC RESEARCH AIRPLANE Executive Summary,
Apr - May 1976**

Henry G Combs D H Campbell M D Cassidy, C D Sumpter,
E Seitz B J Kachel R P James J Walters J Love and R
T Passon Oct 1977 54 p
(Contract NAS1-14222)
(NASA-CR-145274) Avail NTIS HC A04/MF A01 CSCL
01C

Bottom line results were made of a three-phase study to determine the feasibility of designing building and operating and maintaining an air-launched high performance aircraft capable of cruising at speeds up to Mach 8 for short durations The results show that Lockalloy heat-sink structure affords the capability for a work-horse vehicle which can serve as an excellent platform for this research It was further concluded that the performance of a blended wing body configuration surpassed that of a lifting body design for typical X-24C missions The cost of a two vehicle program less engines B-52 modification and contractor support after delivery can be kept within \$70M (in Jan 1976 dollars)

A R H

N79-15941*# Old Dominion Univ Research Foundation Norfolk
Va
**EXPERIMENTAL INVESTIGATION OF EFFECTS OF JET
DECAY RATE ON JET-INDUCED PRESSURES ON A FLAT
PLATE TABULATED DATA**

John M Kuhlman Don S Ousterhout and Ronald W Warcup
Nov 1978 157 p
(Grant NGL-47-003-039)
(NASA-CR-158990) Avail NTIS HC A08/MF A01 CSCL
01C

Tabular data are presented for an experimental study of the effects of jet decay rate on the jet-induced pressure distribution

on a flat plate for a single jet issuing at right angle to the flat plate into a uniform crossflow The data are presented in four sections (1) presents the static nozzle calibration data (2) lists the plate surface static pressure data and integrated loads (3) lists the jet centerline trajectory data and (4) lists the centerline dynamic pressure data

Author

N79-15942*# Boeing Commercial Airplane Co Seattle Wash
BCAC Preliminary Design Dept
**EVALUATION OF LAMINAR FLOW CONTROL SYSTEM
CONCEPTS FOR SUBSONIC COMMERCIAL TRANSPORT
AIRCRAFT Final Report, Sep 1976 - Sep 1978**

Dec 1978 269 p refs
(Contract NAS1-14630)
(NASA-CR-158976 D6-47109) Avail NTIS
HC A12/MF A01 CSCL 01C

A two-year study conducted to establish a basis for industry decisions on the application of laminar flow control (LFC) to future commercial transports was presented Areas of investigation included (1) mission definition and baseline selection (2) concepts evaluations and (3) LFC transport configuration selection and component design The development and evaluation of competing design concepts was conducted in the areas of aerodynamics structures and materials and systems The results of supporting wind tunnel and laboratory testing on a full-scale LFC wing panel suction surface opening concepts and structural samples were included A final LFC transport was configured in incorporating the results of concept evaluation studies and potential performance improvements were assessed Remaining problems together with recommendations for future research are discussed

A R H

N79-15943*# North Carolina State Univ Raleigh Dept of
Mechanical and Aerospace Engineering
**FLIGHT TEST EVALUATION OF PREDICTED LIGHT
AIRCRAFT DRAG, PERFORMANCE, AND STABILITY**

Frederick O Smetana and Stan R Fox 1979 781 p refs
(Grant Nsg-1077)
(NASA-CR-158076) Avail NTIS HC A99/MF A01 CSCL
01C

A technique was developed which permits simultaneous extraction of complete lift, drag and thrust power curves from time histories of a single aircraft maneuver such as a pullup (from V sub max to V sub stall) and pushover (to sub V max for level flight) The technique is an extension to non-linear equations of motion of the parameter identification methods of Liff and Taylor and includes provisions for internal data compatibility improvement as well The technique was shown to be capable of correcting random errors in the most sensitive data channel and yielding highly accurate results This technique was applied to flight data taken on the ATLIT aircraft The drag and power values obtained from the initial least squares estimate are about 15% less than the true values If one takes into account the rather dirty wing and fuselage existing at the time of the tests however the predictions are reasonably accurate The steady state lift measurements agree well with the extracted values only for small values of alpha The predicted value of the lift at alpha = 0 is about 33% below that found in steady state tests while the predicted lift slope is 13% below the steady state value

Author

N79-15944# Von Karman Inst for Fluid Dynamics Rhode-Saint-Genese (Belgium)

**REMOTELY PILOTED VEHICLES - AERODYNAMICS AND
RELATED TOPICS, VOLUME 1**

1977 231 p refs Proc of Lectures held on 23-27 May
1977 2 Vol

(VKI-LS-101-Vol-1) Copyright Avail NTIS HC A11/MF A01
The design of various remotely piloted vehicles (RPV) is discussed along with ground support equipment Wind tunnel tests subjecting RPV models to turbulence are reviewed The communication problem when using several RPV is also considered

N79-15945# Lockheed Missiles and Space Co Palo Alto Calif
[INTRODUCTION TO, GROUND STATION SYSTEMS OF,

AND CIVIL APPLICATIONS OF REMOTELY PILOTED VEHICLES]

S J Colby *In* Von Karman Inst for Fluid Dyn RPV's - Aerodyn and Related Topics Vol 1 1977 89 p refs

Copyright Avail NTIS HC A11/MF A01

If a remotely piloted vehicle system is to perform useful missions the seven major subsystems must be designed as a well integrated set of complimentary hardware and software. The subsystems are (1) ground station (2) data links (3) air vehicle (4) avionics and navigation (5) multiple sensors (6) launch and recovery and (7) age and logistics support. The RPV system is intended to perform many functions of observation, information gathering, battlefield firepower support, and electronic warfare where there is a human operator controlling the RPV's behavior and mission equipment from a remote location. J A M

N79-15946# British Aircraft Corp (Operating) Ltd Bristol (England) Guided Weapons Div

AN RPV DESIGN STUDY

P Swan *In* Von Karman Inst for Fluid Dyn RPV's - Aerodyn and Related Topics, Vol 1 1977 31 p

Copyright Avail NTIS HC A11/MF A01

The vehicle carried a payload of 10kg and has a payload capacity of 0.1 cu meters. The nose was to be kept clean as planned systems included TV cameras and other sensors. The aim was to avoid an oil film over any of the payload area. Maximum speeds of over 40 m/s (80 knots) were desired. The vehicle should be able to fly as slowly as 25 m/s (50 knots). This resulted from early control equipment which was limited to roughly 1 km range. This in turn limited the effective straight & level runs to 500 m. A level flight time of about 10 seconds was needed to analyze the consequences of any maneuvers. Endurances of 1 hour or greater were planned with a maximum operating altitude of about 3 km after an improved control system was commissioned. It was intended to catapult launch the vehicle. However the first flight trials were made using a fixed undercarriage. J A M

N79-15947# British Aircraft Corp (Operating) Ltd, Bristol (England)

AERODYNAMICS

P Swan *In* Von Karman Inst for Fluid Dyn RPV's - Aerodyn and Related Topics Vol 1 1977 44 p

Copyright Avail NTIS HC A11/MF A01

An item that was checked with some care was downwash on both tail-controlled RPV's and a canard design. It was suspected at one stage before any wind tunnel testing, that downwash (and upwash) may be subject to viscous damping at low speeds. The genuine cause of the problem turned out to be an incidence range restriction affecting control response. By implication, if downwash and upwash were confirmed as independent of Reynolds Number the other induced effects such as loading patterns must be reasonable. This was also confirmed by the stall pattern on devices that were tunnel-tested. J A M

N79-15949# Von Karman Inst for Fluid Dynamics, Rhode-Saint-Genese (Belgium)

REMOTELY PILOTED VEHICLES - AERODYNAMICS AND RELATED TOPICS, VOLUME 2

1977 271 p refs Proc of Lectures held on 23-27 May, 1977 2 Vol

(VKI-LS-101-Vol-2) Avail NTIS HC A12/MF A01

The propulsion, launching and recovery of fixed-wing remotely piloted vehicles are discussed as well as the effectiveness of totally integrated systems for aerial reconnaissance and other military applications. Topics covered include computerized simulation, telemetry, data processing and control.

N79-15950# British Aircraft Corp (Operating) Ltd Bristol (England) Guided Weapons Div

PROPULSION

R Stephenson *In* Von Karman Inst for Fluid Dyn RPV's-Aerodyn and Related Topics, Vol 2 1977 57 p refs

Copyright Avail NTIS HC A12/MF A01

The use of internal combustion engines in MINI-(RPV's) of turbojet engines in MIDI- and MAXI-RPV's and of solid propellant and liquid propellant rocket engines, and hybrid motors in battlefield reconnaissance drones is described. Alternative power plants considered include ramjet, pulsejet and pressurejet engines. Future applications of electric propulsion and solar cell propulsion are assessed. A R H

N79-15951# British Aircraft Corp (Operating) Ltd Bristol (England) Guided Weapons Div

LAUNCH AND RECOVERY

R Stephenson *In* Von Karman Inst for Fluid Dyn RPV's-Aerodyn and Related Topics Vol 2 1977 62 p refs

Copyright Avail NTIS HC A12/MF A01

The dynamics of conventional takeoff and landing phases of flight are reviewed and related to the requirements of a fixed-wing mini-RPV. Alternative methods of launch and recovery which are more relevant to military operational conditions are considered such as zero length and catapult launching. Topics covered include air launch, recovery, recoverable versus expendable RPV's, parachutes, parawings, mid-air retrieval systems and arrester hooks and net systems. Favored methods of launch for mobile ground use are catapult with stretched rubber cords for launch weights up to 20 kg, pneumatic catapult for launch weights from 20 kg to 50 kg, and zero or near zero length launcher with solid propellant cast motor. Vertical takeoff and landing vehicles may be preferred to catapult launchers for shipborne RPV's. The use of air cushion takeoff and landing systems and of secondary aerodynamic lifting and arresting devices is under consideration. A R H

N79-15952# Manufacture Belge de Lampes et de Materiel Electronique, Brussels (Belgium)

DESIGN AND OPERATION OF EPERVIER RECONNAISSANCE RPV

C Derouck *In* Von Karman Inst for Fluid Dyn RPV's-Aerodyn and Related Topics, Vol 2 1977 19 p

Copyright Avail NTIS HC A12/MF A01

Requirements for a totally integrated RPV system for target acquisition and identification are discussed. The Epervier system which uses a compact delta wing aircraft is described. The system comprises (1) unmanned vehicles which can be equipped with different types of sensors for day and night missions, (2) highly mobile launchers with associated check-out equipment, (3) a mobile drone control center, (4) maintenance and check-out equipment, and (5) a mobile data processing laboratory. Operational experience demonstrates the main features of the system are low cost, high mobility, great accuracy, navigational flexibility, zone coverage capability and outstanding mission reliability. A R H

N79-15953# Army Missile Command Redstone Arsenal Ala

FEASIBILITY STUDY OF MINI-RPV FOR ATTACK

R B Powell, D W Holder and R E Dickson *In* Von Karman Inst for Fluid Dyn RPV's-Aerodyn and Related Topics Vol 2 1977 79 p refs

Copyright Avail NTIS HC A12/MF A01

A computer simulation was conducted to determine the terminal trajectory and system effectiveness of a ground launched mini-RPV with a midcourse trajectory to target area. Human performance in controlling and attack RPV was also simulated. The weapon system is under consideration for providing surveillance and designation to assure survivability in hostile air defense environments, for over-the-hill surveillance as an expendable jammer in electronic warfare and as an attack RPV. Simulation validation and flight tests results are discussed.

A R H

N79-15954# Army Aviation Engineering Flight Activity Edwards AFB, Calif

ARTIFICIAL ICING TEST PHOBIC COATINGS ON UH-1H HELICOPTER ROTOR BLADES Final Report

John S Tulloch, Raymond B Smith, Frederick S Doten and John A Bishop Jun 1978 80 p refs
(AD-A059875 USAAEFA-77-30) Avail NTIS HC A05/MF A01 CSCL 11/3

The United States Army Aviation Engineering Flight Activity conducted a limited evaluation of the General Electric G697 compound and the Dow Corning E2460-40-1 substance to determine if either was useful as an ice phobic coating on UH-1H helicopter rotor blades Testing was conducted at Spokane Washington from 9 January through 8 February 1978 During the tests 23 2 flight hours were accumulated of which 6 5 hours were in the icing environment Within the scope of this test both and G697 and the E2460-40-1 aided in shedding ice accreted on the main rotor blades GRA

N79-15955# Royal Aircraft Establishment Farnborough (England) Structures Dept

IMPEDANCE MEASUREMENTS ON A SPINNING MODEL HELICOPTER ROTOR

R Cansdale and D R Gaukroger London Aeron Res Council 1978 48 p ref Supersedes RAE-TR-76086, ARC-37251 (ARC-CP-1389 BR63389, RAE-TR-76086 ARC-37251) Avail NTIS HC A03/MF A01, HMSO £ 2 50 PHI

The technique for measuring rotor impedances at the shaft of a model rotor was further developed Values of impedance are presented for a four-blade rotor of semi-rigid design operating at zero lift zero advance ratio and a range of rotational speeds The problems of interpreting and applying rotor impedances are discussed G G

N79-15956# Royal Aircraft Establishment Farnborough (England) Structures Dept

THE DEVELOPMENT OF A PARAMETRIC METHOD OF MEASURING FIN FATIGUE LOADS BASED ON FLIGHT MEASUREMENTS ON A LIGHTNING Mk T5

Anne Burns J P Thompson and E W Wells London Aeron Res Council 1978 58 p refs Supersedes RAE-TR-76161 ARC-37442 (ARC-R/M-3824 BR64876, RAE-TR-76161 ARC-37442) Avail NTIS HC A04/MF A01 HMSO £ 6 PHI

Load measurement is discussed in which load is deduced from a statistical correlation with an appropriate combination of aircraft motion variables and control surface angles A full-scale flight experiment on a Lightning Mk T5 is described aimed at developing a parametric method for the measurement of fin fatigue loads under operational conditions An empirical relationship was established between the fin root bending moment as determined from a multi-strain gauge installation and a combination of parameters The parameters from which the combination is selected include translational and rotational accelerations rates of rotation rudder angle and angle of sideslip The study covers the measurement of fin loads under a wide range of loading conditions G G

N79-15957# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio

MEASURED AND PREDICTED NOISE OF THE AVCO-LYCOMING YF-102 TURBOFAN NOISE

Bruce J Clark Jack G McArdle and Leonard Homyak 1979 18 p refs Presented at 5th Aeroacoustics Conf Seattle 12-14 Mar 1979 sponsored by AIAA (NASA-TM-79069 E-9885 AIAA-Paper-79-0641) Avail NTIS HC A02/MF A01

Acoustic testing of the AVCO-Lycoming YF-102 turbofan engine was done on a static test stand in support of the quiet short-haul research aircraft acoustic design Overall noise levels were dominated by the fan noise emanating from the exhaust duct except at high power settings when combination tones were generated in the fan inlet Component noise levels, calculated by noise prediction methods were in reasonable agreement with the measured results Far-field microphones placed at ground level were found superior to those at engine centerline height even at high frequencies J A M

N79-15958*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio

THE GATE STUDIES ASSESSING THE POTENTIAL OF FUTURE SMALL GENERAL AVIATION TURBINE ENGINES

William C Strack 1979 24 p refs Presented at the Intern Ann Gas Turbine Conf San Diego Calif 11-15 Mar 1979 sponsored by Am Soc of Mechanical Engineers (NASA-TM-79075 E-9892) Avail NTIS HC A02/MF A01 CSCL 21E

Four studies were completed that explore the opportunities for future General Aviation turbine engines (GATE) in the 150-1000 SHP class These studies forecasted the potential impact of advanced technology turbine engines in the post-1988 market identified important aircraft and missions desirable engine sizes engine performance and cost goals Parametric evaluations of various engine cycles configurations design features and advanced technology elements defined baseline conceptual engines for each of the important missions identified by the market analysis Both fixed-wing and helicopter aircraft, and turboshaft turboprop and turbofan engines were considered Sizable performance gains (e.g 20% SFC decrease) and large engine cost reductions of sufficient magnitude to challenge the reciprocating engine in the 300-500 SHP class were predicted J A M

N79-15959*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio

APPLICATIONS OF VELOCITY POTENTIAL FUNCTION TO ACOUSTIC DUCT PROPAGATION AND RADIATION FROM INLETS USING FINITE ELEMENT THEORY

K J Baumeister and R K Majjigi (GE Co Cincinnati Ohio) 1979 12 p refs Presented at the 5th Aeroacoustics Conf Seattle Wash 12-14 Mar 1979 sponsored by AIAA (NASA-TM-79071 E-9888) Avail NTIS HC A02/MF A01 CSCL 21E

A finite element velocity potential program was developed to study acoustic wave propagation in complex geometries For irrotational flows relatively low sound frequencies and plane wave input the finite element solutions showed significant effects of inlet curvature and flow gradients on the attenuation of a given acoustic liner in a realistic variable area turbofan inlet The velocity potential approach can not be used to estimate the effects of rotational flow on acoustic propagation since the potential acoustic disturbances propagate at the speed of the media in sheared flow Approaches are discussed that are being considered for extending the finite element solution to include the far field as well as the internal portion of the duct A new matrix partitioning approach is presented that can be incorporated in previously developed programs to allow the finite element calculation to be marched into the far field The partitioning approach provided a large reduction in computer storage and running times J A M

N79-15960*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio

ANALYSIS OF RADIATION PATTERNS OF INTERACTION TONES GENERATED BY INLET RODS IN THE JT15D ENGINE

M F Heidmann and A V Saule 1979 27 p refs Presented at the 5th Aeroacoustics Conf Seattle, 12-14 Mar 1978 sponsored by AIAA (NASA-TM-79074 E-9891) Avail NTIS HC A03/MF A01 CSCL 21E

Interaction tones were intentionally generated by circumferential arrays of equally spaced rods that protrude radially from the inlet wall near the face of the 28-blade fan Arrays of 28 and 41 rods selected to give specific far field radiation properties, were tested The expected properties were readily apparent in the measured radiation patterns A more detailed analysis of the test data showed both the precision and limitations of the applied acoustic theory Rods protruding 23 percent of the radius predominantly generated only lowest radial order modes as expected Measured and predicted radiation patterns were generally in good agreement The agreement however depended on a significant degree of implied refraction due to inlet velocity gradients Refraction if present would impact static-flight noise comparisons Author

N79-15961*# National Aeronautics and Space Administration
Lewis Research Center Cleveland Ohio
**THE ROTARY COMBUSTION ENGINE A CANDIDATE FOR
GENERAL AVIATION**
1978 190 p refs Symp held at Cleveland Ohio 28 Feb
1978
(NASA-CP-2067 E-9800) Avail NTIS HC A09/MF A01 CSCL
21A

The state of development of the rotary combustion engine is discussed. The nonturbine engine research programs for general aviation and future requirements for general aviation powerplants are emphasized.

N79-15962*# National Aeronautics and Space Administration
Washington D C
OVERVIEW OF NASA GENERAL AVIATION PROGRAM
Roger L Winblade /In NASA Lewis Res Center The Rotary
Combust Engine 1978 p 1-11

Avail NTIS HC A09/MF A01 CSCL 21A

The NASA efforts devoted to new technology for general aviation are summarized. Areas covered include (1) improved safety through improved crashworthy structural design, spin resistance and improved operations around uncontrolled airports (2) reduced environmental impact for both reciprocating and turbine engines and (3) research for improvement in the performance of both aerodynamic and system components.

J M S

N79-15963*# National Aeronautics and Space Administration
Langley Research Center Hampton Va
**GENERAL AVIATION ENERGY-CONSERVATION RE-
SEARCH PROGRAMS**
Edward A Willis /In its The Rotary Combust Engine 1978
p 13-35 refs

Avail NTIS HC A09/MF A01 CSCL 21A

A review is presented of nonturbine general aviation engine programs underway at the NASA-Lewis Research Center. The program encompasses conventional lightweight diesel, and rotary engines. Its three major thrusts are (1) reduced SFC's (2) improved fuels tolerance, and (3) reducing emissions. Current and planned future programs in such areas as lean operation, improved fuel management, advanced cooling techniques, and advanced engine concepts, are described. These are expected to lay the technology base by the mid to latter 1980's for engines whose total fuel costs are as much as 30% lower than today's conventional engines.

J M S

N79-15964*# Toyo Kogyo Co Ltd Hiroshima (Japan)
**DEVELOPMENT STATUS OF ROTARY ENGINE AT TOYO
KOGYO**
Kenichi Yamamoto /In NASA Lewis Res Center The Rotary
Combust Engine 1978 p 37-84
N79-15961 07-07)

Avail NTIS HC A09/MF A01 CSCL 21A

Progress in the development of rotary engines which use a thermal reactor as the primary part of the exhaust emission control system is reviewed. Possibilities of further improvements in fuel economy of future rotary engines are indicated.

J M S

N79-15965*# Audi NSU Auto Union A G Neckarsulm (West
Germany)
**UPDATE OF DEVELOPMENT ON THE NEW AUDI NSU
ROTARY ENGINE GENERATION**
Richard vanBasshuysen /In NASA Lewis Res Center The
Rotary Combust Engine 1978 85-107
Avail NTIS HC A09/MF A01 CSCL 21A

Rotary engines with a chamber volume of 750 cc as a two rotor automotive powerplant, called KKM 871 are described. This engine is compared to a 3 liter or 183 cubic inch six-cylinder reciprocating engine. Emphasis is placed on exhaust emission control and fuel economy.

J M S

N79-15966*# Audi NSU Auto Union A G Neckarsulm (West
Germany)
**REVIEW OF THE RHEIN-FLUGZEUGBAU WANKEL POW-
ERED AIRCRAFT PROGRAM**
Manfred Riethmüller /In NASA Lewis Res Center The Rotary
Combust Engine 1978 p 109-122

Avail NTIS HC A09/MF A01 CSCL 21A

The development of light aircraft with special emphasis on modern propulsion systems and production is discussed in terms of the application of rotary engines to aircraft. Emphasis is placed on the integrated ducted-fan propulsion system using rotary engines.

J M S

N79-15967*# Curtiss-Wright Corp Wood-Ridge NJ
**ROTARY ENGINE DEVELOPMENTS AT CURTISS-WRIGHT
OVER THE PAST 20 YEARS AND REVIEW OF GENERAL
AVIATION ENGINE POTENTIAL**
Charles Jones /In NASA Lewis Res Center The Rotary Combust
Engine 1978 p 123-174 refs

Avail NTIS HC A09/MF A01 CSCL 21A

The development of the rotary engine as a viable power plant capable of wide application is reviewed. Research results on the stratified charge engine with direct chamber injection are included. Emission control, reduced fuel consumption and low noise level are among the factors discussed in terms of using the rotary engine in general aviation aircraft.

J M S

N79-15968*# National Aeronautics and Space Administration
Langley Research Center, Hampton, Va
**ENGINE REQUIREMENTS FOR FUTURE GENERAL AVIA-
TION AIRCRAFT**
Joseph W Stickle /In NASA Lewis Res Center The Rotary
Combust Engine 1978 p 175-186

Avail NTIS HC A09/MF A01 CSCL 21A

The market place is examined for general aviation aircraft into the 1980's. The visible constraints that engine manufacturers must face regardless of the type of cycle are indicated.

J M S

N79-15969*# National Aeronautics and Space Administration
Lewis Research Center Cleveland Ohio
**EVALUATION OF TWO INFLOW CONTROL DEVICES FOR
FLIGHT SIMULATION OF FAN NOISE USING A JT15D
ENGINE**
W L Jones J G McArdle and L Homyak 1979 17 p refs
Presented at 5th Aeroacoustics Conf Seattle Washington 12-14
Mar 1978 sponsored by AIAA
(NASA-TM-79072 E-9889) Avail NTIS HC A02/MF A01
CSCL 21E

The program was developed to accurately simulate flight fan noise on ground static test stands. The results generally indicated that both the induct and external ICD's were effective in reducing the inflow turbulence and the fan blade passing frequency tone generated by the turbulence. The external ICD was essentially transparent to the propagating fan tone but the induct ICD caused attenuation under most conditions.

Author

N79-15970# National Aeronautics and Space Administration
Langley Research Center, Hampton, Va
**DESIGN AND ANALYSIS OF AN ACTIVE JET CONTROL
SYSTEM FOR HELICOPTER SLING LOADS M S. Thesis -
Old Dominion Univ**
Mark D Pardue and J D Shaughnessy Jan 1979 35 p refs
(NASA-TP-1397 L-11836) Avail NTIS HC A03/MF A01
CSCL 01C

An active jet control system for stabilizing the swinging motion of helicopter external sling loads in hover (and forward flight) is described. A velocity feedback control law is obtained by using classical control theory. A nondimensional analysis is performed to give a simple chart for determining the appropriate value of feedback gain as a function of cable length, sling length, and load parameters to provide theoretical damping ratios of 0.7. The sensitivity to parameter changes was studied and + or - a 10 percent change in parameters was found to affect system

performance only slightly Implementation of the control scheme in a nonlinear simulation produced damping ratios equal to or greater than those calculated A limited number of piloted flights in a visual simulator indicated a significant reduction in load swinging in the transition to hover and thus the pilot was able to concentrate on load altitude and position control Author

N79-15971# Royal Aircraft Establishment Farnborough (England)

THE RESPONSE OF AIRCRAFT TO DISCRETE RAMP GUSTS

A G Purcell Nov 1977 31 p refs (RAE-TR-77165 BR61322) Avail NTIS HC A03/MF A01

An aircraft response as a function of time on encountering an isolated ramp gust was derived from its response to a unit step gust Two FORTRAN programs are described which treat separately straight ramp and smooth ramp (one-minus-cosine) gust profiles The (critical) gust length causing maximum dynamic response was determined and responses to simple gust patterns (pairs) were investigated J A M

N79-15972# Royal Aircraft Establishment Farnborough (England) Structures Dept

WEIGHT OPTIMISATION WITH FLUTTER CONSTRAINTS

L T Niblett London Aeron Res Council 1978 29 p refs Supersedes RAE-TR-77130 ARC-37537 (ARC-R/M-3823 BR64875 RAE-TR-77130 ARC-37537) Avail NTIS HC A03/MF A01 HMSO £ 3 50 PHI

It was argued that the method of applying a flutter constraint in weight optimization was so complicated that it was best to apply it only if the structure obtained from optimization with the other constraints alone was flutter-prone In this way much unnecessary and possibly inappropriate calculation could be avoided A method of weight optimization with only flutter constraints based on inverse iteration which can be used in conjunction with any suitable optimization procedure was suggested Its use in association with more than one procedure is described as is the optimization of a wing of fairly-high aspect ratio J A M

N79-15973# Advisory Group for Aerospace Research and Development Neuilly-Sur-Seine (France)

PILOTED AIRCRAFT ENVIRONMENT SIMULATION TECHNIQUES

Oct 1978 306 p refs In ENGLISH and FRENCH Presented at the Flight Mech Specialists Meeting Brussels 24-27 Apr 1978

(AGARD-CP-249 ISBN-92-835-0222-1) Avail NTIS HC A14/MF A01

Papers presented at the Flight Mechanics Panel Specialists Meeting on Piloted Aircraft Environment Simulation Techniques held in Brussels, Belgium 24-27 April 1978 are reported The conference was divided into the following sessions (1) requirements on simulation of the environment (2) simulation of the atmospheric environment (3) atmospheric models for simulation (4) out of the cockpit visual scenes (5) visual versus nonvisual motion cues (6) motion simulation, and (7) up and away mission phases

N79-15974# Tactical Air Warfare Center, Eglin AFB Fla

CURRENT DEFICIENCIES IN SIMULATION FOR TRAINING

Charles D Brown In AGARD Piloted Aircraft Environ Simulation Tech Oct 1978 7 p

Avail NTIS HC A14/MF A01

A representative of the Tactical Air Warfare Center (USAF-TAWC) is given the opportunity to air some of his views on the subject of aircrew training devices and their utilization Some of the major simulator modifications of some combat aircraft are discussed G Y

N79-15975# British Aerospace Aircraft Group Warton (England)

SIMULATING THE VISUAL APPROACH AND LANDING

A G Barnes In AGARD Piloted Aircraft Environ Simulation Tech Oct 1978 13 p refs

Avail NTIS HC A14/MF A01

A general view is taken of the standards of simulation which are currently achieved in training and research simulators The approach and landing is subdivided into separate phases straight-in approach curved approach flare and ground roll The piloting task is critically examined in each case with particular reference to the use of outside world visual cues The merits and deficiencies of existing simulators as a means of providing the equivalent information are then discussed Improvements to the overall simulation of the landing approach are more likely to emerge if a better understanding of the information which the pilot uses in each phase is available This paper is an attempt to assemble some of the information pieces and to relate them to the technology of simulation G Y

N79-15976# Boeing Aerospace Co Seattle Wash Crew Systems

VISUAL CRITERIA FOR OUT OF THE COCKPIT VISUAL SCENES

Conrad L Kraft and Larry W Shaffer In AGARD Piloted Aircraft Environ Simulation Tech Oct 1978 18 p refs Prepared in cooperation with Gen Elec Co Daytona Beach Fla

Avail NTIS HC A14/MF A01

In 1973 a small committee of four men, representative of the disciplines of electronics, flight and vision were asked to develop the criteria for a visual system for flight crew training in air transportation This is a review of the visual system criteria developed for this out of the cockpit visual scene generation The available classes of visual systems in 1973 were three film and anamorphic projection closed circuit television and fixed terrain model and computer generated image system The last had the highest risk but promised much greater flexibility higher quality images and a day/night scene G Y

N79-15977*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif

MISSION ENVIRONMENT SIMULATION FOR ARMY ROTORCRAFT DEVELOPMENT REQUIREMENTS AND CAPABILITIES

David L Key, Billy L Odneal and John B Sinacon In AGARD Piloted Aircraft Environ Simulation Tech Oct 1978 17 p refs Prepared in cooperation with Army Aviation Res and Develop Command Moffett Field, Calif

Avail NTIS HC A14/MF A01 CSCL 01E

The rich and varied detail visible in terrain flight must be presented by a wide field-of-view system with much detail and high resolution The rotary-wing R&D simulator must have great versatility for easy change of cab configurations and the capability to accommodate a two or three man crew Basic specifications for an adequate visual display were developed and are compared with current and forecasted techniques for image generation and presentation Results of a study performed to determine the feasibility of meeting these requirements using the current technology of TV camera-model image generation and projected display are discussed and an assessment of the possibility that computer generated imagery can achieve the desired level of detail is presented G Y

N79-15978# Naval Air Test Center, Patuxent River Md Rotary Wing Aircraft Test Directorate

ENVIRONMENTAL REQUIREMENTS FOR SIMULATED HELICOPTER/VTOL OPERATIONS FROM SMALL SHIPS AND CARRIERS

C W Woomer and R L Williams In AGARD Piloted Aircraft Environ Simulation Tech Oct 1978 13 p refs Prepared in cooperation with McDonnell-Douglas Electron Co, St Charles, Mo

Avail NTIS HC A14/MF A01

The specific requirements for the simulated environment to satisfactorily provide training for shipboard takeoff and landing

are discussed Test techniques to validate trainer fidelity in flying qualities performance and environmental simulation are discussed The specific subject of calligraphic visual systems is extensively covered, including a report on the current state-of-the-art as related to the at-sea environment The utilization of a high-fidelity trainer is explored for research as well as for expanded fleet training G Y

N79-15979# Boeing Co Seattle Wash
PROPOSED ADVANCEMENTS IN SIMULATION OF ATMOSPHERIC PHENOMENA FOR IMPROVED TRAINING
 William J Allsopp *In* AGARD Piloted Aircraft Environ Simulation Tech Oct 1978 11 p refs

Avail NTIS HC A14/MF A01

Obviously flight simulators are a major training vehicle and the desire to reduce in-airplane training is the driving force to obtain better flight simulator visual systems As the result of both commercial and military applications major advancements were made in simulator visual systems resulting in commercial use of the various electronically generated visual systems Improvements appear to be required in many areas, such as field of view, resolution, brightness scene content, lights, visual/motion integration, simulated airplane short-period response, and atmospheric environment The latter is the subject of this paper G Y

N79-15980# Technische Hogeschool Delft (Netherlands) Dept of Aerospace Engineering
NON-GAUSSIAN STRUCTURE OF THE SIMULATED TURBULENT ENVIRONMENT IN PILOTED FLIGHT SIMULATION
 G A J vandeMoesdijk *In* AGARD Piloted Aircraft Environ Simulation Tech Oct 1978 27 p refs

Avail NTIS HC A14/MF A01

A description of the general nongaussian characteristics of actual atmospheric turbulence as observed in the atmosphere is presented A nongaussian turbulence simulation model is described The nongaussian characteristics are classified as patchiness and intermittency, both dependent on higher order statistics These nongaussian characteristics are mathematically elaborated and described The effects of patchiness on pilot's behavior, using physiological parameters are evaluated in a small simulator experiment G Y

N79-15981# Federal Aviation Administration Washington D C Systems Research and Development Service
HANDLING QUALITIES OF A SIMULATED STOL AIRCRAFT IN NATURAL AND COMPUTER-GENERATED TURBULENCE AND SHEAR
 S R M Sinclair and T C West *In* AGARD Piloted Aircraft Environ Simulation Tech Oct 1978 16 p refs Prepared in cooperation with Natl Aeron Estab, Ottawa
 Avail NTIS HC A14/MF A01

A program was undertaken to measure naturally-occurring wind shear and turbulence along the approach to an urban STOL-port and to investigate the effects of these atmospheric disturbances on the flying qualities of a powered-lift STOL aircraft The experiment entailed both an in-flight phase using the NAE (National Aeronautical Establishment of Canada) Airborne V/STOL Simulator and a ground-based simulation phase G Y

N79-15982# Royal Aircraft Establishment Farnborough (England)
VISIBILITY MODELLING FOR A LANDING SIMULATOR WITH SPECIAL REFERENCE TO LOW VISIBILITY
 D Johnson *In* AGARD Piloted Aircraft Environ Simulation Tech Oct 1978 10 p refs

Avail NTIS HC A14/MF A01

When a simulator is used to demonstrate or investigate the effects of restricted visibility on a pilot's ability to land an aircraft it is important that the visual sequence displayed is as realistic as possible The characteristics of the visual world by day and

by night are described In particular the topics of contrast the apparent horizon and the perception of the lights are considered A brief account is also given of the characteristics of some of the more commonly encountered fogs whose effects could usefully be represented in simulating low visibility conditions These include shallow fogs and those with marked vertical density gradients Various ways of simulating the outside world in general are briefly described and discussed in relation to fog and vision G Y

N79-15983*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
VISUAL SIMULATION REQUIREMENTS AND HARDWARE
 John C Dusterberry *In* AGARD Piloted Aircraft Environ Simulation Tech Oct 1978 7 p refs

Avail NTIS HC A14/MF A01 CSCL 01E

Requirements for any out-of-the-cockpit visual simulation system can easily lead to a set of system specifications which are clearly beyond the visual scene that can be produced by current technology Therefore the requirements of any proposed system must be assessed in light of the expected simulated aircraft and missions, experiments on pilot response and available image generation and display hardware A review is made of some of the recent experiments and the results are related to aircraft and missions with particular emphasis on research and development simulators Recent visual simulation hardware is considered in light of extending the range of applications of piloted aircraft simulators and a method of design approach is proposed G Y

N79-15984# Royal Aircraft Establishment Farnborough (England)
LOW BUDGET SIMULATION IN WEAPON AIMING
 P Manville and E D Whybray *In* AGARD Piloted Aircraft Environ Simulation Tech Oct 1978 8 p

Avail NTIS HC A14/MF A01

The Flight Systems Department at RAE (Royal Aircraft Establishment) has developed and operated a low budget research simulator designed to explore aiming sequences accuracies and real time usage in air-to-ground weapon delivery from low altitude The simulator was expanded to permit the aiming sequences of air-to-air combat and air-to-ground designators to be evaluated This paper describes a special purpose research simulator that was developed to study the close interaction of the crew and system during the vital moments prior to weapon delivery The description of the techniques and equipment employed illustrates how accuracy and fidelity can be achieved within modest resources G Y

N79-15985# Deutsche Lufthansa Aktiengesellschaft Frankfurt am Main (West Germany)
THE LUFTHANSA DAY/NIGHT COMPUTER GENERATED VISUAL SYSTEM
 M Wekwerth *In* AGARD Piloted Aircraft Environ Simulation Tech Oct 1978 6 p
 Avail NTIS HC A14/MF A01

After defining some Computer Generated Image Visual System (CGI) terminology the paper outlines the functioning of the system in a block diagram manner The capabilities of the system with respect to display and computational capacity are discussed The layout of the computer landscape model the training aspects that influence the positioning of objects the coloring and the color saturation are covered A comparison between a conventional rigid model closed circuit television system and the CGI reveals the high flexibility of the CGI and its adaptability to varying training concepts The shortcomings of CGI with respect to realism and picture detail are also shown Remarks on future system requirements and improvements with respect to higher content (texture) and larger fields of view are presented G Y

N79-15986# CAE Electronics Ltd, Montreal (Quebec)
RECENT ADVANCES IN TELEVISION VISUAL SYSTEMS
 Brian L Welch *In* AGARD Piloted Aircraft Environ Simulation Tech Oct 1978 12 p refs

Avail NTIS HC A14/MF A01

A closed circuit television model board visual system which was designed for a CH-47 helicopter is described. The attributes and deficiencies of the system are discussed in an attempt to show how a model board based visual system suitable for full mission simulation in Nap of the earth environments could be designed. A new computer generated image visual system which makes extensive use of texture is presented as an alternative to the model board approach. The importance of realism in full mission simulators as distinct from flight and weapons trainers is also discussed. G Y

N79-15987# Redifon Simulation Ltd Crawley (England)
A HIGH RESOLUTION VISUAL SYSTEM FOR THE SIMULATION OF IN-FLIGHT REFUELLING

Martin J P Bolton /n AGARD Piloted Aircraft Environ Simulation Tech Oct 1978 14 p refs

Avail NTIS HC A14/MF A01

A unique visual system developed for the simulation of the in-flight refuelling task is described. It incorporates both wide bandwidth and computer generated image (CGI) techniques. The in-flight refuelling task and the simulation requirements are reviewed. Redifon's previous experience in this field is outlined and the overall design of the latest visual system is described. The problem of providing the essential visual information within the constraints of cost and available technology is presented. The special effects unit which provides all video processing and image generation functions under the control of an autonomous computer, is examined. S E S

N79-15988# Naval Training Equipment Center Orlando Fla Army Office of Project Manager for Training Devices
WIDE ANGLE VISUAL SYSTEM DEVELOPMENTS

Carl R Driskell /n AGARD Piloted Aircraft Environ Simulation Tech Oct 1978 12 p

Avail NTIS HC A14/MF A01

Two alternative approaches to a high resolution wide angle visual system for military flight simulation were described. The basic feasibility of each system was established through studies and subsystem demonstrations but the practical realization of each total system design remains to be proven. Breadboard models of each visual system are developed. S E S

N79-15989*# Massachusetts Inst of Tech Cambridge Dept of Aeronautics and Astronautics

VISUALLY INDUCED MOTION IN FLIGHT SIMULATION
 Lawrence R Young /n AGARD Piloted Aircraft Environ Simulation Tech Oct 1978 8 p refs

(Grant NsG-2236 Contract F33615-76-C-0039)

Avail NTIS HC A14/MF A01 CSCL 01E

Visually induced yaw (circularvection) resulting from a moving wide field presentation and its interaction with vestibular yaw cues generated by base motion is discussed. A model is presented for the interaction between visual and motion cues in yaw which rationalizes the high frequency utilization of vestibular cues and the low frequency use of visual cues to support sustained angular velocity. The implications for fixed and moving base flight simulator design are discussed. Similar considerations apply to visually induced linear velocity (linearvection) and interesting asymmetries in the fore-aft direction are noted. Visually induced pitch and roll are discussed and modelled in terms of conflict between the visually induced motion and the information regarding attitude based upon graviceptor signals. S E S

N79-15990# Royal Aircraft Establishment Bedford (England) Flight Systems Dept
MOTION VERSUS VISUAL CUES IN PILOTED FLIGHT SIMULATION

J R Hall /n AGARD Piloted Aircraft Environ Simulation Tech Oct 1978 13 p refs

Avail NTIS HC A14/MF A01

In the ground based simulation of piloted flight the provision of adequate cues to the pilot is essential for both training and the successful evaluation of handling and ride qualities. Two examples are presented to show that motion cues can be vital even when adequate alternative visual cues are available. The first shows that practical low gain roll motion cues are better than nominally perfect peripheral vision cues for controlling a vehicle with an unstable dutch roll mode and the second that motion can be vital even for developing items such as head-up displays for which it might not at first sight seem necessary. Results indicate that for the prediction and evaluation of handling qualities using a piloted flight simulator it is not always sufficient for the pilot to achieve a similar performance in the simulator as in flight. It is also necessary that he should adopt the same control strategy. To achieve this it is often essential to provide the pilot with motion cues as no substitute in these circumstances has yet been found. S E S

N79-15991# Air Force Human Resources Lab Wright-Patterson AFB Ohio Advanced Systems Div
MOTION AND FORCE CUING REQUIREMENTS AND TECHNIQUES FOR ADVANCED TACTICAL AIRCRAFT SIMULATION

William B Albery Don R Gum and Gerald J Kron (Singer Co., Binghamton N Y) /n AGARD Piloted Aircraft Environ Simulation Tech Oct 1978 10 p refs

Avail NTIS HC A14/MF A01

Data base development efforts which are in process have provided a better understanding of the type of motion and force cuing required for U S Air Force tactical aircraft simulators and the type of devices necessary to effectively and efficiently provide this cuing. An advanced g-cuing system was developed which provides both rapid onset and sustained cuing. It is capable of stimulating the important tactile and pressure as well as nonvestibular proprioceptive human sensory modalities throughout the frequency spectrum and for the duration of motion and force cuing presented during most tactical flight maneuvers. High-g augmentation devices are investigated and designed which should efficiently provide some of the additional cuing present during extremely high-g flight environments. S E S

N79-15992# National Aerospace Lab Amsterdam (Netherlands)
INFLUENCE OF MOTION WASH-OUT FILTERS ON PILOT TRACKING PERFORMANCE

M F C vanGool /n AGARD Piloted Aircraft Environ Simulation Tech Oct 1978 5 p refs

Avail NTIS HC A14/MF A01

The NLR moving base flight simulator was investigated to establish the influence of the simulator motion wash-out filters in the pitch and roll axis on the performance of four pilots when stabilizing an aircraft disturbed by turbulence in either of these axes. For this compensatory tracking task, pilot describing functions remnant spectra and other performance measures were determined. The results lead to the conclusion that for the task under consideration no significant differences can be observed when the break frequency of the (linear second-order) wash-out filter is varied from 0.1 rad/sec to 0.5 rad/sec. Then performance in either condition is considerably better when compared to fixed-base results. This is also reflected in the pilot comments and effort ratings, stating that the task is easier with motion. S E S

N79-15993# Aeronautical Systems Div Wright-Patterson AFB, Ohio
DYNAMIC CHARACTERISTICS OF FLIGHT SIMULATOR MOTION SYSTEMS

Paul T Kemmerling, Jr /n AGARD Piloted Aircraft Environ Simulation Tech Oct 1978 20 p refs

Avail NTIS HC A14/MF A01

Recognition is made of the complete lack of substantive data on the quality of motion produced by multiple degree of freedom aircraft simulator motion systems and efforts made to produce this data are discussed. Working Group #07 of the

Flight Mechanics Panel of AGARD was given the charter to identify and define the pertinent physical characteristics of flight simulator motion systems, establish procedures for their measurement and prepare a report on their findings. The seven main characteristics identified by the Group are outlined and efforts by several of the members to apply the characteristic techniques in laboratory measurements are discussed. Acknowledgement is made of the difficulties in establishing universally workable definitions and techniques for cataloguing motion characteristics, and alternatives are suggested. The conclusion is reached that a taxonomy of motion characteristics is a valuable asset in determining the optional use of currently available motion systems. Author

N79-15994# Cranfield Inst of Technology Bedfordshire (England)
THE DEVELOPMENT AND EVALUATION OF A g SEAT FOR A HIGH PERFORMANCE MILITARY AIRCRAFT TRAINING SIMULATOR

N O Matthews and C A Martin *In* AGARD Piloted Aircraft Environ Simulation Tech Oct 1978 8 p

Avail NTIS HC A14/MF A01

The original type of seat and attempts to improve its performance, leading to the design of a completely new concept in simulator g seats are tested. Philosophy behind the changes in design are considered and the implementation of these in terms of hardware are described. The proto-type model of the new seat were tested in conjunction with a 3 axis motion system of improved performance characteristics at Cranfield Institute of Technology and the results of evaluations by a number of service test pilots and pilots are described. S E S

N79-15995# Le Materiel Telephonique, Trappes (France) Div Simulateurs et Systemes Electroniques
SIX DEGREES OF FREEDOM LARGE MOTION SYSTEM FOR FLIGHT SIMULATORS

Michel Baret *In* AGARD Piloted Aircraft Environ Simulation Tech Oct 1978 8 p

Avail NTIS HC A14/MF A01

The long-stroke, hollow-rod jack with hydrostatic bearings of the six degrees of freedom large motion system is described. Techniques are provided that improve and reduce the level of unwanted accelerations normally generated by motion systems while offering new possibilities in the study of control laws. S E S

N79-15997# Industrieanlagen-Betriebsgesellschaft m b H Ottobrunn (West Germany)
DIFFERENCES BETWEEN SIMULATION AND REAL WORLD AT THE IABG AIR TO AIR COMBAT SIMULATOR WITH A WIDE ANGLE VISUAL SYSTEM

E Vogl *In* AGARD Piloted Aircraft Environ Simulation Tech Oct 1978 11 p refs

Avail NTIS HC A14/MF A01

The experiences of IABG with its Dual Flight Simulator (DFS) for air-to-air combat are presented. First of all IABG has discovered that air-to-air combat simulation without a motion system is no problem to the pilots. During the verification phase it was found that the results of simulations at DFS were very good. All simulator effects in respect to human factors were researched. Results indicated that these effects are unimportant to air-to-air combat simulators. S E S

N79-15998# McDonnell Aircraft Co St Louis Mo Flight Simulation Dept
MANNED AIR COMBAT SIMULATION A TOOL FOR DESIGN DEVELOPMENT AND EVALUATION FOR MODERN FIGHTER WEAPON SYSTEMS AND TRAINING OF AIRCREWS

R H Matthews *In* AGARD Piloted Aircraft Environ Simulation Tech Oct 1978 6 p

Avail NTIS HC A14/MF A01

Manned air combat simulation has matured into a major element in modern fighter aircraft design and development. The simulation fidelity now available allows meaningful training to be accomplished such that the U S Government is now procuring an Air Combat Maneuvering Simulator (ACMS) for fighter tactics training. The contributions of manned air combat simulation to the F-15 fighter weapon systems from design concept through successful introduction to squadron service are presented. Specific examples are given of airframe avionics and integrated systems simulation support in the design and development process. Flight and simulation results in several test programs including air combat maneuvering are compared. The Air Combat Maneuvering Simulator provided to the U S Navy for air combat training is described. S E S

N79-15999*# National Aeronautics and Space Administration Langley Research Center, Hampton Va
USE OF PILOTTED SIMULATION FOR STUDIES OF FIGHTER DEPARTURE/SPIN SUSCEPTIBILITY

William P Gilbert and Luat T Nguyen *In* AGARD Piloted Aircraft Environ Simulation Tech Oct 1978 13 p refs

Avail NTIS HC A14/MF A01 CSCL 01E

The NASA-Langley Research Center has incorporated into its stall/spin research program on military airplanes the use of piloted, fixed-base simulation to complement the existing matrix of unique research testing techniques. The piloted simulations of fighter stall/departure flight dynamics are conducted on the Langley Differential Maneuvering Simulator (DMS). The objectives of the simulation research are reviewed. The rationale underlying the simulation methods and procedures used in the evaluation of airplane characteristics is presented. The evaluation steps used to assess fighter stall/departure characteristics are discussed. Simulation results are presented to illustrate the flight dynamics phenomena dealt with. The considerable experience accumulated in the conduct of piloted stall/departure simulation indicates that simulation provides a realistic evaluation of an airplane's maneuverability at high angles of attack and an assessment of the departure and spin susceptibility of the airplane. This realism is obtained by providing the pilot a complete simulation of the airplane and control system which can be flown using a realistic cockpit and visual display in simulations of demanding air combat maneuvering tasks. The use of the piloted simulation methods and procedures described were found very effective in identifying stability and control problem areas and in developing automatic control concepts to alleviate many of these problems. A good level of correlation between simulated flight dynamics and flight test results were obtained over the many fighter configurations studied in the simulator. S E S

N79-16172# Electromagnetic Compatibility Analysis Center Annapolis Md
AUTOMATED VHF FREQUENCY ASSIGNMENT SYSTEM (FAS) FOR FAA AIR TRAFFIC CONTROL COMMUNICATIONS Final Report

Thomas C Hensler (ITT Research Inst) Jul 1978 17 p refs (Contracts DOT-FA76WAI-612)

(AD-A061336, ECAC-PR-76-005 FAA-RD-76-14-Suppl-1)
 Avail NTIS HC A02/MF A01 CSCL 17/2

A new assignment model that considers cosine and intersite constraints in determining the assignment order and to make program modifications to existing FAS models for the purpose of reducing system response time increasing the efficiency of computer usage is developed. The system is used for assignment gaming including partial and complete assignments detecting violators, statistical analyses and plots of service volume. S E S

N79-16183# Royal Aircraft Establishment Farnborough (England) Radio and Navigation Dept
NAVSTAR AIRCRAFT AERIAL SYSTEM SOME INITIAL CONSIDERATIONS

M J Sidford Nov 1976 23 p refs (RAE-TM-RAD-NAV-44 BR55426) Avail NTIS HC A02/MF A01

Aircraft aenal systems for use with the Navstar global positioning system are categorized and initial design considerations are given for each category from simple omnidirectional aenals to systems with ECCM capabilities Author

N79-16184# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt Oberpfaffenhofen (West Germany) Inst fuer Flugfunk und Mikrowellen

COMPUTATION OF THE RADIATION CHARACTERISTIC OF ANTENNAS ON COMPLICATED STRUCTURES IN THE HIGH FREQUENCY CASE PRINCIPLE OF THE GEOMETRICAL THEORY OF DIFFRACTION

Arno Schrott 26 Jan 1978 111 p refs In GERMAN ENGLISH summary (DFVLR-FB-78-02) Avail NTIS HC A06/MF A01

The geometrical theory of diffraction is used to determine the radiation characteristic of antennas on complicated structures such as satellites and aircrafts and the scattering at these structures in the high frequency case For the solution the complicated structures were divided into canonical forms which can be analyzed by rigorous asymptotic methods Beside the ray-optical construction of the high frequency field the important canonical problem of the diffraction at an edge was treated extensively The diffraction coefficients for the computation of the diffracted field are presented The problem of vertex diffraction is discussed G G

N79-16238# Royal Aircraft Establishment Bedford (England) Aerodynamics Dept

AN EXPERIMENTAL INVESTIGATION INTO THE INFLUENCE OF ACOUSTIC DISTURBANCES ON THE DEVELOPMENT OF A TURBULENT BOUNDARY LAYER

D J Weeks and J Hodges London Aeron Res Council 1978 41 p refs Supersedes RAE-TR-77035 ARC-37524 (ARC-R/M-3825 BR64877 RAE-TR-77035 ARC-37524) Avail NTIS HC A03/MF A01 HMSO £ 5 PHI

The effects of acoustic disturbances on the mean flow in a turbulent boundary layer developing in a mildly favorable pressure gradient are discussed A Hartmann generator mounted on the center line of a transonic wind tunnel was used as a noise source and the mean flow in the boundary layer on the tunnel sidewall was examined for any effects of the noise It was not possible to identify any effect of the noise itself on the boundary layer It is concluded that the acoustic disturbances generally found in the working sections of transonic wind tunnels are likely to exert a measurable influence on the development of turbulent boundary layers G G

N79-16241# Von Karman Inst for Fluid Dynamics Rhode-Saint-Genese (Belgium)

THEORETICAL AND EXPERIMENTAL INVESTIGATION OF THE FLOW AT THE INLET OF THE VANED DIFFUSER FOR A HIGH PRESSURE RATIO CENTRIFUGAL COMPRESSOR

G Verdonk Mar 1978 62 p refs (VKI-TN-125) Avail NTIS HC A04/MF A01

A theoretical and experimental investigation of the flow in the vaneless and semi-vaneless space of a transonic radial compressor diffuser especially for working points corresponding to the mass flow below choking values is examined A type-independent finite difference calculation was developed for the inviscid flow This method was combined with a shock-boundary layer interaction theory which allowed calculation in a more realistic way The velocity distribution took into account the boundary layer variation along the sidewalls J A M

N79-16300*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio

EXPERIMENTAL EVALUATION OF THE EFFECT OF INLET DISTORTION ON COMPRESSOR BLADE VIBRATIONS

J F Lubomski 1979 17 p refs Presented at the Intern Gas Turbine Conf, San Diego Calif 12-15 Mar 1979 sponsored by Am Soc of Mechanical Engineers (NASA-TM-79066 E-9882) Avail NTIS HC A02/MF A01 CSDL 20K

Compressor rotor strain gage data from an engine test conducted with an inlet screen distortion were reduced and analyzed These data are compared to data obtained from the same engine without inlet pressure distortion to determine the net effect of the distortion on the vibratory response of the compressor blades The results obtained are presented Author

N79-16311# Royal Aircraft Establishment Farnborough (England) Structures Dept

FATIGUE ACCELERATION IN BOX BEAMS UNDER MECHANICAL AND THERMAL STRESS (SECOND SERIES)

F E Keates F E Kiddle R F Mousley and D Gunn London Aeron Res Council 1978 67 p refs Supersedes RAE-TR-76096 ARC-37369

(ARC-R/M-3817 BR64191 RAE-TR-76096 ARC-37369) Avail NTIS HC A04/MF A01 HMSO £ 6 PHI

To assist the development and interpretation of the Concorde Major Fatigue Test a technique for accelerating fatigue testing was evaluated on structural box specimens under combined mechanical and thermal loadings It is shown that for a moderate level of thermal fatigue the acceleration achieved was in reasonably good agreement with prediction but that at a high level of thermal fatigue the acceleration was appreciably higher than predicted A tendency was observed for acceleration to be higher in crack propagation than in crack initiation G Y

N79-16346 California Univ Los Angeles

AEROELASTIC RESPONSE AND STABILITY OF A COUPLED ROTOR/SUPPORT SYSTEM WITH APPLICATION TO LARGE HORIZONTAL AXIS WITH TURBINES Ph D Thesis

William Warmbrodt 1978 326 p

Avail Univ Microfilms Order No 7901415

The derivation of a governing set of nonlinear equations of motion for a coupled rotor/support system is presented The model includes an n-bladed rotor with elastic blade flap and lead-lag degrees of freedom The blades can have precone pitch bearing offset built-in twist and cross sectional offsets between the aerodynamic center the center of mass and the elastic axis The rotor support has two translational degrees of freedom and three rotational degrees of freedom The general set of equations were specialized to analytically represent a coupled n-bladed rotor/fuselage model of a helicopter in hover or forward flight The fuselage was modeled as a rigid body Inertia aerodynamic structural and gravitational loads are considered Wind gusts in all three directions was included Rotor/fu elage matching was performed by requiring force and moment equilibrium between the rotor and the fuselage Dissert Abstr

N79-16640 Kansas Univ Lawrence

GENERAL AVIATION INTERIOR NOISE STUDY Ph D Thesis

Tonnis Dick Peschier 1978 154 p

Avail Univ Microfilms Order No 7824861

The organization of and work completed for an ongoing general aviation interior noise research project focusing on the transmission of sound through aircraft type panels is presented Described are typical noise source sound transmission path and acoustic cabin properties and their effect on interior noise Based on both annoyance and physiological damage criteria it is concluded that typical in-cabin noise levels of around 90 dBA or greater are undesirably high Some theoretical and empirical methods are discussed that are intended for prediction and analysis of the transmission of sound through panels Included is a description of the construction calibration and properties of an acoustic panel test facility Some preliminary experimental results obtained in this facility are presented Dissert Abstr

N79-16641*# National Aeronautics and Space Administration Langley Research Center Hampton Va

FLUCTUATING LOADS MEASURED ON AN OVER-THE-WING SUPERSONIC JET MODEL

Conrad M Willis Jan 1979 41 p refs

(NASA-TP-1366 L-12511) Avail NTIS HC A03/MF A01 CSDL 20A

Fluctuating pressure loads on the wing and flap of an over-the-wing supersonic jet model were measured. The model was tested statically and at a Mach number of 0.1 in a small free jet to simulate forward speed. Test parameters were impingement angle, nozzle height and flap deflection. Load levels as high as 170 db were measured at the center of the impingement region during static tests. Forward speed reduced the loading about 1 db. Load level increased with increasing impingement angle and decreasing nozzle height above the wing. The effect of flap deflection was small. When scaled to full-size aircraft conditions, the maximum amplitude of the one-third-octave fluctuating pressure spectra was about 154 db at about 160 Hz. Maximum load level occurred near the intersection of the nozzle center line with the impinged surface. Downstream of the maximum, the fluctuating pressure is inversely proportional to the distance downstream of the nozzle. A R H

N79-16645*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
FULL-SCALE ENGINE TESTS OF BULK ABSORBER ACOUSTIC INLET TREATMENT
 L J Heidelberg and L Homyak 1979 16 p refs Presented at the 5th Aeroacoustics Conf Seattle 12-14 Mar 1979 sponsored by AIAA
 (NASA-TM-79079 E-9899) Avail NTIS HC A02/MF A01 CSCL 20A

Three different densities of Kevlar bulk absorber fan inlet treatment were tested on a YF 102 turbofan engine. This bulk absorber material may have potential for flight application. Farfield noise measurements were made and the attenuation properties of the three treatment densities were compared. In addition, the best bulk treatment was compared to the best single degree of freedom SDOF (honeycomb and perforated cover sheet) treatment from another investigation. Although the density was varied over a large range (3 to 1) the effect on attenuation was small. The highest density treatment (118 lb/cubic ft) had a somewhat broader attenuation bandwidth. The comparison of the best bulk and SDOF treatments showed the bulk to have a much greater attenuation bandwidth. At the design frequency, both types of treatment had almost equal performance. Author

N79-16647*# National Aeronautics and Space Administration Lewis Research Center Cleveland, Ohio
EFFECTS OF INFLOW DISTORTION PROFILES ON FAN TONE NOISE CALCULATED USING A 3-D THEORY
 Hiroshi Kobayashi and John F Groeneweg 1979 18 p refs Presented at the 5th Aeroacoustics Conf Seattle Wash 12-14 Mar 1979 sponsored by AIAA
 (NASA-TM-79082 E-9904) Avail NTIS HC A02/MF A01 CSCL 20A

Calculations of the fan tone acoustic power and modal structure generated by complex distortions in axial inflow velocity are presented. The model used treats the motor as a rotating three-dimensional cascade and calculates the acoustic field from the distortion-produced dipole distribution on the blades, including noncompact source effects. Radial and circumferential distortion shapes are synthesized from Fourier-Bessel components representing individual distortion modes. The relation between individual distortion modes and the generated acoustic modes is examined for particular distortion cases. Comparisons between theoretical and experimental results for distortions produced by wakes from upstream radial rods show that the analysis is a good predictor of acoustic power dependence on disturbance strength. Author

N79-16648*# Lockheed-Georgia Co Marietta
BLOWN FLAP NOISE PREDICTION Final Report, Sep 1977 - 1978
 N N Reddy Sep 1978 97 p refs
 (Contract NAS1-15068)
 (NASA-CR-158978 LG78ERO237) Avail NTIS HC A05/MF A01 CSCL 20A

Theoretical and experimental developments of flow-surface interaction noise with a particular emphasis on blown-flap noise were reviewed. Several blown-flap noise prediction methods were evaluated by comparing predicted acoustic levels, directivity and spectra with a recently obtained data base. A prediction method

was selected and a detailed step-by-step description of this method was provided to develop a computer module to calculate one-third octave band frequency spectra at any given location in the far-field for under-the-wing and upper surface blown configurations as a function of geometric and operational parameters. G G

N79-16649*# National Aeronautics and Space Administration Langley Research Center Hampton Va
MEASUREMENTS OF ACOUSTIC SOURCES IN MOTION
 L Maestrello and T D Norum Dec 1978 14 p refs To be presented at VKI/AGARD Special Course Brussels 28 May 1979 - 1 Jun 1979
 (NASA-TM-78819) Avail NTIS HC A02/MF A01 CSCL 20A

Results of the far-field pressures measured from three different types of moving sources are presented. These acoustic sources consist of a point monopole, a small model jet, and an aircraft. Results for the pressure time history produced by the point source show good agreement with those predicted analytically. Both actual and simulated forward motion of the model jet show reductions in noise levels with forward speed at all angles between the source and observer. Measurement with the aircraft over both an anechoic floor and over the ground yields a method for evaluating the transfer function for ground reflections at various angles between the moving aircraft and measurement position. G Y

N79-16652# Royal Aircraft Establishment Farnborough (England) Aerodynamics Dept
JET NOISE RADIATION FROM DISCRETE VORTICES
 E G Broadbent London Aeron Res Council 1978 30 p refs Supersedes RAE-TR-76034 ARC-36785
 (ARC-R/M-3826 BR64878 RAE-TR-76034 ARC-36785)
 Avail NTIS HC A03/MF A01 HMSO £ 3 50 PHI

The modes of vibration of simple two-dimensional discrete vortices are examined and some analysis given for the acoustic radiation from such modes after a disturbance. The dominant radiation is shown to be of quadrupole type with a frequency proportional to the mean vorticity and in a jet mixing region this frequency is expected to fall linearly with increasing vortex radius. Some speculations are made about the practical effect of forward speed on jet noise. Author

N79-16801*# United Technologies Research Center East Hartford Conn
THE INFLUENCE OF SWEEP ON THE AERODYNAMIC LOADING OF AN OSCILLATING NACA0012 AIRFOIL VOLUME 2 DATA REPORT
 A O St Hilaire and F O Carta Feb 1979 387 p ref
 (Contract NAS1-14873)
 (NASA-CR-145350) Avail NTIS HC A17/MF A01 CSCL 01A

The effect of sweep on the dynamic response of the NACA 0012 airfoil was investigated. Unsteady chordwise distributed pressure data were obtained from a tunnel spanning wing equipped with 21 single surface transducers (13 on the suction side and 8 on the pressure side of the airfoil). The pressure data were obtained at pitching amplitudes of 8 and 10 degrees over a tunnel Mach number range of 0.10 to 0.46 and a pitching frequency range of 2.5 to 10.6 cycles per second. The wing was oscillated in the unswept and swept positions about the quarter-chord pivot axis relative to mean incidence angle settings of 0, 9, 12, and 15 degrees. A compilation of all the response data obtained during the test program is presented. These data are in the form of normal force, chord force, lift force, pressure drag, and moment hysteresis loops derived from chordwise integrations of the unsteady pressure distributions. The hysteresis loops are organized in two main sections. In the first section, the loop data are arranged to show the effect of sweep ($\lambda = 0$ and 30 deg) for all available combinations of mean incidence angle, pitching amplitude, reduced frequency, and chordwise Mach number. The second section shows the effect of chordwise Mach number ($MC = 0.30$ and $MC = 0.40$) on the swept wing response for all available combinations of mean incidence angle, pitching amplitude, and reduced frequency. F O S

N79-16802*# National Aeronautics and Space Administration
Langley Research Center Hampton Va

A NEW BOUNDARY-LAYER INTERACTION TECHNIQUE FOR SEPARATED FLOWS

James E Carter Jun 1978 26 p refs
(NASA-TM-78690) Avail NTIS HC A03/MF A01 CSCL 01A

A new viscous-inviscid interaction procedure is presented which is applicable to separated flows. The new procedure is simple, converges rapidly and does not require numerical smoothing and underrelaxation at least in the cases computer thus far. Calculations are presented for the low-speed separated flow in the juncture region between an axisymmetric body and wing. The viscous computation is done with an inverse boundary-layer procedure which was previously developed. The inviscid computation is made with an axisymmetric transonic code called RAXBOD. The main advantage of the new interaction procedure is that it combines an inverse boundary-layer technique which is applicable to separated flows with an existing inviscid analysis code with only a slight boundary condition change required in the inviscid code. Author

N79-16803*# National Aeronautics and Space Administration
Langley Research Center Hampton Va

EFFECTS OF SPANWISE BLOWING ON THE SURFACE PRESSURE DISTRIBUTION AND VORTEX-LIFT CHARACTERISTICS OF A TRAPEZOIDAL WING-STRAKE CONFIGURATION

James F Campbell and Gary E Erickson (Northrop Corp Hawthorne Calif) Feb 1979 72 p refs
(NASA-TP-1290 L-11641) Avail NTIS HC A04/MF A01 CSCL 01A

The effects of spanwise blowing on the surface pressures of a 44 deg swept trapezoidal wing-strake configuration were measured. Wind tunnel data were obtained at a free stream Mach number of 0.26 for a range of model angle of attack, jet thrust coefficient and nozzle chordwise location. Results showed that spanwise blowing delayed the leading edge vortex breakdown to larger span distances and increased the lifting pressures. Vortex lift was achieved at span stations immediately outboard of the strake-wing junction with no blowing, but spanwise blowing was necessary to achieve vortex lift at increased span distances. Blowing on the wing in the presence of the strake was not as effective as blowing on the wing alone. Spanwise blowing increased lift throughout the angle-of-attack range, improved the drag polars and extended the linear pitching moment to higher values of lift. The leading edge suction analogy can be used to estimate the effects of spanwise blowing on the aerodynamic characteristics. J A M

N79-16804*# National Aeronautics and Space Administration
Langley Research Center Hampton Va

THE DESIGN OF SUPERCRITICAL WINGS BY THE USE OF THREE-DIMENSIONAL TRANSONIC THEORY

Michael J Mann Feb 1979 33 p refs
(NASA-TP-1400 L-12552) Avail NTIS HC A03/MF A01 CSCL 01A

A procedure was developed for the design of transonic wings by the iterative use of three dimensional inviscid transonic analysis methods. The procedure was based on simple principles of supersonic flow and provided the designer with a set of guidelines for the systematic alteration of wing profile shapes to achieve some desired pressure distribution. The method was generally applicable to wing design at conditions involving a large region of supercritical flow. To illustrate the method it was applied to the design of a wing for a supercritical maneuvering fighter that operates at high lift and transonic Mach number. The wing profiles were altered to produce a large region of supercritical flow which was terminated by a weak shock wave. The spanwise variation of drag of this wing and some principles for selecting the streamwise pressure distribution are also discussed. J A M

N79-16805*# National Aeronautics and Space Administration
Langley Research Center Hampton, Va

DETECTION OF THE TRANSITIONAL LAYER BETWEEN LAMINAR AND TURBULENT FLOW AREAS ON A WING SURFACE Patent Application

William R Hood inventor (to NASA) Filed 27 Nov 1978 7 p

(NASA-Case-LAR-12261-1 US-Patent-Appl-SN-964009) Avail NTIS HC A02/MF A01 CSCL 01A

Airflow is passed over a wing surface. A scanning valve is adjusted so that a pneumatic tube extending from an orifice is connected via a pneumatic tube to an accelerometer and to a pressure transducer. As air passes over the orifice the pressure and noise levels are measured by the two instruments as recorded by a data acquisition system. The noise may also be heard via audio output and recorded by audio tape. The scanning valve is then adjusted so that the pneumatic tube extending from the orifice is connected via the pneumatic tube to the pressure transducer and to the accelerometer. The pressure and noise measurements are taken for the orifice in the same manner, the scanning valve subsequently connects each of the remaining orifices one at a time to the measuring and recording apparatus. The laminar to turbulent boundary is determined easily by visual inspection of the resulting graph. The need for an operator to be in the wind tunnel is eliminated and pressure measurements made simultaneously with the noise level measurements. NASA

N79-16806# Naval Weapons Center China Lake Calif
IN-FLIGHT MEASUREMENTS OF CAPTIVE LOADS ON A STORE AS COMPARED WITH WIND TUNNEL AND MATHEMATICAL SIMULATIONS Technical Publication, FY 1978 - FY 1977

A R Maddox R E Dix, and G R Mattasits Apr 1978 46 p refs
(WF32323202)
(AD-A060960 NWC-TP-6026) Avail NTIS HC A03/MF A01 CSCL 01/3

A series of flight tests were made to acquire captive loads data on a store to compare with corresponding data from several wind tunnel tests with conditions matched as closely as possible as well as with the best mathematical models available. The store consisted of a Mk 83 bomb shape mounted on a triple-ejector rack (TER) on an F-4 aircraft which was instrumented complete with a standard research boom mounted on the nose. The flight conditions spanned Mach 0.6 to 0.9 in both maneuvering and steady flight. The data show good correlation between flight test and wind tunnel for moderate subsonic Mach numbers when good geometric similarity is maintained but there is a pronounced divergence in this agreement as the Mach number is increased. Correlation between mathematical models of this problem and the flight test show the same magnitude in loads and moments but the trends do not always agree. This is most pronounced in the pitch plane. GRA

N79-16807# Boeing Vertol Co, Philadelphia Pa
INTERACTIONAL AERODYNAMICS OF THE SINGLE ROTOR HELICOPTER CONFIGURATION VOLUME 2-A HARMONIC ANALYSES OF AIRFRAME SURFACE PRESSURE DATA, RUNS 7-14, FORWARD SECTION Final Report, Mar 1977 - Feb 1978

Philip F Sheridan Sep 1978 266 p
(Contract DAAJ02-77-C-0020)
(AD-A061359, USARTL-TR-78-23B-Vol-2A) Avail NTIS HC A12/MF A01 CSCL 01/3

This is the first of the nine sub-volumes of Volume 2. These documents contain harmonic analyses of the waveforms generated by each of the 53 pressure transducers, which covered the surface of the model fuselage and empennage. This sub-volume covers the first eight of the twenty-seven runs devoted to surface pressure testing. The analyses encompass the transducers in the forward section of the model. Test conditions and configurations include baseline data, climb and descent, disk loading variation and application of strakes. Author (GRA)

N79-16808# Boeing Vertol Co Philadelphia Pa
INTERACTIONAL AERODYNAMICS OF THE SINGLE ROTOR HELICOPTER CONFIGURATION VOLUME 2-C HARMONIC ANALYSIS OF AIRFRAME SURFACE PRESSURE DATA, RUNS 7-14, AFT SECTION Final Report, Mar 1977 - Feb 1978

Philip F Sheridan Sep 1978 220 p
(Contract DAAJ02-77-C-0020)
(AD-A061360 USARTL-TR-78-23B-Vol-2C) Avail NTIS
HC A10/MF A01 CSCL 01/3

This is the third of the nine sub-volumes of Volume 2. These documents contain harmonic analyses of the waveforms generated by each of the 53 pressure transducers which covered the surface of the model fuselage and empennage. This sub-volume covers the first eight of the twenty-seven runs devoted to surface pressure testing. The analyses encompass the transducers in the aft section of the model. Test conditions and configurations include baseline data, climb and descent, disk loading variation, and application of strakes. Author (GRA)

N79-16809# Boeing Vertol Co., Philadelphia Pa
INTERACTIONAL AERODYNAMICS OF THE SINGLE ROTOR HELICOPTER CONFIGURATION VOLUME 2-D HARMONIC ANALYSES OF AIRFRAME SURFACE PRESSURE DATA, RUNS 15-22, FORWARD SECTION Final Report, 15 Mar 1977 - 13 Feb 1978

Philip F Sheridan Sep 1978 158 p
(Contract DAAJ02-77-C-0020)
(AD-A061079, USARTL-TR-78-23B-Vol-2D) Avail NTIS
HC A08/MF A01 CSCL 01/3

This is the fourth of the nine sub-volumes of Volume 2. These documents contain harmonic analyses of the waveforms generated by each of the 53 pressure transducers which covered the surface of the model fuselage and empennage. This sub-volume covers the second eight of the twenty-seven runs devoted to surface pressure testing. The analyses encompass the transducers in the forward section of the model. Test conditions and/or configurations include effects of root cut-out vortex generators and strakes, autorotation, and rotor height. Author (GRA)

N79-16810# Boeing Vertol Co., Philadelphia Pa
INTERACTIONAL AERODYNAMICS OF THE SINGLE ROTOR HELICOPTER CONFIGURATION VOLUME 2-F HARMONIC ANALYSES OF AIRFRAME SURFACE PRESSURE DATA, RUNS 15-22, AFT SECTION Final Report, 15 Mar 1977 - 13 Feb 1978

Philip F Sheridan Sep 1978 151 p
(Contract DAAJ02-77-C-0020)
(AD-A061080 USARTL-TR-78-23B-Vol-2F) Avail NTIS
HC A08/MF A01 CSCL 01/3

This is the sixth of the nine sub-volumes of Volume 2. These documents contain harmonic analyses of the waveforms generated by each of the 53 pressure transducers which covered the surface of the model fuselage and empennage. This sub-volume covers the second eight of the twenty-seven runs devoted to surface pressure testing. The analyses encompass the transducers in the aft section of the model. Test conditions and/or configurations include effects of root cut-out vortex generators and strakes, autorotation, and rotor height. Author (GRA)

N79-16811# Boeing Vertol Co., Philadelphia Pa
INTERACTIONAL AERODYNAMICS OF THE SINGLE ROTOR HELICOPTER CONFIGURATION VOLUME 2-G HARMONIC ANALYSES OF AIRFRAME SURFACE PRESSURE DATA, RUNS 23-33, FORWARD SECTION Final Report, Mar 1977 - Feb 1978

Philip F Sheridan Sep 1978 212 p
(Contract DAAF02-77-C-0020)
(AD-A061361 USARTL-TR-78-23B-Vol-2G) Avail NTIS
HC A10/MF A01 CSCL 01/3

This is the seventh of the nine sub-volumes of Volume 2. These documents contain harmonic analyses of the waveforms generated by each of the 53 pressure transducers which covered the surface of the model fuselage and empennage. This sub-volume covers the final eleven of the twenty-seven runs devoted to surface pressure testing. The analyses encompass the transducers in the forward section of the model. Test conditions here involve speeds from 20 knots to 160 knots in level flight. Author (GRA)

N79-16812# National Aerospace Lab., Amsterdam (Netherlands)
Flight Div
IN-FLIGHT MEASUREMENT OF AERODYNAMIC LOADS ON CAPTIVE STORES. DESCRIPTION OF THE MEASUREMENT

EQUIPMENT AND COMPARISON OF RESULTS WITH DATA FROM OTHER SOURCES

G J Alders 15 Jun 1978 34 p refs Presented at the 4th JTCG/MD Aircraft/Stores Compatibility Symp Fort Walton Beach La 12-14 Oct 1977
(NLR-MP-77028-U) Avail NTIS HC A03/MF A01

The limitations of wind tunnel measurements, panel method calculations, and calculations based on measured store separation trajectories as reliable aerodynamic interference data were investigated. An aerodynamic load measuring store was developed consisting of a support structure to be mounted from 14 to 30 inch bomb racks, a load measuring balance, and a shape representing the store to be analyzed. A flight test program was carried out with a store resembling a BLU 1/B, on an NF-5A aircraft in various configurations. The results are compared with wind tunnel data from various sources, panel method calculation results, and data obtained from in-flight separation tests. It is shown that in-flight measurement of aerodynamic loads allows a reduction in the number of flight tests required to demonstrate safe separation. J M S

N79-16813# Civil Aeromedical Inst., Oklahoma City Okla
CONSPICUITY ASSESSMENT OF SELECTED PROPELLER AND TAIL ROTOR PAINT SCHEMES

Kenneth W Welsh, John A Vaughn and Paul G Rasmussen
Aug 1978 25 p refs
(FAA-AM-78-29) Avail NTIS HC A02/MF A01

An investigation was conducted to rank the conspicuity of three paint schemes for airplane propellers and two schemes for tail rotor blades previously recommended by the U.S. military and British Civil Aviation Authority. Thirty volunteer subjects with normal vision viewed rotating propellers at 6.1 m and tail rotor blades at 9.1 m under bright sunlight conditions. Observations of the grouped airplanes and helicopters were made from three angles that included viewing upward from a crouched position, at eye level while standing, and downward from an elevated platform. At all viewing angles, the propeller design consisting of black and white stripes asymmetrically placed on opposing blades was judged most conspicuous by a wide margin. The red and white stripe design (symmetrically placed) was considered slightly more effective than the yellow tip design. Of two designs for tail rotors, the black and white asymmetrical stripe scheme was chosen more conspicuous than a red, white, and black stripe design. L S

N79-16814# Lockheed-California Co., Burbank
GENERAL AVIATION AIRPLANE STRUCTURAL CRASH-WORTHINESS PROGRAMMERS MANUAL Final Report, Nov 1977 - Dec 1978

W L Labarge Dec 1978 210 p refs
(Contract DOT-FA75WA-3707)
(FAA-RD-78-120 LR-23683) Avail NTIS HC A10/MF A01

One of a series of operational documents is presented for the KRASH digital computer program which predicts the structural response of vehicles to multidirectional crash environments. The manual is intended to facilitate bringing the program to an operational status on a user's computer system. Sections included are program KRASH system requirements, input data deck, and the demonstration problem. Material within each section can be expanded or revised as necessary without affecting the other sections. A R H

N79-16815# National Aviation Facilities Experimental Center
Atlantic City N J

TESTS OF CRASH-RESISTANT FUEL SYSTEM FOR GENERAL AVIATION AIRCRAFT Final Report, Feb 1976 - Jul 1978

William M Perrella Jr Dec 1978 38 p refs
(FAA Proj 184-521-100)
(FAA-RD-78-122, FAA-NA-78-48) Avail NTIS
HC A03/MF A01

A significant percentage of general aviation aircraft accidents result in postcrash fires due to the ignition of fuel spillage, often contributing injury or death to the aircraft occupants. Tests were conducted to demonstrate the performance of light-weight, flexible,

crash-resistant fuel cells combined with the use of frangible fuel line couplings. Four full-scale crash tests of a typical light twin aircraft were included in these tests. In three tests the crash-resistant fuel system performed satisfactorily. The fourth and final test, where the lightest weight tanks were used, resulted in tank failures and demonstrated a possible lower strength limit to the tank material. S E S

N79-16817# Lockheed-California Co. Burbank
DEVELOPMENT, EXPERIMENTAL VERIFICATION AND APPLICATION OF PROGRAM KRASH FOR GENERAL AVIATION AIRPLANE STRUCTURAL CRASH DYNAMICS Final Report, Nov 1977 - Dec 1978

Gil Wittlin Dec 1978 166 p refs
 (Contract DOT-FA75WA-3707)
 (LR-28682 FAA-RD-78-119) Avail NTIS HC A08/MF A01
 Results are presented for a three-task effort to develop experimentally verify and apply digital computer program KRASH to structure of general aviation airplanes subjected to a survivable crash environment. The Task 1 provided the essential results of the evaluation of occupant capacity, the evaluation of NTSB and CAMI accident data and an assessment of industry analytical requirements insofar as crash analysis is involved. The Task 2 presented the highlights of the full-scale test preparation, the crash test condition, the crash test results, the mathematical models used to represent the crash test condition, the correlation between analysis and test results and an overview description of the KRASH user's manual. The Task 3 effort included the parameter variation study and the application of program KRASH in the evaluation of structural design concepts during a survivable crash environment. J A M

N79-16819# Air Force Civil Engineering Center Tyndall AFB Fla

AN EVALUATION OF THE BIRD/AIRCRAFT STRIKE HAZARD AT DOVER AIR FORCE BASE, DELAWARE

Larry T Clark, Joseph Michael Laney and James S Kent Apr 1978 25 p refs
 (AD-A061297 AFCEC-M-1-78) Avail NTIS HC A02/MF A01 CSCL 01/2

The AFCEC Bird/Aircraft Strike Hazard (BASH) Team surveyed Dover AFB DE from 6 March to 17 March 1978. During this period operational procedures, vegetation, animal populations and habitats were studied. Special emphasis was given to bird hazards to aircraft. Specific recommendations for operational changes and habitat modifications aimed at reducing the BASH potential at DOVER AFB are discussed. Author (GRA)

N79-16820# Air Force Civil Engineering Center Tyndall AFB Fla

AN EVALUATION OF THE BIRD/AIRCRAFT STRIKE HAZARD (BASH) AT AREA C-62, EGLIN AFB, FL Final Report, 23 Mar 1977 - 30 Mar 1978

Michael J Harrison, Larry T Clark, Ernest R Godsey, William H Niemeier and Richard D Smedley Apr 1978 18 p refs
 (AD-A061371 AFCEC-M-3-78) Avail NTIS HC A02/MF A01 CSCL 01/2

The bird/aircraft strike hazard (BASH) at Eglin Bombing Range Test Area (TA) C-62 was surveyed periodically from 23 March 1977 to 30 March 1978. Turkey Vultures (*Cathartes aura*), Black Vultures (*Coragyps atratus*) and Cattle Egrets (*Bubulcus ibis*) were found to create the major bird hazard at TA C-62. Recommendations aimed at reducing the range bird strike potential are included in this report. Author (GRA)

N79-16821# National Aerospace Lab Tokyo (Japan)
THE IMPLEMENTATION AND APPLICATION OF A SENSOR INTERFACING UNIT FOR STRAPDOWN INERTIAL SYSTEMS

Kozo Homma, Masao Naka and Hiromichi Yamamoto Apr 1978 46 p refs. In JAPANESE ENGLISH summary
 (NAL-TR-532) Avail NTIS HC A03/MF A01

Design, fabrication and application of a sensor interfacing unit (SIF) that is a connection between an inertial measurement

unit and a guidance computer in strapdown inertial guidance systems are reported. The SIF takes pulse inputs from the inertial measurement unit, adds them up with counters during an update interval and sends a sequence of the counted values to the computer under the appropriate timing controls. It is designed and constructed as a laboratory type unit and has performed in evaluation tests. It was applied to a real time hybrid simulation experiment combined with a sensor package and a servo table or flight table for the study of strapdown inertial attitude reference computations. G G

N79-16822*# Old Dominion Univ Norfolk Va
COMPARATIVE STUDY OF FLARE CONTROL LAWS Progress Report, 15 Dec 1977 - 14 Dec 1978

A A Nadkarni (Old Dominion Univ Research Foundation) and W J Breedlove Jr Feb 1979 73 p refs
 (Grant NsG-1480)
 (NASA-CR-158114) Avail NTIS HC A04/MF A01 CSCL 17G

A digital 3-D automatic control law was developed to achieve an optimal transition of a B-737 aircraft between various initial glide slope conditions and the desired final touchdown condition. A discrete time-invariant optimal closed-loop control law presented for a linear regulator problem was extended to include a system being acted upon by a constant disturbance. Two forms of control laws were derived to solve this problem. One method utilized the feedback of integral states defined appropriately and augmented with the original system equations. The second method formulated the problem as a control variable constraint, and the control variables were augmented with the original system. The control variable constraint control law yielded a better performance compared to feedback control law for the integral states chosen. A R H

N79-16823# Lincoln Lab, Mass Inst of Tech, Lexington
AIRBORNE MEASUREMENTS OF ATRCBS FRUIT

William H Harman 3 Oct 1978 30 p refs
 (Contracts DOT-FA77WAI-727 F19628-78-C-0002 FAA Proj 052-241-04)
 (ATC-84 FAA-RD-77-149) Avail NTIS HC A03/MF A01

Air Traffic Control Radar Beacon System (ATCRBS) fruit is defined as an asynchronous reply from ATCRBS transponders. Airborne measurements were undertaken to provide a more firm basis for assessing the interference with an instrumented aircraft flying along the East Coast from Boston to Washington and in the Los Angeles Basin. The results of these measurements are reported with fruit-rates given as a function of altitude, geographical location and receiver threshold for receptions on both top-mounted and bottom-mounted aircraft antenna. The tightest observed fruit rates, approximately 10 000 replies/sec occurred on the LA Basin. To complement the measurements, a first-order fruit prediction model is defined. Predictions of this model are compared with the measurements, generally showing favorable agreement in absolute fruit rate in power distribution, and in the functional dependence on traffic density. S E S

N79-16824*# Analytical Mechanics Associates Inc, Hampton Va

DEVELOPMENT OF A DIGITAL GUIDANCE AND CONTROL LAW FOR STEEP APPROACH AUTOMATIC LANDINGS USING MODERN CONTROL TECHNIQUES Final Report

Nesim Halyo Feb 1979 72 p refs
 (Contract NAS1-14088)
 (NASA-CR-3074 AMA-NO-77-24) Avail NTIS HC A04/MF A01 CSCL 17G

The development of a digital automatic control law for a small jet transport to perform a steep final approach in automatic landings is reported along with the development of a steady-state Kalman filter used to provide smooth estimates to the control law. The control law performs the functions of localizer and glides capture, localizer and glideslope track, decrab and place. The control law uses the microwave landing system position data and aircraft body-mounted accelerators, attitude and attitude rate information. The results obtained from a digital simulation of the aircraft dynamics, wind conditions and sensor noises using the control law and filter developed are described. J M S

N79-16826# Systems Control Inc Palo Alto, Calif Champlain Technology Industries Div

IMPACT OF AREA NAVIGATION ON CONTROLLER PRODUCTIVITY AND ATC SYSTEM CAPACITY Final Report, Nov 1978 - Jan 1978

Eric H Bolz Jan 1978 187 p refs
(Contract DOT-FA72WA-3098)

(FAA-RD-78-51) Avail NTIS HC A09/MC A01

A detailed analysis is given of the impact of Area Navigation (RNAV) on ATC controller's tasks and the resulting productivity of control sectors and of the impact on airport and enroute system capacities. The results are expressed in terms of projected savings in ATC controller staff growth requirements (man-years and dollars), and in terms of savings in aircraft delays (aircraft time and fuel consumption, and dollars). The terminal area and enroute (high and low altitude) environments were considered separately. The analysis considered the time period from 1982 to 2000. The effects of other features of the Upgraded Third Generation ATC System on controller tasks and system capacity were considered directly in each analysis. All dollar results were computed as 1976 present value equivalents which were used to update a comprehensive RNAV benefit/cost analysis from an earlier report under this contract. LS

N79-16826# National Aviation Facilities Experimental Center, Atlantic City N J

TERMINAL AREA DELAY AND FUEL CONSUMPTION ANALYSIS Final Report, Aug 1977 - 1978

Arthur G Halverson and Gordon Jolitz Jan 1979 122 p refs
(FAA-EM-78-20 FAA-NA-78-40) Avail NTIS HC A06/MF A01

First-order estimates of delay and excess fuel consumption were derived through analysis of track data recorded online by the advanced radar terminal system (ARTS 3) during the 1974-1975 time period from the Chicago Miami Los Angeles and Washington terminal areas. Results show that the use of ARTS track data is an effective approach provided appropriate processing and manual review of the data are effected. Of the four terminal areas studied only the data from the Chicago O'Hare airport (ORD) were sufficiently representative of delay-producing conditions to warrant credible estimates of annual delay costs. The average delay for 635 arrival tracks in the ORD data was approximately 10 minutes with an estimated excess fuel consumption of approximately 1,055 pounds (157 gallons) per track. Simple extension of these data to an annual basis yields delay and excess fuel consumption in the order of 2.5 million minutes and 40 million gallons, respectively. ARH

N79-16827# National Aviation Facilities Experimental Center, Atlantic City N J

AIR TRAFFIC CONTROL IN THE YEAR 2000 Final Report

Joseph M DelBlazo Nov 1977 20 p Presented at the 22d Ann Meeting of the Air Traffic Control Assoc on Tomorrow's NAS Concepts and Requirements in Light of the Realities of Today Las Vegas Nev 10-13 Oct 1977
(FAA Proj 975-001-01A)

(FAA-NA-78-4, NA-78-4) Avail NTIS HC A02/MF A01

Data entry and display technology, cockpit display of traffic information, terminal area guidance and mass weather dissemination techniques are reviewed. Alternate energy sources are discussed along with data link applications and remote maintenance monitoring system. Several unanswered questions on operational philosophy of the air traffic control system in the year 2000 are also considered. JAM

N79-16828# Kaman Aerospace Corp Bloomfield Conn
DESIGN AND DEMONSTRATION OF A SYSTEM FOR ROUTINE, BOOMLESS SUPERSONIC FLIGHTS Final Report

Richmond Perley Apr 1977 283 p refs
(Contract DOT-FA74WA-3363)

(FAA-RD-77-72, R-1505) Avail NTIS HC A13/MF A01

A design for incorporating the concepts of boomless supersonic flight into air carrier operations using currently

disseminated weather data was developed. These design concepts were used to support the planning and execution of eight supersonic flights. The average ground speed of these flights was 200 mph faster than would have been achieved at Mach 8 and none of them produced a sonic boom on the surface. The criteria for boomless supersonic flight based on weather conditions were extended to use winds with respect to the desired ground track rather than winds with respect to the aircraft heading, thus simplifying the calculation procedure. The justification for neglecting weather conditions between the aircraft and the surface was developed on the basis of a five-year history of climatological data. These data also show that these concepts can provide an increase in average ground speeds of 43% in the summer and 31% in the winter when practical constraints on maximum subsonic and minimum supersonic speeds and data errors are considered. Author

N79-16829# National Aviation Facilities Experimental Center Atlantic City, N J

TEST EVALUATION OF PHASE III BENDIX BASIC NARROW AND SMALL COMMUNITY TIME REFERENCE SCANNING BEAM MICROWAVE LANDING SYSTEM Final Report, Sep 1976 - Sep 1977

Clifford W Mackin Nov 1978 103 p
(FAA Proj 045-390-100)

(FAA-RD-78-127 FAA-NA-78-29) Avail NTIS HC A06/MF A01

Two models of the Time Reference Scanning Beam Microwave Landing System (MLS), the Basic Narrow and Small Community systems were examined. Functional requirements and compliance with contractual specifications were considered. SES

N79-16830# Federal Aviation Administration Washington D C Office of Systems Engineering Management

FAA BCAS CONCEPT, APPENDICES A-E

E J Koenke Apr 1978 465 p refs
(FAA-EM-78-5-3-A) Avail NTIS HC A20/MF A01

Radio frequency garble on 1090 MHz is analysed. Techniques are presented which are thought to be effective in reducing the active and passive garble in radio systems. LS

N79-16831# Federal Aviation Administration Washington D C Office of Systems Engineering Management

FAA BCAS CONCEPT, APPENDICES F-M

E J Koenke et al Apr 1978 316 p refs
(FAA-EM-78-5-3-B) Avail NTIS HC A14/MF A01

An airborne aircraft collision avoidance system concept is presented which assures adequate separation from the largest possible percentage of potential collision threats. The concept operates in all airspace as a compatible backup to the present and evolving ATC system and is acceptable to the pilot and the user community. The system concept capitalizes on the aviation community's large existing investment in ATRCBS transponders and on the ground based beacon surveillance system network for the basic sources of the collision avoidance information. LS

N79-16832# Federal Aviation Administration Washington D C System Research and Development Service

ENGINEERING AND DEVELOPMENT PROGRAM PLAN TERMINAL/TOWER CONTROL

Nov 1978 93 p
(FAA-ED-14-2A) Avail NTIS HC A05/MF A01

The engineering and development plan for FAA E&D Program 14 TERMINAL/TOWER CONTROL is documented. The relationship of Program 14 to the overall E&D effort, the purpose, scope and direction of the program and the major technical elements of the program are presented. The plan is intended to provide guidance to personnel charged with carrying out development activities under Program 14 and to provide a tool for the continuing management and control of these activities. The funds estimates required and for seeking approval of budgets are determined. SES

N79-16833# Ohio Univ Athens Avionics Engineering Center

CAPTURE-EFFECT AND SIDEBAND-REFERENCE GLIDE-

SLOPE PERFORMANCE IN THE PRESENCE OF DEEP SNOW 1977-1978 Final Report, 8 Feb 1977 - 8 Aug 1978

Kent Chamberlin Jul 1978 35 p refs
(Contract DOT-FA77WA-3941)
(EER-36-1 FAA-R-6750-1) Avail NTIS HC A03/MF A01

Results of capture effect and sideband reference glide slope system response to up to 21 inches of snow in the reflecting zone are presented. These results show that the capture effect path angle increases at 0.08 deg per foot of snow and the sideband reference path angle increases at 0.30 deg per foot of snow. No significant degradation in path clearance or width was observed. Data were also collected on near field and integral monitors performance and static path angle values at runway threshold. J A M

**N79-16834# INCOSYM Inc, Calabasa Calif
FAILURE MODES AND REDUNDANCY ANALYSIS FOR THE MULTIFUNCTION INERTIAL REFERENCE ASSEMBLY (MIRA) Final Report, 3 Jan - 22 Dec 1977**

R J Craig and J Russell Mar 1978 149 p refs
(Contract F33615-77-C-3015)
(AD-A061449, AFFDL-TR-78-25) Avail NTIS
HC A07/MF A01 CSCL 17/7

This report analyzes potential failure modes for various gyroscope and accelerometer designs and their associated electronics and considers the most appropriate mechanizations to accomplish a fail-operational/fail-operational Inertial Reference Assembly. Author (GRA)

N79-16835# National Aerospace Lab Amsterdam (Netherlands) Scientific Services**A METHOD TO DETERMINE THE DELAYS OF LANDING AIRCRAFT WITH RESPECT TO RUNWAY CAPACITY**

M vanderWilt 15 Jun 1978 8 p refs Presented at Simulation 77 Montreux Switz 22-24 Jun 1977
(NLR-MP-77016-U) Avail NTIS HC A02/MF A01

An analytic queuing model characterized by a Poisson arrival process and by a deterministic service time is developed to give accurate estimates of aircraft landing delays. The result is confirmed with the results of the Monte Carlo simulation. The Monte Carlo simulation is used to model those aspects which cannot be accounted for in an analytic method. The model for the Monte Carlo simulations is described. S E S

**N79-16837# Oklahoma Univ Norman School of Aerospace Mechanical and Nuclear Engineering
ASSESSMENT OF NEW TECHNOLOGIES FOR GENERAL AVIATION AIRCRAFT Final Report**

Karl H Bergey Sep 1978 90 p refs
(Contract W1-78-5504-1)
(GARC-4 FAA-RD-78-132) Avail NTIS HC A05/MF A01

The potential for a technology demonstration program aimed specifically at the needs of general aviation was studied. It concluded that at least 46 new or under-used technologies could be incorporated in general aviation aircraft with benefit to safety, performance and cost. The rate at which these new technologies might be integrated into the fleet will depend on social and political trends as well as on the technologies themselves. This report identifies 22 trends that will influence general aviation development. J A M

**N79-16838# Systems Technology, Inc Hawthorne, Calif
A STUDY OF THE EFFECTS OF AIRCRAFT DYNAMIC CHARACTERISTICS ON STRUCTURAL LOADS CRITERIA Final Report, Jan 1977 - Nov 1978**

Robert L Stapleford and Richard J DiMarco Nov 1978 245 p refs
(Contract DOT-FA77WA-3936)
(STI-TR-1099-1 FAA-RD-78-155) Avail NTIS
HC A11/MF A01

An analysis of in-flight airframe failure accidents which occurred during a ten-year period 1966-1975 is included. A number of potentially contributing factors including stability and control characteristics and handling qualities are examined and correlated with the accident data. The study also covers a review of proposed criteria for continuous gusts and a comparison

with existing discrete gust criteria. Problems in the selection of a turbulence penetration speed are also examined. G Y

**N79-16839*# Lockheed-California Co Burbank
CONFIGURATION DEVELOPMENT STUDY OF THE X-24C HYPERSONIC RESEARCH AIRPLANE, PHASE 2 Technical Report, Apr - May 1976**

Henry G Combs et al Jan 1977 94 p refs
(Contract NAS1-14222)
(NASA-CR-145074 SP-4534) Avail NTIS HC A05/MF A01
CSCL 01C

The X-24C Hypersonic Research Vehicle configured with a heat-sink structure a launch mass limit of 31.75 Mg and powered by an LR-105 Rocket Engine plus 12 LR-101 Sustainer Engines was found to be the more cost effective of the candidate configurations. In addition the configuration provides the maximum off design growth potential capability and subsequently, was selected as the candidate configuration to be subjected to the design refinement study in the remaining segment of the study. Selection of this configuration was based on the analytical study conducted on the performance growth capabilities of the candidate configurations selected from the Phase 1 Study. G Y

**N79-16840*# Lockheed-California Co Burbank
CONFIGURATION DEVELOPMENT STUDY OF THE X-24C HYPERSONIC RESEARCH AIRPLANE, PHASE 3 Final Report, May - Aug 1976**

Henry G Combs et al Jan 1977 139 p refs
(Contract NAS1-14222)
(NASA-CR-145103) Avail NTIS HC A07/MF A01 CSCL
01C

The conclusion evolved from the three phased study on the configuration development of the X-24C Hypersonic Research Airplane makes it evident that it is practical to design and build the high performance National Hypersonic Flight Research Facility airplane with today's state of the art within the cost and operational constraints established by NASA. The vehicle launched at 31.75 Mg from the B-52 can cruise for 40 seconds at Mach 6.78 on scramjets. Without scramjets it can approach Mach 8 with a 453.6 Kg payload or do 70 seconds of cruise at Mach 6 with a 2.27 Mg payload. Reduction in cost is possible with a vehicle scaled to a lesser mass and capability. G Y

**N79-16841# Naval Postgraduate School Monterey Calif
THE DEVELOPMENT AND IMPLEMENTATION OF ALGORITHMS FOR AN A-7E PERFORMANCE CALCULATOR M S Thesis**

Gary Lang Koger Sep 1978 158 p refs
(AD-A061344) Avail NTIS HC A08/MF A01 CSCL 09/2

In this thesis the algorithms for an A-7E performance calculator were developed and then implemented on three small data processors of different programming levels and storage capabilities. The utility of data is a function of several variables including accuracy and availability. Nine performance chart groups yielding the data usually considered necessary for flight, were reduced to a series of analytical expressions. These analytical expressions were demonstrated to reproduce NATOPS Manual data to a high degree of accuracy. Implementation was demonstrated on a deck computer, a hand held calculator and a microprocessor. GRA

**N79-16843# General Dynamics/Convair San Diego Calif
THE AERODYNAMIC AND THERMODYNAMIC CHARACTERISTICS OF FOUNTAINS AND SOME FAR FIELD TEMPERATURE DISTRIBUTIONS Technical Report, 1 May 1976 - 30 Jun 1978**

Aadu Karemaa, Charles W Smith, Hank A Weber and Jacke Garner Aug 1978 201 p refs
(Contract N00014-76-C-0698)
(AD-A061335 CASD-NSC-78-001 ONR-CR212-237-1F) Avail
NTIS HC A10/MF A01 CSCL 01/3

This document addresses the flow fields about and below a multi-nozzle VTOL vehicle hovering in the presence of ground. Three specific topics are covered: far field temperature distributions and the thermodynamic and aerodynamic characteristics of the fountain segment of the near field. An extensive amount of test data was obtained in all three areas and analyzed in

order to model the key aspects of this flow field and to permit the development of methodology for the prediction of fountain induced forces and flow field temperature distributions GRA

N79-16844# Vought Corp Advanced Technology Center Inc Dallas Tex
ANALYSIS OF NOISE IN US ARMY AIRCRAFT Final Report, Jul 1976 - Mar 1978

Austin J Brown and Richard A Ely Nov 1978 242 p refs (Contract DAAB07-76-C-1746)
(AD-A061351 ATC-94100/BCR-41
USAAVRADCOM-TR-76-1746-F) Avail NTIS
HC A11/MF A01 CSCL 01/3

Tape recordings were made of acoustical and electrical noise in the crew compartments and on the interphone lines of 7 models of US Army aircraft during flight operations. The data were analyzed to determine noise and speech levels in the communication channel, especially at crew members ears. Calculations were then performed to estimate hearing damage risk and estimate the intelligibility of speech. The purpose of the project was to identify harmful noise levels and sources in the communication channel and to make recommendations for reducing such noise. At frequencies below about 1000 Hz, noise in the communication channel is due primarily to ambient noise which enters the circumaural earcup through leaks between the cushion and the head. Above 1000 Hz the noise in the channel is due primarily to ambient noise which is picked up by the microphone and transmitted to the earphone. The hearing damage risk calculations show that less than 1% of air crewmen would suffer more than a 10 dB hearing loss at speech frequencies after 10 years of flight duty. This is based on 4 hours per day of flight. Typical inter- and intra- aircraft speech intelligibilities were predicted to be greater than 95% GRA

N79-16845# Aeronautical Research Inst of Sweden Stockholm Aerodynamics Dept

TEMPERATURE MEASUREMENTS ON THE VICKERS VISCOUS STABILIZER IN FLIGHT UNDER ICING CONDITIONS

Arlid Bertelrud Aug 1977 35 p refs Sponsored by Bromma Accident 1977-01-15 Investigating Comm
(FFAP-A-396) Avail NTIS HC A03/MF A01

Sensors were mounted on the inner and outer leading and suction edges of the stabilizer to acquire and record the magnitude and variations of skin temperature. A 6-channel amplifier was used to obtain the desired gain and level for the various sensors. The 6-channel paper trace was on during the entire flight which was conducted to study both heating/cooling of an anti-icing system, as well as its steady state characteristics. The most important conclusions that can be drawn are that the temperature drop between the tail duct and the stabilizer leading edge is very large and the heat loss from the stabilizer is so large that the heat is gone within seconds after the systems are switched off. Test results are included. A R H

N79-16846# Vought Corp, Dallas Tex
STANDARD AVIONIC MODULE STUDY Final Technical Report, 11 Oct 1977 - 1 Mar 1978

D B McBrayer G R Courtney and A R Tomme Mar 1978 183 p refs
(Contract N00123-77-C-0094)
(AD-A061349) Avail NTIS HC A09/MF A01 CSCL 09/5

This report covers the Standard Avionic Module (SAM) study performed by Vought Corporation under Contract N00123-77-C-0094 Work Assignment 0008 for the Naval Weapons Center. The purpose of this study was to propose the characteristics of a standard module based upon the data and conclusions of previous Navy studies. The proposed module should satisfy the greatest majority of requirements enumerated in the final reports for those studies. The data base and reference reports were reviewed to determine those factors which significantly affect the selected size of a standard module. Each of these factors were analyzed based upon a compilation of data from the reports and conclusions reached on each individual factor. These factors in each area are Functional Commonality Connector Integrated Circuit Packaging Technology Weight and Volume Constraints Thermal Considerations Built-In-Test and Reliability GRA

N79-16847# National Aerospace Lab Amsterdam (Netherlands) Scientific Services

A COMPUTER-CONTROLLED AVIONICS-DATA ACQUISITION SYSTEM

F J Abbink 10 Mar 1978 32 p refs Presented at the 2d Biennial Air Data Systems Conf Colorado Springs 1-5 May 1978

(NLR-MP-78004-U) Avail NTIS HC A03/MF A01

An airborne data acquisition system around an airborne computer was realized. A standard interface unit was developed for interfacing the computer with various different sensor systems. All parts of a computer-controlled avionics data acquisition system (CADAS) were installed in standard instrumentation racks to enable full system integration and testing in the laboratory for each individual project. Two CADAS applications are discussed. The first application was the prototype evaluation of a multi-DME position reference system for the calibration of radio navigation aids and radars. The second application was the evaluation of a measurement method of the aircraft performance during a dynamic maneuver. J A M

N79-16849# National Aeronautics and Space Administration Lewis Research Center, Cleveland Ohio

NEW OPPORTUNITIES FOR FUTURE SMALL CIVIL TURBINE ENGINES OVERVIEWING THE GATE STUDIES

William C Strack 1979 36 p Proposed for presentation at the Business and Aircraft Meeting, Wichita Kans 3-6 Apr 1979, sponsored by Soc of Automotive Engineers, Inc

(NASA-TM-79073 E-9890) Avail NTIS HC A03/MF A01 CSCL 21E

An overview of four independent studies forecasts the potential impact of advanced technology turbine engines in the post 1988 market, identifies important aircraft and missions desirable engine sizes, engine performance and cost goals. Parametric evaluations of various engine cycles, configurations, design features and advanced technology elements defined baseline conceptual engines for each of the important missions identified by the market analysis. Both fixed-wing and helicopter aircraft, and turboshaft, turboprop and turbofan engines were considered. Sizable performance gains (e.g. 20% SFC decrease) and large engine cost reductions of sufficient magnitude are predicted to challenge the reciprocating engine in the 300-500 SHP class. G G

N79-16850# Pratt and Whitney Aircraft East Hartford, Conn
ENERGY EFFICIENT ENGINE PROPULSION SYSTEM-AIRCRAFT INTEGRATION EVALUATION Topical Report, Mar 1978 - Sep 1978

R E Owens Mar 1979 311 p refs
(Contract NAS3-20646)
(NASA-CR-159488, PWA-5594-48) Avail NTIS
HC A14/MF A01 CSCL 21E

Flight performance and operating economics of future commercial transports utilizing the energy efficient engine were assessed as well as the probability of meeting NASA's goals for TSFC, DOC, noise, and emissions. Results of the initial propulsion systems aircraft integration evaluation presented include estimates of engine performance, predictions of fuel burns, operating costs of the flight propulsion system installed in seven selected advanced study commercial transports, estimates of noise and emissions, considerations of thrust growth, and the achievement-probability analysis. A R H

N79-16851# Pennsylvania State Univ University Park
THE ANALYSIS OF PROPELLERS INCLUDING INTERACTION EFFECTS

B W McCormick 1979 38 p refs Proposed for presentation at the SAE Business Aircraft Meeting, Wichita, Kans, 3-6 Apr 1979

(Grant NsG-1308)
(NASA-CR-158111) Avail NTIS HC A03/FM A01 CSCL 02A

Analytical and experimental studies were undertaken on propellers operating in the unsteady flow field produced by interaction effects due to the fuselage wing and nacelles. Methods were developed and verified experimentally for determining the

velocity field in which a propeller operates as well as its aerodynamic and dynamic response to this unsteady environment. Methods are presented for predicting and net thrust of a propeller-wing-body combination as well as the unsteady thrust and torque acting on the propeller. Sample calculations as well as wind tunnel and flight test results are presented which illustrate the sensitivity of a propeller to the flow field in which it is operating. JMS

N79-16852*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
EFFECT OF CASING TREATMENT ON PERFORMANCE OF A TWO-STAGE HIGH-PRESSURE-RATIO FAN
 Donald C Urasek Feb 1979 68 p refs
 (NASA-TP-1409 E-8997) Avail NTIS HC A04/MF A01 CSCL 21E

A two-stage fan previously tested with a solid casing was tested with a casing with circumferential grooves over the tips of both rotors (casing treatment). Tests were conducted at 80 and 100 percent of design speed with uniform flow. The casing treatment improved the flow range and stall margin significantly without changing the characteristics overall performance curves of total-pressure and efficiency as functions of weight flow other than extending them to lower weight flows. Author

N79-16853*# United Technologies Research Center East Hartford Conn
STUDY OF MEAN- AND TURBULENT-VELOCITY FIELDS IN A LARGE-SCALE TURBINE-VANE PASSAGE Final Report
 Douglas A Bailey Feb 1979 123 p refs
 (Contract NAS3-19752)
 (NASA-CR-3067) Avail NTIS HC A06/MF A01 CSCL 21E

Laser-Doppler velocimetry and to a lesser extent hot-wire anemometry were employed to measure three components of the mean velocity and the six turbulent stresses at four planes within the turbine inlet-guide-vane passage. One variation in the turbulent inlet boundary layer thickness and one variation in the blade aspect ratio (span/axial chord) were studied. A longitudinal vortex (passage vortex) was clearly identified in the exit plane of the passage for the three test cases. The maximum turbulence intensities within the longitudinal vortex were found to be on the order of 2 to 4 percent with large regions appearing nonturbulent. Because a turbulent wall boundary layer was the source of vorticity that produced the passage vortex, these low turbulence levels were not anticipated. For the three test cases studied, the lateral velocity field extended significantly beyond the region of the longitudinal velocity defect. Changing the inlet boundary layer thickness produced a difference in the location, the strength, and the extent of the passage vortex. Changing the aspect ratio of the blade passage had a measurable but less significant effect. The experiment was performed in a 210 mm pitch, 272 mm axial chord model in low speed wind tunnel at an inlet Mach number of 0.07. ARH

N79-16854# General Motors Corp., Indianapolis, Ind Detroit Diesel Allison Div
EXPLORATORY DEVELOPMENT OF AN OVERHAUL COATING PROCESS FOR GAS TURBINE PROPONENTS Final Technical Report, May 1978 - Mar 1978
 Q O Shockley, J O Hodshire, and T Pacala Jun 1978 136 p
 (Contract F33615-76-C-5130 AF Proj 7312)
 (AD-A061270, DDA-EDR-9460, AFML-TR-78-84) Avail NTIS HC A07/MF A01 CSCL 11/3

The purpose of this program was to demonstrate the feasibility of a single diffusion coating process which may be used for re-application of aluminate protective coatings to various superalloy turbine components during overhaul of Air Force aircraft gas turbine engines. The electrophoretic coating process developed by Detroit Diesel Allison Division General Motors Corporation was chosen as the program coating procedure for the five task development effort. An Al-Cr-Mn coating, identified as AEP 32, was successfully applied to four program alloys, C1023 B1900, Rene 80 and Alloy 713C. In addition, a comprehensive test program was conducted to comparatively evaluate the environmental performance and mechanical properties of the program

alloys coated with AEP 32 and their respective production coatings. The AEP 32 coating on all alloys demonstrated excellent environmental performance without degradation of mechanical properties as compared to production coatings. A chemical stripping procedure was developed for removing the service coatings without significant substrate attack. A variety of engine components were stripped and recoated as demonstration parts. In addition, documentation for recoating overhaul turbine components is given. Author (GRA)

N79-16855# Florida Univ Gainesville Dept of Environmental Engineering Sciences
THE FEASIBILITY OF CONTROLLING TURBINE ENGINE TEST CELL PARTICULATE EMISSIONS WITH A BAGHOUSE Final Report, Sep 1977 - Mar 1978
 John R Geiger and Peter S Daley Sep 1978 79 p refs
 (Contract F08637-78-M-0252)
 (AD-A061120L CEEDO-TR-78-24) Avail NTIS HC A05/MF A01 CSCL 21/5

Air pollution regulations dictate that the Department of Defense attempt to control visible emissions emitted from turbine engine test cells. Previous studies have summarily dismissed baghouses as a control device because of potential size, pressure drop, explosion and fire hazard, and excessive cost. This report addresses these problems in the design of a baghouse for controlling emissions from a TF30-P100 engine. GRA

N79-16856# AiResearch Mfg Co Phoenix Ariz
SMALL LAMINATED AXIAL TURBINE HOT-RIG TEST PROGRAM Interim Report, 15 Sep 1978 - 28 Feb 1978
 R W Vershure, Jr and J C Mays Jul 1978 74 p refs
 (Contract F33615-76-C-2176)
 (AD-A061062, AiResearch-21-2878 AFAPL-TR-78-47) Avail NTIS HC A04/MF A01 CSCL 21/5

In September 1976, AiResearch Manufacturing Company of Arizona initiated a program for the United States Air Force Aero Propulsion Laboratory to hot-rig test TFE731-3 Axial Laminated Turbine Rotors and verify their heat-transfer performance and mechanical integrity. The testing was to be conducted in the AiResearch High Temperature Turbine Test Facility, and three major tests were planned - a heat-transfer performance test, an accelerated stress-rupture test, and a thermal cyclic test. This interim report describes the progress to date on the Hot-Rig Program just prior to the redirection in accordance with contract modification P00003. This redirection concludes the Hot-Rig activities. The redirected test program will test one of the laminated turbine wheels directly in the Model 1131-1 Advanced Gas Generator. Also, a small laminated axial turbine rotor suitable for cruise missile application will be designed during this program. Author (GRA)

N79-16857# Air Force Aero Propulsion Lab Wright-Patterson AFB Ohio
OPERATING AND PERFORMANCE CHARACTERISTICS OF A DUCT BURNING TURBOFAN ENGINE WITH VARIABLE AREA TURBINES Final Report, 1 Jan 1977 - 1 Mar 1978
 Edward K Norvaisis May 1978 52 p refs
 (AD-A061026 AFAPL-TR-78-29) Avail NTIS A04/MF A01 CSCL 21/5

Several variable geometry/variable cycle concepts for aircraft gas turbine engines are being investigated by the industry in search for new propulsion systems with potential operating and performance benefits over conventional engines. This paper describes some of the operating and performance characteristics of one such concept in a fighter application - a separate flow duct burning turbofan with variable area turbines. An existing cycle performance and component matching simulation of a fixed turbine turbofan was extensively modified to incorporate the variable geometry. Data was generated for a representative fighter type cycle at several important flight conditions. Comparison was made to the fixed turbine version of the cycle. Installation drags were not calculated. Author (GRA)

N79-16858# Scott Environmental Technology Inc Plumsteadville Pa
AIR FORCE TURBINE ENGINE EMISSION SURVEY

**UNITED STATES VOLUME 1 TEST SUMMARIES
Final Report, Jan 1975 - Jun 1978**

Anthony F Souza and Peter S Daley (Civil and Environ Eng Develop Office) Aug 1978 195 p refs
(Contract F29601-75-C-0046)
(AD-A061532 SET-1492-50-0877-Vol-1
CEEDO-TR-78-34-Vol-1) Avail NTIS HC A09/MF A01 CSCL 21/5

The gaseous exhaust emissions from 14 military gas turbine engines were measured at various power levels from idle to full power including afterburning SAE smoke number was determined All measurements were made using the Air Force Mobile Emissions Laboratory which is a self-contained state-of-the-art gas turbine emissions test laboratory Emission rates of hydrocarbons carbon monoxide and oxides of nitrogen were calculated The emission rate of sulfur oxides was estimated from fuel analyses The body of data was analyzed to show relationships among the data These studies included the effect of power setting on emission index and smoke number variation of gas concentrations across the exhaust plume and the degree of uncertainty introduced by abbreviated sampling methods A summary table of Best Estimate emission factors for all the engines tested is provided

Author (GRA)

N79-16869# Scott Environmental Technology Inc Plumsteadville Pa

**US AIR FORCE TURBINE ENGINE EMISSION SURVEY
VOLUME 3 ENGINE MODEL SUMMARIES Final Report,
Jan 1975 - Jun 1978**

Anthony F Souza and Peter S Daley (Civil and Environ Eng Develop Office) Aug 1978 96 p
(Contract F29601-75-C-0046)
(AD-A061483 CEEDO-TR-78-34) Avail NTIS
HC A05/MF A01 CSCL 21/5

The gaseous exhaust emissions from 14 military gas turbine engines were measured at various power levels from idle to full power including afterburning SAE smoke number was determined The body of data was analyzed to show relationships among the data These studies included the effect of power setting on emission index and smoke number variation of gas concentrations across the exhaust plume and the degree of uncertainty introduced by abbreviated sampling methods A summary table of Best Estimate emission factors for all the engines tested is provided

GRA

N79-16860# National Aerospace Lab Amsterdam (Netherlands)
Structures and Materials Div

**TESTING OF COATINGS AND MATERIALS FOR JET
ENGINE COMPONENTS IN SIMULATED OPERATIONAL
ENVIRONMENTS**

W J vanderVet Dec 1977 18 p refs Presented at the NACE Corrosion Conf Houston Tex Mar 1978
(NLR-MP-78001-U) Avail NTIS HC A02/MF A01

Military aircraft flying low level missions in Western Europe encountered very different environment from that in most of the United States Industrial pollution caused atmospheric moisture to be highly acid and the corrosion rate of jet engine components was greatly increased with consequent high maintenance costs To help combat this problem special tests rigs for testing jet engine materials and coatings under simulated environmental conditions were built These test rigs and some results are discussed

J A M

N79-16861# Aeronautical Research Associates of Princeton Inc N J

**GUST RESPONSE ANALYSES FOR TEN GENERAL AVIA-
TION AIRCRAFT USING A TWO-DEGREE-OF-FREEDOM
POWER SPECTRAL TECHNIQUE Final Report, Apr 1977 -
Apr 1978**

Guy G Williamson Oct 1978 153 p refs
(ARAP-344 FAA-RD-78-117) Avail NTIS HC A08/MF A01

A power spectral technique for estimating gust loads on aircraft is presented The technique used employs two-degree-of-freedom models of the longitudinal and lateral aircraft motions due to atmospheric turbulence The results of this technique are compared with those obtained using Peele's method and simpler

one-degree-of-freedom models The primary conclusion is that this new method would be a useful design tool for the small aircraft manufacturer with access to a digital computer SES

N79-16862# Massachusetts Inst of Tech, Cambridge
**GUST RESPONSE AND ITS ALLEVIATION FOR A HINGE-
LESS HELICOPTER ROTOR IN CRUISING FLIGHT
Final Report**

Masahiro Yasue Sep 1978 182 p refs
(Contracts N00019-76-C-0278 N00019-77-C-0535)
(AD-A061134 ASRL-TR-189-1) Avail NTIS
HC A09/MF A01 CSCL 01/3

The vertical gust response and its alleviation for hingeless helicopter rotor blades in cruising flight is studied theoretically and experimentally An evaluation is performed of the effectiveness of torsional stiffness variation in conjunction with chordwise center-of-gravity shift in alleviating the blade flapping response to decrease the root bending moment The theoretical analysis utilizes the equations of motion of hingeless rotor blades exposed to vertical gusts in forward flight for the flapping lagging and elastic and rigid pitch degrees of freedom The equations include the effect of steady-state deflections in the trim conditions and various hingeless rotor configurations such as precone droop and torque offset as well as chordwise center-of-gravity shift and aerodynamic center offset The experimental program involves the wind tunnel tests of a five-foot diameter rotor subject to a sinusoidal waveform gust Testing involves variation of the blade chordwise center-of-gravity location the blade torsional stiffness rotor advance ratio and vertical gust frequency

Author (GRA)

N79-16863# Grumman Aerospace Corp Bethpage NY
**HYPOSH (HYDRAULIC POWER SHARING SYSTEM) Final
Engineering Report, 25 Jul - 25 Aug 1978**

Paul F Marino 23 Oct 1978 30 p
(Contract N62269-78-M-8416 WF41400000)
(AD-A061408 NADC-78089-60) Avail NTIS
HC A03/MF A01 CSCL 13/7

A one month test program was conducted to investigate the surface response rates of the flight control and combined hydraulic systems utilizing the power sharing concept The basis for this testing was to establish the feasibility of using power sharing valves to reduce flight control and combined systems pump output requirements The F-14 simulator was used to evaluate the performance of the power sharing valves The test results provided verification that by utilizing the HYPOSH (Hydraulic Power Sharing) concept stabilizer surface rates produced during 100% pump output can be achieved at 50% pump output Recommendations are made for improvement of the valve design and for the flight testing of a prototype power sharing valve with a destroyed F-14 pump (1/2 output) performing several missions to demonstrate satisfactory system performance

Author (GRA)

N79-16864# Advisory Group for Aerospace Research and Development Neuilly-Sur-Seine (France)

ACTIVE CONTROLS IN AIRCRAFT DESIGN

Peter R Kurzhals ed Nov 1978 176 p refs Prepared in cooperation with NASA Washington D C
(AGARD-AG-234, ISBN-92-835-0225-6) Avail NTIS
HC A09/MF A01

Related control-configured vehicle design and system considerations are considered Representative applications of active control for fighter and transport aircraft are included

N79-16865# National Aeronautics and Space Administration
Ames Research Center, Moffett Field Calif

**ACTIVE CONTROLS IN AIRCRAFT DESIGN EXECUTIVE
SUMMARY**

Peter R Kurzhals In AGARD Active Controls in Aircraft Design
Nov 1978 4 p Presented at the FMP Symp on Stability and Control, Ottawa Oct 1978

Avail NTIS HC A09/MF A01

Control-configured vehicle design and system considerations are discussed. Representative applications of active control for fighter and transport aircraft are summarized. J M S

N79-16866# Service Technique de l'Aeronautique Paris (France)
CONTROL CONFIGURED VEHICLE DESIGN PHILOSOPHY
 Jean-Michel Duc /n AGARD Active Controls in Aircraft Design
 Nov 1978 6 p
 Avail NTIS HC A09/MF A01

Evolution of the control configured vehicle (CCV) is reviewed. Functions of the CCV discussed include augmented stability, increased maneuverability, turbulence alleviation, reduction of static loads and flutter suppression. J M S

N79-16867# Douglas Aircraft Co Inc Long Beach Calif
ACTIVE-CONTROL DESIGN CRITERIA
 Robert B Harris and William W Rickard /n AGARD Active Controls in Aircraft Design Nov 1978 13 p refs

Avail NTIS HC A09/MF A01

The definition and background of active control technology are discussed along with the functions contemplated to be performed by active control systems. The various design criteria for each are included and the subject of government regulations affecting aircraft design is covered. J M S

N79-16868# British Aircraft Corp Preston (England) Military Aircraft Div
CONTROL-CONFIGURED COMBAT AIRCRAFT
 B R A Burns /n AGARD Active Control in Aircraft Design
 Nov 1978 17 p refs

Avail NTIS HC A09/MF A01

The effects of Active Controls Technology on combat aircraft in terms of weight reduction, achieved performance and handling improvements are reviewed. It is shown that very significant improvements in performance can be achieved with artificial longitudinal stability coupled with automatic operation of combat flaps. The adoption of spin prevention and automatic maneuver limitation will give carefree maneuvering. The combination of the performance and handling improvements will lead to greatly increased operational capability. The engineering features of a full-time fly by wire system to achieve these ends are discussed briefly. J M S

N79-16869# General Dynamics/Fort Worth Tex Aerospace Technology Div
F-16 MULTI-NATIONAL FIGHTER
 Charles A Anderson /n AGARD Active Controls in Aircraft Design Nov 1978 15 p refs

Avail NTIS HC A09/MF A01

The F-16 multinational fighter flight control system is described. The basic functions of the flight control system are discussed as well as the unique features such as relaxed static longitudinal stability, fly-by-wire, and side-stick pilot's controller. In addition, the basic philosophy behind the selection of the flight control system functions and unique features as well as flight test results and future applications are discussed. J M S

N79-16870*# National Aeronautics and Space Administration
 Hugh L Dryden Flight Research Center Edwards Calif
F-8 ACTIVE CONTROL
 Gary L Hartmann, Gunter Stein, Kenneth J Szalai, Samuel R Brown and Kevin L Petersen /n AGARD Active Controls in Aircraft Design Nov 1978 28 p refs. Prepared in cooperation with Honeywell Systems and Res Center Minneapolis Minn

Avail NTIS HC A09/MF A01

An advanced flight control research program conducted with a modified F-8C aircraft is described. Key technologies investigated include system redundancy management and active control laws. Two control law packages proposed for flight test are discussed.

The first is the control configured vehicle package which incorporates command augmentation, boundary control, ride smoothing and maneuver flap functions. The second package is an adaptive control law based on a parallel channel maximum likelihood estimation algorithm. The design, implementation, and flight test experience with both sets of control laws are described. J M S

N79-16871*# National Aeronautics and Space Administration
 Hugh L Dryden Flight Research Center Edwards Calif
HIGHLY MANEUVERABLE AIRCRAFT TECHNOLOGY
 Dwain A Deets and Carl A Crother (Rockwell Intern Corp Los Angeles) /n AGARD Active Controls in Aircraft Design
 Nov 1978 14 p refs

Avail NTIS HC A09/MF A01

A remotely piloted research vehicle (RPRV) with active controls designed to develop high maneuverable aircraft technologies (HiMAT) is described. The HiMAT RPRV is the central element in a new method to bring advanced aircraft technologies to a state of readiness. The RPRV is well into the construction phase with flight test evaluations planned. The closely coupled canard-wing vehicle includes relaxed static stability, direct force control and a digital active control system. Nonlinearities in the aerodynamics led to unusual demands on the active control systems. For example, the longitudinal static margin is 10-percent negative at low angles of attack but increases to 30-percent negative at high angles of attack and low Mach numbers. The design procedure followed and experiences encountered as they relate to the active control features are discussed. Emphasis is placed on the aspects most likely to be encountered in the design of a full-scale operational vehicle. In addition, a brief overview of the flight control system features unique to the RPRV operation is presented. J M S

N79-16872*# National Aeronautics and Space Administration
 Hugh L Dryden Flight Research Center, Edwards Calif
PROPULSION-FLIGHT CONTROL INTEGRATION TECHNOLOGY
 Frank W Burcham Jr /n AGARD Active Controls in Aircraft Design Nov 1978 9 p refs

Avail NTIS HC A09/MF A01

The propulsion-flight control integration technology (PROFIT) concept to be implemented on a high performance supersonic twin-engine aircraft which will make possible the evaluation of a wide variety of integrated control concepts is discussed. The aircraft's inlet engine and flight control systems are to be integrated with a digital computer. The airplane control hardware is to be modified to provide the necessary capability for control research. Software will be used to provide flexibility in the control integration capability. The background for flight and propulsion control system development and probable future trends are described. Examples of integrated control research that have application to future aircraft designs are also presented. J M S

N79-16873# British Aircraft Corp, Weybridge (England)
 Commercial Aircraft Div
ACTIVE CONTROLS FOR CIVIL TRANSPORTS
 H Hitch /n AGARD Active Controls in Aircraft Design Nov 1978 12 p
 Avail NTIS HC A09/MF A01

The principles involved in Active Control Technology (ACT) for civil transports are described and estimates are made of the probable benefits. The ACT functions: maneuver load alleviation, gust load alleviation, relaxed stability, flutter suppression, ride quality improvement, and fatigue improvement are discussed in turn and the problems and benefits outlined. It is concluded that load alleviation approaching 50% may be accepted as a target and that direct operating cost of about 7% is possible and worthwhile. Author

N79-16874# Lockheed-California Co Burbank Structural and Material Div
FUEL CONSERVATIVE SUBSONIC TRANSPORT

W A Stauffer, R L Foss, and J G Lewolt /n AGARD Active Controls in Aircraft Design Nov 1978 13 p refs

Avail NTIS HC A09/MF A01

A fuel saving active control system being developed for commercial application of the L-1011 airplane in the early 1980s is described. Highlighted are features of the TriStar that permit an effective yet simple load relieving system to be adopted. A description of the active control system, which involves integrated movement of both the aileron and horizontal tail is given. The load relieving benefits obtained and the ability to increase wing span without major structural change are discussed. The potential fuel savings offered by this system is indicated. Comments on the structural design criteria established for the system, the analytic models employed in the active controls analysis, and the initial breadboard control system hardware defined for ground and flight test purposes are included. Also described are ground simulation and flight test plans and results, and thoughts on further application of active controls for future consideration. J M S

N79-16875# Lockheed-Georgia Co Marietta C-5 Structural Requirements Dept

C-5A LOAD ALLEVIATION

T E Disney /n AGARD Active Controls in Aircraft Design Nov 1978 16 p refs

Avail NTIS HC A09/MF A01

The load alleviation systems for the C-5A are considered. The evolution of the present load alleviation system is described including the system mechanization and a simplified functional block diagram. Comparisons of analytical and flight test measured maneuvers and continuous turbulence loads are shown. Comparisons are also shown for Active Lift Distribution Control System ON and OFF airplane response and wing stress measurements obtained during the C-5A Service Loads Recording Program. The effects of loads changes on fatigue damage rate predictions are discussed, with particular emphasis on the implications of multiple component load changes i.e. reduced bending moments and increased torsional moments. J M S

N79-16876# Rockwell International Corp Los Angeles Calif Dynamics Technology Div

B-1 RIDE CONTROL

John H Wykes and Christopher J Borland /n AGARD Active Controls in Aircraft Design Nov 1978 15 p refs

Avail NTIS HC A09/MF A01

The B-1 aircraft is one of the first aircraft to include a control-configured vehicle (CCV) concept ride control, in the early design phases. A substantial savings in weight was achieved with this approach as compared to direct material stiffening. The design development, including system requirements and mechanization details is discussed. The design implementation is also discussed, including hardware and installation details. Finally, flight test performance evaluations, comparisons of analytical and test data system improvements and flight crew evaluations are presented. While the detailed information is provided for a system designed to improve ride quality through control of structural motion, it is concluded that the technology discussed is applicable to load relief and even flutter suppression of flexible vehicles military or commercial. J M S

N79-16878# National Aviation Facilities Experimental Center Atlantic City, N J

EVALUATION OF THRESHOLD AND PRETHRESHOLD LIGHTS FOR MEDIUM INTENSITY APPROACH LIGHTING SYSTEMS Final Report, Mar 1977 - Jul 1978

Guy S Brown Dec 1978 46 p refs

(FAA Proj 071-412-550)

(FAA-NA-78-44, FAA-RD-78-44)

Avail NTIS

HC A03/MF A01

Runway threshold lights were screened medium intensity approach lights with strobe lights systems. Three different lamps and fixtures were selected for final evaluation. Based on flight tests and photometric measurements, it is concluded that

300 watt, 300PAR56/NSP lamps would provide the improved visual guidance and conspicuity of the threshold necessary for operations in visibility conditions as low as Category 1, 2 400 feet runway visual range. The green threshold lights spaced 10 feet apart with the outer lights inline with the runway edge lights will conform to ALSF-1 and ICAO criteria for Category 1 operations. Proposed configurations of red wing bar lights in the prethreshold area to augment the threshold lights for improved visual guidance were also evaluated. The test results concluded that with the bold and distinctive threshold red prethreshold wing bar lights did not provide appreciable improvement in guidance under the test conditions. A R H

N79-16879# National Aviation Facilities Experimental Center Atlantic City N J

ATARS/ATC SIMULATION TESTS WITH SITE-ADAPTATION LOGIC Final Report, Dec 1977 - Apr 1978

James R Windle Gary Morfitt P J Devine Sidney B Rosstter and Arthur W Filius Jan 1979 37 p refs

(FAA-NA-78-42, FAA-RD-78-138)

Avail NTIS

HC A03/MF A01

The objective was to assess the effectiveness of proposed Automatic Traffic Advisory and Resolution Service (ATARS) site-adapted logic designed to reduce unnecessary alarms in a terminal air traffic control environment. Test results indicated that the site-adapted logic reduced the numerous unnecessary alarms experienced in previous simulation tests. In fact no ATARS alarms were generated in any of the tests involving instrument flight rules (IFR) separation procedures. Under IFR and visual flight rules (VFR) separation rules a total of seven ATARS controller alerts were issued over four 1-hour data runs. The major of the eight controllers participating in these tests favored ATARS use and indicated that ATARS with site-adapted logic did not impact control procedures. Recommendations are made for further improvements in ATARS desensitization in the terminal ATC area and for additional studies to improve tracker performance and ATARS performance under reduced VFR ATC separation criteria. L S

N79-16880# Quanta Systems Corp Rockville Md

APPROACH LIGHT AIMING CRITERIA Final Report, period ending 4 Dec 1978

Charles A Douglas 4 Dec 1978 66 p refs Prepared for Naval Air Engineering Center Lakehurst N J

(Contracts DOT-FA77WA1-786, N68335-78-C-2022)

(NAEC-911 FAA-RD-78-137) Avail NTIS HC A04/MF A01

A method of determining the elevation setting for approach lights based upon fundamental principles was developed. This method considers the effects of the applicable decision height, the required visual range, the glide slope angle, the distance of the light from the threshold and the vertical beam spread of the light. This method, defined as the visual segment method was compared with other methods and found to be preferable. Elevation-setting-angles were computed for the lights of the MALSR and ALSF-2 approach-light systems when lamped with the types of lamps presently in service. The suitability of the intensity distribution characteristics of the lights currently used in U S approach-light systems was analyzed and possible changes noted. L S

N79-16881# Gellman Research Associates Inc Jenkintown Pa

A STUDY OF AIRCRAFT TOWING AS PROPOSED FOR BOSTON-LOGAN INTERNATIONAL AIRPORT

Mar 1977 252 p Prepared in cooperation with Unified Industries

Inc Alexandria Va

(FAA-AEQ-77-5) Avail NTIS HC A12/MF A01

The impact of the proposed revisions to airport rules regarding ground movement of aircraft by towing in lieu of taxiing in selected areas was studied. Methods used depended on the subject matter under review in the areas of (1) safety-historical data from operating airlines was reviewed (2) economics-previous economic data regarding the adjacent neighborhoods was evaluated and compared (3) capacity-actual experience of an involved airline was used, and (4) environment-readings of noise were made under operational conditions. The results indicate

that the proposed extended towing is hazardous and it raises problems in communications creates congestion exposes ground personnel to jet blast and passengers standing in aisles to possible injury Conclusions are that additional studies of these impacts should be made before these proposed revised rules are made mandatory at Logan International Airport A R H

N79-16882# Naval Air Engineering Center, Lakehurst NJ Engineering Div
A STUDY OF THE EFFECT OF DIFFERENT CAM DESIGNS ON MARK 7 MOD 1 ARRESTING GEAR PERFORMANCE Final Report
 Michael F Louise 2 Aug 1978 77 p refs
 (AD-A061486 NAEC-91-7927) Avail NTIS HC A05/MF A01 CSCL 01/3

This report develops a hydraulic simulation program for the Mark 7 Mod 1 Arresting Gear It also compares theoretical performance with aircraft arrestments using different cam profiles The present cam rotated on its dwell provides as much hydraulic load reduction as any new cam design Author (GRA)

N79-16884# National Technical Information Service Springfield Va
ROADS AND RUNWAYS, SNOW REMOVAL AND DEICING TECHNIQUES A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, 1964 - Nov 1978
 Robena J Brown Dec 1978 210 p
 (NTIS/PS-78/1284/5 NTIS/PS-77/1118 NTIS/PS-76/0987 NTIS/PS-75/829 NTIS/PS-75/061) Avail NTIS HC \$28 00/ MF \$28 00 CSCL 13B

Materials maintenance costs, corrosion inhibition pollution and the planning applied to snow and ice removal are reported Applications cover bridges and railroads as well as highways and runways This updated bibliography contains 203 abstracts 26 of which are new entries to the previous edition GRA

N79-16930*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
EVALUATION OF THE APPLICATION OF SOME GAS CHROMATOGRAPHIC METHODS FOR THE DETERMINATION OF PROPERTIES OF SYNTHETIC FUELS
 Albert C Antoine Jan 1979 46 p refs Presented at the Aerospace Meeting San Diego Calif 27-30 Nov 1978 sponsored by the Soc of Automotive Engr
 (NASA-TM-79035 E-9834) Avail NTIS HC A03/MF A01 CSCL 21B

The purpose of the investigation was to evaluate the applicability to some synthetic fuels of some gas chromatographic methods now under development for use with petroleum based fuels Thirty-two jet and diesel fuel samples which were prepared from oil shale and coal syncrudes were examined The boiling range distribution of each was determined by gas chromatography and from that data distillation properties were calculated The calculated results gave sufficient agreement with the measured values that the equations could be useable in their present form Bulk fuel properties were calculated for the sixteen JP-5 and Diesel No 2 type fuels The results show that the equations would not give useable results Capillary column gas chromatography was used to determine the n-alkane content of the eight JP-5 type samples and the results related to the observed freezing points The results show that the concentrations of the long straight chain molecules in the fuels exert influence on the freezing point but are not the complete controlling factor L S

N79-16932# Factory Mutual Research Corp Norwood Mass
PRESSURE MODELING OF VERTICALLY BURNING AIRCRAFT MATERIALS Final Report, Oct 1977 - Jul 1978
 R L Alpert Jan 1979 64 p refs
 (Contract DOT-FAA77NA-4048)
 (RC78-BT-29 OAOR8 BU FAA-RD-78-139 FAA-NA-79-150)
 Avail NTIS HC A04/MF A01

The possibility of evaluating relative rates of upward fire spread on aircraft cabin materials is investigated with small-scale

models burned at elevated ambient air pressure The modeling technique which preserves the fluid Grashof number of the full-scale fire spread process is verified with vertical walls of polymethyl methacrylate (PMMA) fuel ignited at one atmosphere (full-scale) and at elevated absolute pressures (model) to 3.5 MPa (515 psia) Fifteen aircraft cabin samples are subjected to a small PMMA ignition source for a range of elevated ambient air pressures Rates of upward fire spread characterized by flame height exponential growth factors are measurable for nearly all the aircraft cabin materials at absolute pressures from 1.18 MPa (165 psia) to 3.2 MPa (465 psia) Ranking of the materials by rate of upward fire spread is facilitated by the nearly two order of magnitude separation between highest and lowest growth factor at each pressure level A R H

N79-16958# Lockheed Missiles and Space Co Palo Alto Calif
A FEASIBILITY STUDY FOR DEVELOPMENT OF STRUCTURAL ALUMINUM ALLOYS FROM RAPIDLY SOLIDIFIED POWDERS FOR AEROSPACE STRUCTURAL APPLICATIONS Technical Report, 1 Jun 1977 - 31 May 1978
 Richard E Lewis Donald Webster and Ian G Palmer Jul 1978 159 p refs
 (Contract F33615-77-C-5186 ARPA Order 3417)
 (AD-A061428 AFML-TR-78-102) Avail NTIS HC A08/MF A01 CSCL 11/6

A study was conducted to determine the feasibility of developing aluminum alloys from rapidly solidified powders having significant improvements in properties for aerospace structural applications This study was comprised of four tasks (1) survey of current technology for rapid solidification of aluminum alloy powders (2) metallurgical and property evaluation of unusual composition aluminum alloys having some promise for advanced structural applications (3) a series of design tradeoff studies of selected space missile and aircraft structures to assess the effect of assumed property improvements on weight savings and where possible performance and (4) formulation of a plan to exploit advanced aluminum alloys for application to new weapons systems where significant improvements in systems effectiveness would result GRA

N79-16965# National Aerospace Lab Amsterdam (Netherlands) Structures and Materials Div
HEAT TREATMENT STUDIES OF ALUMINUM ALLOY FORGINGS OF THE AZ 74 61 TYPE FATIGUE CRACK PROPAGATION PERFORMANCE UNDER MANEUVER SPECTRUM LOADING Interim Report
 L Schra, H P VanLeeuwen and A E Meulman 13 Jul 1978 52 p refs
 (Contract RNLA-FRB-KLU-C1)
 (NLR-TR-76074-U IR-3) Avail NTIS HC A04/MF A01

The fatigue crack propagation of the alloy AZ 74 61 under maneuver spectrum loading was studied The crack propagation behavior was also compared with that of the American forging alloy AA 7050 not only for simulated maneuver loading but also for simulated gust loading and program loading It was found that at comparable strength the alloy AA 7050 was superior to Az 74 61 Macrofractographic observations revealed that the crack propagation behavior differed with respect to heat treatment type of the load spectrum and specimen type These observations emphasize the complexity of fatigue damage accumulation under variable amplitude loading Author

N79-16966# National Aerospace Lab Amsterdam (Netherlands) Structures and Materials Div
RESIDUAL STRENGTH OF THE ALUMINUM ALLOY 7475-T76 AT LOW TEMPERATURES
 W G J Thart 13 Jul 1978 46 p refs
 (Contract NIVR-1764)
 (NRL-TR-76103-U) Avail NTIS HC A03/MF A01

Residual strength tests were performed on 300 mm wide center cracked panels of various thicknesses at room temperature and at -50 C During the tests stable crack growth was filmed and recorded with the electric potential method Fracture toughness was determined using the method of Feddersen J M S

N79-16967# National Aerospace Lab Amsterdam (Netherlands) Structures and Materials Div

THERMOMECHANICAL TREATMENT OF ALUMINUM ALLOYS

R J H Wanhill and G F J A VanGestel 15 Jun 1978 33 p refs Submitted for publication (NIR-MP-77031-U) Avail NTIS HC A03/MF A01

The effects of thermomechanical treatment (TMT) on the engineering properties of aluminum alloys are discussed. At present only one type of TMT seems commercially practicable. This is a T3XX type treatment for 2000 series alloy sheet. Of the other kinds of TMT, those with the most potential are high temperature aging and final thermomechanical treatments. The main incentive for continued investigation of TMT and the most likely key to its commercial exploitation is the possibility of improving fatigue properties. Author

N79-16968# National Aerospace Lab Amsterdam (Netherlands) Structures and Materials Div

SOME ENGINEERING PROPERTY COMPARISONS FOR 7050 AND AZ 74 61 DIE FORGINGS

R J H Wanhill, L Schra and H P vanLeeuwen 15 Jun 1978 41 p refs Sponsored in part by RNLAf and NIVR Submitted for publication (NLR-MP-77040-U) Avail NTIS HC A03/MF A01

A comparison of some of the engineering properties of 7050-T736 and AZ 74 61 die forgings is made. The properties investigated were strength, fracture toughness, stress corrosion resistance and fatigue life and crack propagation resistance. Some of the properties of these alloys are also compared with those of 7079 and DTD 5024 die forgings. It is concluded that 7050 possessed a superior combination of properties. However, the susceptibility of 7050 to general corrosion warrants extra consideration of corrosion protection systems applied to this alloy. Author

N79-16989# Naval Surface Weapons Center White Oak, Md **POLYURETHANE FOAMS FOR AIRCRAFT SHOCK MOUNTS 1 POLYETHER BASED FOAMS Progress Report, Oct 1977 - Jul 1978**

Hubert J Booth and James V Duffy Jul 1978 83 p refs (AD-A061482 NSWC/WOL/TR-78-125) Avail NTIS HC A05/MF A01 CSCL 11/9

The objective of this program was to develop flexible foam systems which would meet the specifications outlined in MIL-F-81334B(AS). This report deals with the results obtained from a series of one-shot polyether foams derived from mixtures of poly(oxytetramethylene) glycol, poly(oxypropylene) and ethylene oxide terminated poly(oxypropylene) polyols. Polyol ratios, surfactant type, surfactant concentration and stannous octoate/tert-amine ratios were studied to determine their influence on foam properties. Properties such as density, compressibility, rebound, tensile strength, elongation, hydraulic fluid resistance, porosity and vibration damping were obtained on the most promising systems. GRA

N79-16999# National Aeronautics and Space Administration Washington D C

NACA RESEARCH ON HYDROGEN FOR HIGH ALTITUDE AIRCRAFT

In its Liquid Hydrogen as a Propulsion Fuel 1945-1959 1978 p 95-112 Avail NTIS MF A01 HC SOD CSCL 21D

In 1954 the fuels and propulsion panel of the Scientific Advisory Board met to survey the major aspects of the propulsion program of the Air Force. The panel was greatly interested in high-energy fuels and the Air Force program on them. A proposal was introduced to use hydrogen in a high altitude aircraft powered by a unique engine called Rex 1. This touched off a strong renewal of interest in liquid hydrogen for aircraft. The historical investigations during 1954-1957 of liquid hydrogen for high altitude aircraft and missiles are discussed. The experiments began with an investigation of low pressure combustion in a single turbojet combustor extended to other components and complete turbojet engine systems and culminated in the first (and only)

flight experiments. A partial list of the many contributions of this research effort is presented. GY

N79-17000# National Aeronautics and Space Administration, Washington D C

NEW INITIATIVES IN HIGH ALTITUDE AIRCRAFT

In its Liquid Hydrogen as a Propulsion Fuel 1945-1959 1978 p 112-139 refs Avail NTIS MF A01 HC SOD CSCL 21D

The Air Force began planning work to achieve very-high altitude flight in late 1952. In 1954 a high-altitude reconnaissance airplane that was sponsored by the government was proposed. This became the U-2 aircraft. In 1954 a novel hydrogen fueled subsonic airplane capable of high-altitude flight was proposed. Although never built, it spawned considerable interest and activity on the potential of hydrogen as a fuel. An account of the contract work undertaken to develop the airplane and its engine is presented. As interest grew and specifications changed from a subsonic to a supersonic airplane, the required engine power increased. This meant a much larger hydrogen fueled engine. The growth in engine size effectively took the contractor out of competition. This case history of an inventor and contractor and their frustrations with a single customer (U.S. Government) is analyzed. GY

N79-17001# National Aeronautics and Space Administration Washington D C

SUNTAN

In its Liquid Hydrogen as a Propulsion Fuel 1945-1959 1978 p 141-166

Avail NTIS MF A01 HC SOD CSCL 21D

The largest and most extraordinary project for using hydrogen as a fuel was carried out by the Air Force in 1956-1958 in supersecrecy. The project was code-named Suntan and even this was kept secret. Suntan was an effort by the Air Force to develop a hydrogen-fueled airplane with performance superior to the secret spy plane the U-2. The aircraft and engine design for this project is reviewed. Due to technological problems and conflicting technical views over its feasibility and the best way to accomplish reconnaissance, the Suntan project simply faded away and was cancelled in 1959. GY

N79-17008# National Aeronautics and Space Administration Washington D C

HYDROGEN TECHNOLOGY, 1900-1945

In its Liquid Hydrogen as a Propulsion Fuel 1945-1959 1978 p 265-269

Avail NTIS HC A01 HC SOD CSCL 21D

In addition to the considerations of liquid hydrogen for rockets by the rocket pioneers, other concurrent activities contributed to hydrogen technology. The largest and best known of these was the development and operation of the large dirigibles (airships) in Germany, Great Britain, Italy and the United States from 1900 to 1937. A historical account of experimentation in hydrogen technology from science 1900-1940 is summarized. This is followed by a brief discussion of rocket experiments with liquid oxygen and liquid hydrogen 1937-1940. GY

N79-17011# Purdue Univ Lafayette Ind School of Mechanical Engineering

ALTERNATIVE HYDROCARBON FUELS COMBUSTION AND CHEMICAL KINETICS

Craig T Bowman ed (Stanford Univ Calif) and Jorgen Birkeland ed (DOE Washington, D C) Oct 1978 473 p refs Proc of a Proj SQUID Workshop held at Loyola Coll Conf Center Columbia Md 7-9 Sep 1977 Sponsored in part by AFOSR and DOE

(Contract N00014-75-C-1143 Proj SQUID, NR Proj 098-038) (AD-A061050 SQUID-PU-R2-78) Avail NTIS HC A20/MF A01 CSCL 21/4

Contents: Alternative Fuel Availability and Anticipated Combustion Problems, Critical Processes in Combustion of Alternative Fuels, Pyrolysis and Oxidation Kinetics of Alternative Fuels, Pollutant Emissions Considerations for Alternative Fuel Combustion and Summary and Conclusions. GRA

N79-17012# Exxon Research and Engineering Co Linden N J

STATIC ELECTRICITY HAZARDS IN AIRCRAFT FUEL SYSTEMS Final Report, 27 Apr 1977 - 27 Apr 1978

William G Dukek John M Ferraro and William F Taylor Aug 1978 204 p refs

(Contract F33615-77-C-2046 AF Proj 3048)

(AD-A061450 AFAPL-TR-78-56 Exxon/GRUS 1PEB 78) Avail NTIS HC A10/MF A01 CSCL 21/4

Static discharges that occurred during fueling in small-scale test rigs which simulated aircraft fuel tanks containing open-pore polyurethane foam were used to develop design criteria with respect to foam type inlet configuration and JP-4 conductivity. Blue polyether foam is more electrostatically active than red polyester foam; sparks can be eliminated only with a multiple orifice inlet and a minimum fuel conductivity level of 50 pS/m achieved by adding anti-static additive. With red polyester foam either the multiple orifice inlet or minimum conductivity fuel suppresses static discharges. Spark energies from blue foam or from high velocity single orifice inlets appear to be 10-100 times greater than from red foam or from multiple orifice inlets. Variables such as flow rate inlet type and exit velocity metal charge collectors, fuel conductivity foam dielectric properties, and other non-metallic fuel components were studied. For example a rubber bladder cell is not significantly different from an empty tank in terms of static discharges. An aluminum mesh substitute for open-pore foam proved to be effective in minimizing static buildup but produced unacceptable metal fragments which acted as charge collectors. Author (GRA)

N79-17014# Air Force Aero Propulsion Lab Wright-Patterson AFB Ohio

EVALUATION OF MOTOR GASOLINE IN THE JET FUEL THERMAL OXIDATION TESTER Final Report, Jan 1976 - Jul 1978

Royce P Bradley Oct 1978 46 p refs

(AD-A061027 AFAPL-TR-78-86) Avail NTIS HC A03/MF A01 CSCL 21/4

Motor gasoline is a potential emergency fuel for aircraft using turbine engines. Due to the lack of data on the deposit forming tendencies of motor gasoline a series of tests was conducted on four samples using the jet fuel thermal oxidation tester. The motor gasoline samples responded to exposure to high temperatures in a manner identical to the response of JP-4 with the exception that the breakpoint temperature was approximately 10 C below the specification limit for JP-4. Filter plugging was not a problem. The effect of contamination of JP-4 with motor gasoline was investigated. The thermal stability of the resulting blend may be lowered to the thermal stability level of the motor gasoline. Hence the blend may not meet JP-4 specification requirements. Author (GRA)

N79-17022# Research Inst of National Defence Stockholm (Sweden)

INTRODUCTORY STUDIES OF SOFRAM, A RAM ENGINE WITH SOLID PROPELLANT [INLEDANDE STUDIER KRING SOFRAM, EN RAMMOTOR MED FAST BRAENSLE]

Ralf Eliasson Mar 1978 41 p refs In SWEDISH

(FOA-C-20229-D3) Avail NTIS HC A03/MF A01

Construction of a test rig for studying a ram engine with solid propellant SOFRAM (Solid Fuel Ramjet) is described. Preheating of the inlet air is effected in an unconventional manner by using an existing liquid rocket test rig and known hybrid rocket techniques. Preliminary results for SOFRAM with black polyethylene as a propellant and simulated flight Mach number approx 2 are presented. Author

N79-17046# Shock and Vibration Information Center (Defense) Washington D C

THE SHOCK AND VIBRATION DIGEST, VOLUME 10, NO 9

Judith Nagle-Eshleman ed Sep 1978 89 p refs

Avail SVIC Code 8404 Naval Res Lab Washington D C 20375 \$15 00/set

The Shock and Vibration Digest is a monthly publication of the Shock and Vibration Information Center. Subjective and objective analyses of the literature are provided along with news and editorial material. The following topics are reported: (1) balancing machines (2) transonic blade flutter - a survey of new developments and (3) recent progress in dynamic plastic behavior of structures.

N79-17078# Harry Diamond Labs Adelphi Md

DESIGN OF VHF AND UHF COMMUNICATIONS AIR/ GROUND ANTENNAS Intern Report

A Sindoris F Farrar and D Schaubert Feb 1978 124 p refs

(Contract DOT-FA78WAI-851)

(FAA-RD-79-7) Avail NTIS HC A06/MF A01

The Harry Diamond Laboratories (HDL) undertook the investigation of improved communication antennas for the Federal Aviation Administration (FAA). HDL devoted an intensive design search into available technology and conducted a concurrent analysis of the key variables affecting the performance of FAA antennas during the first six months of this effort. In doing so it has concentrated on six types of antennas specifically designated for primary consideration by the FAA, namely VHF and UHF dipoles, VHF and UHF medium-gain omnidirectional types and high-gain VHF and UHF directional antennas. Certain constraints were also specified such as limiting sizes and weights and power capacities. Analysis was also required in related areas such as lightning protection. The two dipole designs were deleted by the FAA but the remaining results include design recommendations for four of the FAA applications and should prove very useful in establishing future antenna design standards and performance specifications. L S

N79-17123# National Severe Storms Lab Norman Okla
ECHO INTERPRETATION OF SEVERE STORMS ON AIRPORT SURVEILLANCE RADARS Progress Report, 15 Feb 1977 - 31 May 1978 on phase 1

W David Zittel Apr 1978 71 p refs

(Contract DOT-FA77WAI-724)

(AD-A061085 FAA-RD-78-60) Avail NTIS HC A04/MF A01 CSCL 17/9

Past research indicates ASR radars have sufficient sensitivity to detect severe storms. This report provides background information about severe storm climatology and morphology and then considers the effects various ASR radar operational fixes have in identifying severe storms based on current knowledge of storm structure. Results show identification of severe storms with ASR radars is unlikely without accurate reflectivity displays and with the use of MTI and CP. Operationally it is recommended that outside data sources provide initial severe storm identification while the ASRs are used to supplement this data by giving storm positions in real time. Author (GRA)

N79-17158# Bristol Univ (England) Dept of Electrical Engineering

AN INVESTIGATION INTO VOLTAGE MODULATION IN AIRCRAFT V S C F SYSTEMS Ph D Thesis

Mervyn Richard Paton Mar 1978 233 p refs

Avail NTIS HC A11/MF A01

Fixed frequency alternating voltage for aircraft primary electrical power may be generated by the variable speed constant frequency technique in which the variable frequency power from an engine-drive alternator is converted to a fixed frequency by using a power electronic frequency changer known as a cycloconverter. Modulation produced by an ideal cycloconverter is simulated and the excessive amplitude modulation exhibited by the alternating output voltage waveform is investigated. A large reduction in modulation is possible by the controlled addition of third harmonic distortion into the reference signal. Studies of practical aspects of amplitude modulation show that large levels are caused by distorted analog control waveforms. A R H

N79-17172# Air Force Flight Dynamics Lab Wright-Patterson AFB Ohio

EJECTOR OPTIMIZATION Final Report, Nov 1976 - Sep 1977

Siegfried H Hasinger Jun 1978 53 p refs
(AD-A061251, AFFDL-TR-78-23) Avail NTIS
HC A04/MF A01 CSCL 01/3

The ejector optimization process has been amended to include supersonic mixing. Several examples of ejector optimization have been calculated. Two of these examples have been checked experimentally. In one case for a pressure ratio of 3.1 and a mass flow ratio of 2.2 with air as operating media, experiment and analysis are in good agreement. For the other case with helium as secondary medium, the predicted optimum performance could not be reached although operation not too far from optimum is in good agreement with the analysis. Mixing difficulties near the optimum point are apparently responsible for the discrepancies. A flow density plot has been introduced for a graphic interpretation of ejector operations. It shows that optimization brings the flow density at the mixing section exit to a maximum and that transition from subsonic to supersonic mixing, which is generally a requirement for optimization, occurs only after constant pressure. Mixing has been established. GRA

N79-17178# Air Force Flight Dynamics Lab Wright-Patterson AFB Ohio Aerodynamics and Airframe Branch
MASS INJECTION AND JET FLOW SIMULATION EFFECTS ON TRANSONIC AFTERBODY DRAG Final Report, Feb - Sep 1977

Wladimiro Calarese and Ronald E Walterick Jun 1978 180 p refs
(AF Proj 2404)
(AD-A061378, AFFDL-TR-78-57) Avail NTIS
HC A09/MF A01 CSCL 20/4

An experimental investigation was performed to determine the effects of boattail injection and jet flow simulation on the afterbody drag of a slender body of revolution in the transonic regime at zero angle of attack such as engine nacelles and boattailed afterbodies with isolated engines. A correlation between sting and jet diameter was established. The jet plume and the nozzle pressure ratio simulators were found appropriate and useful as a testing technique. Boattail mass injection usually produces a drag coefficient reduction and is more effective at high nozzle pressure ratios. Boattail injection is more effective if used in regions of separated flow. Author (GRA)

N79-17219*# SKF Industries, Inc King of Prussia Pa
AIRCRAFT ENGINE SUMP FIRE MITIGATION, PHASE 2 Final Report

J W Rosenlieb Apr 1978 142 p refs
(Contract NAS3-19436)
(NASA-CR-135379, AL78T007) Avail NTIS
HC A07/MF A01 CSCL 21B

The effect of changes in the input parameters (air leakage flow rate and temperature and lubricating oil inlet flow rate and temperature) over a specified range on the flammability conditions within an aircraft engine bearing sump was investigated. An analytical study was performed to determine the effect of various parameters on the generation rate of oil vapor from oil droplets in a hot air stream flowing in a cylindrical tube. The ignition of the vapor-air mixture by an ignition source was considered. The experimental investigation demonstrated that fires would be ignited by a spark ignitor over the full range of air and oil flow rates and air temperatures evaluated. However, no fires could be ignited when the oil inlet temperature was maintained below 417 K (290 F). The severity of the fires ignited were found to be directly proportional to the hot air flow rate. Reasonably good correlation was found between the mixture temperature in the sump at the ignitor location and the flammability limits as defined by flammability theory, thus a fairly reliable experimental method of determining flammable conditions within a sump was demonstrated. The computerized mathematical model shows that oil droplet size and air temperature have the greatest influence on the generation rate of oil vapor. A R H

N79-17229# Lockheed-California Co Burbank
IMPROVEMENT OF OVERLOAD CAPABILITY OF AIR CARRIER AIRCRAFT TIRES Final Report, Oct 1977 - Sep 1978

Paul C Durup Oct 1978 125 p ref
(Contract DOT-FA77WA-4069)
(FAA-RD-78-133) Avail NTIS HC A06/MF A01

Statistical and analytical data are used to develop Transport Aircraft Ground Operations scenarios describing tire loads, deflections, temperatures, and distance traveled. These scenarios are used to aid in defining the critical conditions causing tire overload. Reasons for failure of overloaded tires are developed and used to identify potential improvements for overload capability for tires currently in use. Cost trade-off studies are made to indicate which of the improvements appear promising for further development. Concepts for new designs capable of overload are discussed along with runflat-ideas. Using information developed in the program, tire maintenance practices that may improve the overload performance of current tires are presented. LS

N79-17252*# Boeing Commercial Airplane Co Seattle Wash
ASSESSMENT OF STATE-OF-THE-ART OF IN-SERVICE INSPECTION METHODS FOR GRAPHITE EPOXY COMPOSITE STRUCTURES ON COMMERCIAL TRANSPORT AIRCRAFT Interim Report, 3 Mar 1978 - 3 Sep 1978
M L Phelps Jan 1979 56 p
(Contract NAS1-15304)
(NASA-CR-158969) Avail NTIS HC A04/MF A01
CSCL 14D

A survey was conducted to determine current in-service inspection practices for all types of aircraft structure and particularly for advanced composite structures. The survey consisted of written questionnaires to commercial airlines, visits to airlines, aircraft manufacturers, and government agencies, and a literature search. Details of the survey including visits, questions asked, a bibliography of reviewed literature, and details of the results are reported. From the results, a current in-service inspection baseline and a preliminary inspection program for advanced composite structures is documented as appendices to the report. G Y

N79-17253*# National Aviation Facilities Experimental Center Atlantic City, N J
PLAN FOR THE RELIABILITY AND MAINTAINABILITY EVALUATION OF THE DISCRETE ADDRESS BEACON SYSTEM (DABS) ENGINEERING LABORATORY MODELS Final Report

Arthur R Moss Oct 1978 89 p refs
(FAA-NA-78-31) Avail NTIS HC A05/MF A01

The primary objective of the reliability and maintainability evaluation of the DABS sensors is to ascertain any weak points or problem areas in the system design. These are evidenced by the occurrence of distinct or repetitive hardware failure patterns, as well as unusual difficulties encountered in diagnosing, isolating, and correcting these failures. A secondary objective is to obtain mean-time-between-failures (MTBF), mean downtime (MDT) and 90th percentile values of maximum corrective maintenance times for both the single-channel sensors being delivered and a theoretically constructed dual-channel sensor. These values would then be compared with the corresponding values specified in the engineering requirement (ER). A detailed description is given of the data collection and analysis procedures to be used in this evaluation, including the automated techniques and mathematical models employed in the analysis. LS

N79-17261# National Aerospace Lab Tokyo (Japan)
STRUCTURAL ANALYSIS OF HOLLOW BLADES. TORSIONAL STRESS ANALYSIS OF HOLLOW FAN BLADES FOR AIRCRAFT JET ENGINES

Akinori Ogawa, Yasushi Sofue, and Toshio Isobe May 1978 15 p refs In JAPANESE ENGLISH summary
(NAL-TR-533) Avail NTIS HC A02/MF A01

The torsional stress analysis of hollow fan blades by the finite element method is presented. The fans are considered to be double circular-arc blades, hollowed 30 percent and twisted by a component of the centrifugal force by the rated revolution. There are 0-7 webs inserted in the hollow section. The following became clear after stress and rigidity analysis of the hollow blades: (1) fan blades hollowed by 30 percent increase the torsional rigidity per cross section by 20-24 percent, and maximum shear stress by 17-27 percent, (2) the number and location of

webs have no considerable effect on torsional rigidity, and (3) there is an optimization web location for torsional rigidity where the shear strain in webs is maximum and (4) shear flows branch away to webs and stress concentrations decrease
G Y

N79-17262*# Sigma Corp Houston, Tex
LOADS A COMPUTER PROGRAM FOR DETERMINING THE SHEAR, BENDING MOMENT AND AXIAL LOADS FOR FUSELAGE TYPE STRUCTURES

William E Nolte Jul 1976 21 p
(Contract NAS9-14520)
(NASA-CR-151905 TN-76-117) Avail NTIS
HC A02/MF A01 CSCL 20K

LOADS determines rigid body vehicle shears bending moments and axial loads on a space vehicle due to aerodynamic loads and propellant inertial loads An example hand calculation is presented and was used to check LOADS A brief description of the program and the equations used are presented LOADS is operational on the Univac 1110 occupies 10505 core and typically takes less than one(1) second of CAU time to execute
G Y

N79-17263*# National Aeronautics and Space Administration
Lewis Research Center Cleveland Ohio
CHARACTERISTICS OF AEROELASTIC INSTABILITIES IN TURBOMACHINERY - NASA FULL SCALE ENGINE TEST RESULTS

Joseph F Lubomski 1979 21 p refs To be presented at the 4th Intern Symp on Air Breathing Eng, Lake Buena Vista Fla 1-6 Apr 1979 sponsored by AIAA
(NASA-TM-79085 E-9908) Avail NTIS HC A02/MF A01 CSCL 20K

Several aeromechanical programs were conducted in the NASA/USAF Joint Engine System Research Programs The scope of these programs the instrumentation data acquisition and reduction and the test results are discussed Data pertinent to four different instabilities were acquired two types of stall flutter choke flutter and a system mode instability The data indicates that each instability has its own unique characteristics These characteristics are described
G Y

N79-17264*# National Aeronautics and Space Administration
Langley Research Center Hampton Va
AN ANALYTICAL TECHNIQUE FOR PREDICTING THE CHARACTERISTICS OF A FLEXIBLE WING EQUIPPED WITH AN ACTIVE FLUTTER-SUPPRESSION SYSTEM AND COMPARISON WITH WIND-TUNNEL DATA

Irving Abel Feb 1979 45 p refs
(NASA-TP-1367 L-12567) Avail NTIS HC A03/MF A01 CSCL 20K

An analytical technique for predicting the performance of an active flutter-suppression system is presented This technique is based on the use of an interpolating function to approximate the unsteady aerodynamics The resulting equations are formulated in terms of linear ordinary differential equations with constant coefficients This technique is then applied to an aeroelastic model wing equipped with an active flutter-suppression system Comparisons between wind-tunnel data and analysis are presented for the wing both with and without active flutter suppression Results indicate that the wing flutter characteristics without flutter suppression can be predicted very well but that a more adequate model of wind-tunnel turbulence is required when the active flutter-suppression system is used
Author

N79-17269# National Aerospace Lab Amsterdam (Netherlands)
Structures and Materials Div
INFLUENCE OF CORROSION DAMAGE ON FATIGUE CRACK INITIATION

W G J Thart A Nederveen J H Nassette and A vanWijk
15 Jun 1978 31 p refs
(Contract RNLA-F-RB-KLU-C11)
(NLR-TR-75080-U) Avail NTIS HC A03/MF A01

The influence of previous corrosion on fatigue crack initiation has been determined Cylindrical specimens and flat specimens with a central hole of the aluminum alloy 7075-T6 were corroded

in a 3.5% NaCl solution The cylindrical specimens were tested under constant amplitude loading while for the specimens with a central hole a block program loading was used It appeared that the reduction in fatigue life was caused by fatigue crack initiation in an early stage from corrosion pits
Author

N79-17270# National Aerospace Lab Amsterdam (Netherlands)
Structures and Materials Div
A SECOND SERIES OF EXPLORATORY ACOUSTIC FATIGUE TESTS USING A SHAKER

P Derijk and J Schijve Dec 1977 16 p refs In DUTCH ENGLISH summary
(NLR-TR-78002-U) Avail NTIS HC A02/MF A01

A second series of exploratory acoustic fatigue tests was carried out again employing simple specimens mounted on a shaker Strain measurements were compared with calculations Crack growth initiated by a central notch was observed A comparison was made between three types of Al-alloy sheet materials
Author

N79-17304# National Aerospace Lab Amsterdam (Netherlands)
OPERATIONAL ASPECTS OF REMOTE SENSING FROM AIRCRAFT

G L Lamers 15 Jun 1978 28 p In DUTCH ENGLISH summary Presented at the Luchtwaarneming Symp Delft Neth 1-2 Sep 1977
(NLR-MP-77036-U) Avail NTIS HC A03/MF A01

Flying surveys with remote sensing equipment have some special aspects In a short discussion of the equipment, especially those characteristics relevant to the execution of survey flights are mentioned The influence of weather conditions on the results of remote sensing flights is discussed Attention is given to the navigation task the required accuracies and the systems available
G Y

N79-17361# Civil and Environmental Engineering Development
Office Tyndall AFB Fla Detachment 1 ADTC
MEASUREMENT AND ANALYSIS OF AIRPORT EMISSION

Interim Report, 1 Mar 1977 - 1 Jul 1978
Peter S Daley Sep 1978 21 p refs
(AF Proj 2103)
(AD-A061295 CEEDO-TR-78-36) Avail NTIS
HC A02/MF A01 CSCL 01/5

This paper is of interest to those involved in regulation and analysis of aircraft related air pollution problems USAF efforts to measure and model airport pollution are summarized Efforts include (1) a joint EPA study at Williams AFB AZ which involves both modeling and measurement (2) photographic studies to track plume rise (3) theoretical model studies to analyze airport pollution The author concludes that the Williams study soon to be completed will greatly aid in determining the accuracy of airport air pollution dispersion models that air quality modeling studies have shown that state-of-the-art Air Force engines cannot be cost effectively modified to reduce pollution except possibly in the hydrocarbon area and that at present unpredictable thermal plume rise of aircraft exhaust renders model ineffective at locations close (1 km) to the source
Author (GRA)

N79-17362# Naval Weapons Center China Lake Calif
BOUNDARY CONDITIONS FOR POLLUTION ABATEMENT OF FAST COOK-OFFS AND STATIC TESTS

D R Cruise Oct 1978 64 p refs
(AD-A061093 NWC-TP-5989) Avail NTIS HC A04/MF A01 CSCL 13/2

The boundary conditions of military usefulness are considered for the static test of rocket motors and the fast cook-off of ordnance in fuel fires A boundary may be geometrical chemical procedural or administrative in nature and represents a point beyond which the military value of the test is greatly diminished In the case of administrative boundaries it is possible that changes can be initiated at higher levels in the Navy Department However if a proposed pollution abatement device violates the other boundaries the tests may no longer have any military value
Author (GRA)

N79-17418*# National Aeronautics and Space Administration
Lewis Research Center Cleveland Ohio

AIRCRAFT ICING

Porter J Perkins *In* Tenn Univ Space Inst Proc of the 2nd
Ann Workshop on Meteorol and Environ Inputs to Aviation
Systems Mar 1978 p 85-99 refs

Avail NTIS HC A12/MF A01 CSCL 04B

A representative of the NASA Lewis Research Center
presented a discussion which concentrated on the meteorology
of icing and its measurements Other areas addressed were
test facilities ice protection systems and the effects of ice on
performance G Y

N79-17419*# Douglas (Charles A) Chevy Chase Md
VISIBILITY IN AVIATION

Charles O Douglas *In* Tenn Univ Space Inst Proc of the
2nd Ann Workshop on Meteorol and Environ Inputs to Aviation
Systems Mar 1978 p 100-126 refs

Avail NTIS HC A12/MF A01 CSCL 04B

An overview of the development of instrumental methods
of making cloud height and visibility measurements is presented
The limitations of these measurements are discussed G Y

N79-17420*# Air Force Flight Dynamics Lab Wright-Patterson
AFB Ohio

LIGHTNING HAZARDS TO AIRCRAFT

Philip B Corn *In* Tenn Univ Space Inst Proc of the 2nd
Ann Workshop on Meteorol and Environ Inputs to Aviation
Systems Mar 1978 p 127-137 refs

Avail NTIS HC A12/MF A01 CSCL 04B

Lightning hazards and, more generally, aircraft static
electricity are discussed by a representative for the Air Force
Flight Dynamics Laboratory An overview of these atmospheric
electricity hazards to aircraft and their systems is presented with
emphasis on electrical and electronic subsystems The discussion
includes reviewing some of the characteristics of lightning and
static electrification trends in weather and lightning-related
 mishaps some specific threat mechanisms and susceptible aircraft
subsystems and some of the present technology gaps A roadmap
(flow chart) is presented to show the direction needed to address
these problems G Y

N79-17421*# Army Research and Technology Labs Fort Eustis
Va

HELICOPTER ICING RESEARCH

Richard I Adams *In* Tenn Univ Space Inst Proc of the 2nd
Ann Workshop on Meteorol and Environ Inputs to Aviation
Systems Mar 1978 p 139-152

Avail NTIS HC A12/MF A01 CSCL 04B

A representative of the U S Army Research and Technology
Laboratories was called upon to brief the workshop on results
of flight test experiments with ice-phobic coatings applied to
helicopter rotor blades An overview of the Applied Technology
Laboratory helicopter icing R and D program is presented G Y

N79-17422*# Naval Air Systems Command Washington D C
**THE PREDICTION OF LIGHTNING-INDUCED VOLTAGES
ON METALLIC AND COMPOSITE AIRCRAFT**

John Birken *In* Tenn Univ Space Inst Proc of the 2nd Ann
Workshop on Meteorol and Environ Inputs to Aviation Systems
Mar 1978 p 153-177 refs

Avail NTIS HC A12/MF A01 CSCL 04B

Various government agencies have put forth effort to enable
the prediction of what lightning current will do to aircraft avionic
systems Ongoing and future efforts of predicting avionic voltages
and currents caused by electromagnetic fields external to the
aircraft are illustrated The Intrasystem Analysis Program (IAP)
was put to use to predict lightning-induced voltages on avionic
systems Presently funded programs are investigating the
modification nonmetallic composite materials will cause to the

metallic IAP program predictions The various factors involved
in designing prediction techniques are discussed G Y

N79-17424*# Battelle Pacific Northwest Labs Richland Wash
SUMMARY REPORT OF THE TURBULENCE COMMITTEE
Charles E Elderkin *In* Tenn Univ Space Inst Proc of the
2nd Ann Workshop on Meteorol and Environ Inputs to Aviation
Systems Mar 1978 p 185-191 refs

Avail NTIS HC A12/MF A01 CSCL 04B

The effects of atmospheric turbulence are discussed
Aircraft design and aircraft operations are reviewed Turbulence
in terms of intensity and scale in design considerations was
examined Turbulence models were used in the form of discrete
gusts spectral distributions and probability distributions Various
aspects of the design and operations problems simulation and
training factors of pilots and weather services and forecasts are
reported S E S

N79-17425*# Army Aviation Research and Development
Command Fort Eustis Va

SUMMARY REPORT OF THE ICING COMMITTEE

Richard I Adams *In* Tenn Univ Space Inst Proc of the 2nd
Ann Workshop on Meteorol and Environ Inputs to Aviation
Systems Mar 1978 p 193-199

Avail NTIS HC A12/MF A01 CSCL 04B

Icing parameters have created problems and the problem
areas that still exist today are presented The problem areas
include, (1) instrumentation (2) test facilities (3) weather
forecasting of icing conditions, (4) meteorological design criteria
and (5) meteorological data S E S

N79-17426*# Air Force Inspection and Safety Center Norton
AFB, Calif

SUMMARY REPORT OF THE VISIBILITY COMMITTEE

Robert L Gardner *In* Tenn Univ Space Inst Proc of the 2nd
Ann Workshop on Meteorol and Environ Inputs to Aviation
Systems Mar 1978 p 200-202

Avail NTIS HC A12/MF A01 CSCL 04B

Problems related to visibility and some possible solutions
are expressed Automatic weather stations aircrew education
and training slant range visibility, twelve airports planning and
designs for new runway guidance are discussed in improving
visibility S E S

N79-17427*# Lightning Technologies Inc Pittsfield Mass
**SUMMARY REPORT OF THE LIGHTNING AND STATIC
ELECTRICITY COMMITTEE**

J Anderson Plumer *In* Tenn Univ Space Inst Proc of the
2nd Ann Workshop on Meteorol and Environ Inputs to Aviation
Systems Mar 1978 p 203-214

Avail NTIS HC A12/MF A01 CSCL 04B

Lightning protection technology as applied to aviation and
identifying these technology needs are presented The flight areas
of technical needs include, (1) the need for In-Flight data on
lightning electrical parameters (2) technology base and guidelines
for protection of advanced systems and structures, (3) improved
laboratory test techniques (4) analysis techniques for predicting
induced effects (5) lightning strike incident data from General
Aviation (6) lightning detection systems (7) obtain pilot reports
of lightning strikes and (8) better training in lightning awareness
The nature of each problem, timeliness impact of solutions, degree
of effort required and the roles of government and industry in
achieving solutions are discussed S E S

N79-17428*# Aircraft Owners and Pilots Association Bethesda,
Md

**SUMMARY OF THE AIRCRAFT OPERATIONS COM-
MITTEE**

Robert T Warner *In* Tenn Univ Space Inst Proc of the 2nd
Ann Workshop on Meteorol and Environ Inputs to Aviation
Systems Mar 1978 p 215-218

Avail NTIS HC A12/MF A01 CSCL 04B

Severe storms and turbulence icing visibility and lightning are discussed in new programs on aircraft operations. The education of pilots and ground service personnel are reviewed. More available information of weather programs and services are examined. S E S

N79-17429*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
SUMMARY REPORT OF THE HUMAN FACTORS COMMITTEE

George E Cooper In Tenn Univ Space Inst Proc of the 2nd Ann Workshop on Meteorol and Environ Inputs to Aviation Systems Mar 1978 p 219-228

Avail NTIS HC A12/MF A01 CSCL 04B

Reduced visibility as a human factors problem was studied in terms of the number of lives lost and cost of aircraft accidents and incidents. Human factors in flight through turbulence in detection and avoidance techniques pilot and crew procedures for handling workloads and distractions caused by turbulence and aircraft handling techniques for safe flights through turbulence are investigated. Education and training were reviewed in icing problems on aircraft. Pilots failure to recognize and detect wind shear in severe storms is examined. The pilots avoidance of lightning is discussed from the human factors point of view. S E S

N79-17430*# Boeing Commercial Airplane Co Seattle Wash
SUMMARY REPORT OF THE AIRCRAFT DESIGN COMMITTEE

John T Rogers In Tenn Univ Space Inst Proc of the 2nd Ann Workshop on Meteorol and Environ Inputs to Aviation Systems Mar 1978 p 229-238

Avail NTIS HC A12/MF A01 CSCL 04B

Aircraft models were designed to solve aircraft lightning severe storms, turbulence icing and visibility problems. Analytical modeling wind tunnel simulation tests ground tests and in-flight tests were conducted. S E S

N79-17431*# Federal Aviation Administration Washington D C
SUMMARY REPORT OF THE WEATHER SERVICES COMMITTEE

Loren J Spencer In Tenn Univ Space Inst Proc of the 2nd Ann Workshop on Meteorol and Environ Inputs to Aviation Systems Mar 1978 p 234-236

Avail NTIS HC A12/MF A01 CSCL 04B

Weather services to severe storms turbulence icing visibility and lightning are discussed. Each weather phenomenon area was explored in terms of needs, problems related to providing services, and availability of timely and appropriate information. S E S

N79-17432*# National Weather Service Silver Spring Md
SUMMARY REPORT OF THE DATA ACQUISITION AND UTILIZATION

Mikhail Alaka In Tenn Univ Space Inst Proc of the 2nd Ann Workshop on Meteorol and Environ Inputs to Aviation Systems Mar 1978 p 238-243

Avail NTIS HC A12/MF A01 CSCL 04B

Data acquisition and utilization in terms of turbulence icing visibility, lightning and severe storms are discussed. The capability to generate the data data collection and reduction and data dissemination and distribution are studied. S E S

N79-17476*# Air Force Flight Dynamics Lab, Wright-Patterson AFB Ohio
THE OPTIMAL CONTROL FREQUENCY RESPONSE PROBLEM IN MANUAL CONTROL

Walter W Harrington In MIT Proc 13th Ann Conf on Manual Control 1977 p 3-16 refs

Avail NTIS HC A20/MF A01 CSCL 09B

An optimal control frequency response problem is defined within the context of the optimal pilot model. The problem is designed to specify pilot model control frequencies reflective of important aircraft system properties such as control feel system dynamics airframe dynamics and gust environment as well as man machine properties such as task and attention allocation. This is accomplished by determining a bounded set of control frequencies which minimize the total control cost. The bounds are given by zero and the neuromuscular control frequency response for each control actuator. This approach is fully adaptive. It does not depend upon user entered estimates. An algorithm is developed to solve this optimal control frequency response problem. The algorithm is then applied to an attitude hold task for a bare airframe fighter aircraft case with interesting dynamic properties. J M S

N79-17499*# Tufts Univ, Medford Mass
AIR TRAFFIC CONTROL BY DISTRIBUTED MANAGEMENT IN A MLS ENVIRONMENT

J G Kreifeldt, L Parkin, and S Hart (San Jose State Univ) In MIT Proc, 13th Ann Conf on Manual Control 1977 p 246-257 refs

(Grant NsG-2156)

Avail NTIS HC A20/MF A01 CSCL 17G

The microwave landing system (MLS) is a technically feasible means for increasing runway capacity since it could support curved approaches to a short final. The shorter the final segment of the approach the wider the variety of speed mixes possible so that theoretically capacity would ultimately be limited by runway occupancy time only. An experiment contrasted air traffic control in a MLS environment under a centralized form of management and under distributed management which was supported by a traffic situation display in each of the 3 piloted simulators. Objective flight data, verbal communication and subjective responses were recorded on 18 trial runs lasting about 20 minutes each. The results were in general agreement with previous distributed management research. In particular distributed management permitted a smaller spread of intercrossing times and both pilots and controllers perceived distributed management as the more ideal system in this task. It is concluded from this and previous research that distributed management offers a viable alternative to centralized management with definite potential for dealing with dense traffic in a safe orderly and expeditious manner. L S

N79-17501*# Tufts Univ Medford Mass Dept of Engineering Design

DESIGN OUTLINE FOR A NEW MULTIMAN ATC SIMULATION FACILITY AT NASA-AMES RESEARCH CENTER

J G Kreifeldt and O Gallagher In MIT Proc 13th Ann Conf on Manual Control 1977 p 266-271 refs

(Grant NsG-2156)

Avail NTIS HC A20/MF A01 CSCL 14B

A new and unique facility for studying human factors aspects in aeronautics is being planned for use in the Man-Vehicle Systems Research Division at the NASA-Ames Research Center. This facility will replace the existing three cockpit-single ground controller station and be expandable to include approximately seven cockpits and two ground controller stations. Unlike the previous system each cockpit will be mini-computer centered and linked to a main CPU to effect a distributed computation facility. Each simulator will compute its own flight dynamic and flight path predictor. Mechanical flight instruments in each cockpit will be locally supported and CRT cockpit displays of (e.g) traffic and or RNAV information will be centrally computed and distributed as a means of extending the existing computational and graphical resources. An outline of the total design is presented which addresses the technical design options and research possibilities of this unique man-machine facility and which may also serve as a model for other real time distributed simulation facilities. L S

N79-17618*# Massachusetts Inst of Tech Cambridge
ACQUISITION OF CONTROL INFORMATION IN A WIND SHEAR

J M Naish *In its Proc* 13th Ann Conf on Manual Control
 1977 p 453-458 refs

Avail NTIS HC A20/MF A01 CSCL 01C

When an aircraft encounters a change of air mass it may experience a change in horizontal wind sufficient to cause appreciable change in airspeed and therefore in lift. It may also suffer a change in vertical wind and, therefore, in vertical speed. The adverse combination of these effects may result in a significant excursion below the correct vertical profile and this may be especially serious if it happens during the latter part of an approach. Appropriate action should then be taken very quickly to avoid a situation from which the aircraft can scarcely recover, implying that suitable information needs to be readily accessible to the pilot. The purpose of this paper is to explore circumstances in which it is difficult to meet this requirement in conventionally equipped aircraft because of time factors affecting the flow of information.

Author

N79-17658# Toronto Univ (Ontario) Inst for Aerospace Studies

ON THE LOUDNESS OF SONIC BOOMS AND OTHER IMPULSIVE SOUNDS

Andrzej Niedzwiecki Dec 1978 106 p refs
 (Grant AF-AFOSR-2808-75)

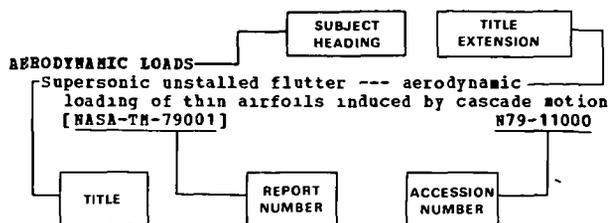
(UTIAS-236 CN-ISSN-0082-5255) Avail NTIS
 HC A06/MF A01

A loudspeaker-driven simulation booth with tended rise time capability (down to 0.22 ms) was used for four subjective loudness tests of sonic boom and other types of impulsive sounds in order to test methods for predicting the loudness of a given transient, provided its waveform or spectrum is known. The electrical input signal was predistorted to counteract the speaker-booth distortion. Three tests related to standard and nonstandard sonic boom waveforms, the other related to simulated quarry blast waves. Results in each series were compared with theoretical predictions. All but the long-duration quarry blast judgements were found to be in very good agreement in terms of relative loudness levels. With an ad hoc, but physically plausible modification (including adjustment of the critical integration time of the ear) the predicative method was extended to encompass the long duration signals as well.

A R H

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Typical Subject Index Listing



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A

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A79-20817

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A79-24087

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A79-24089

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[DGLR PAPER 78-225] A79-20482

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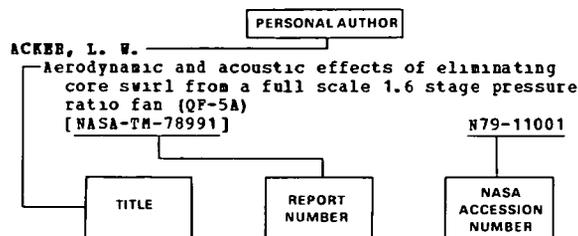
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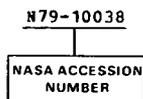
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