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NASA SP-7037 (110)
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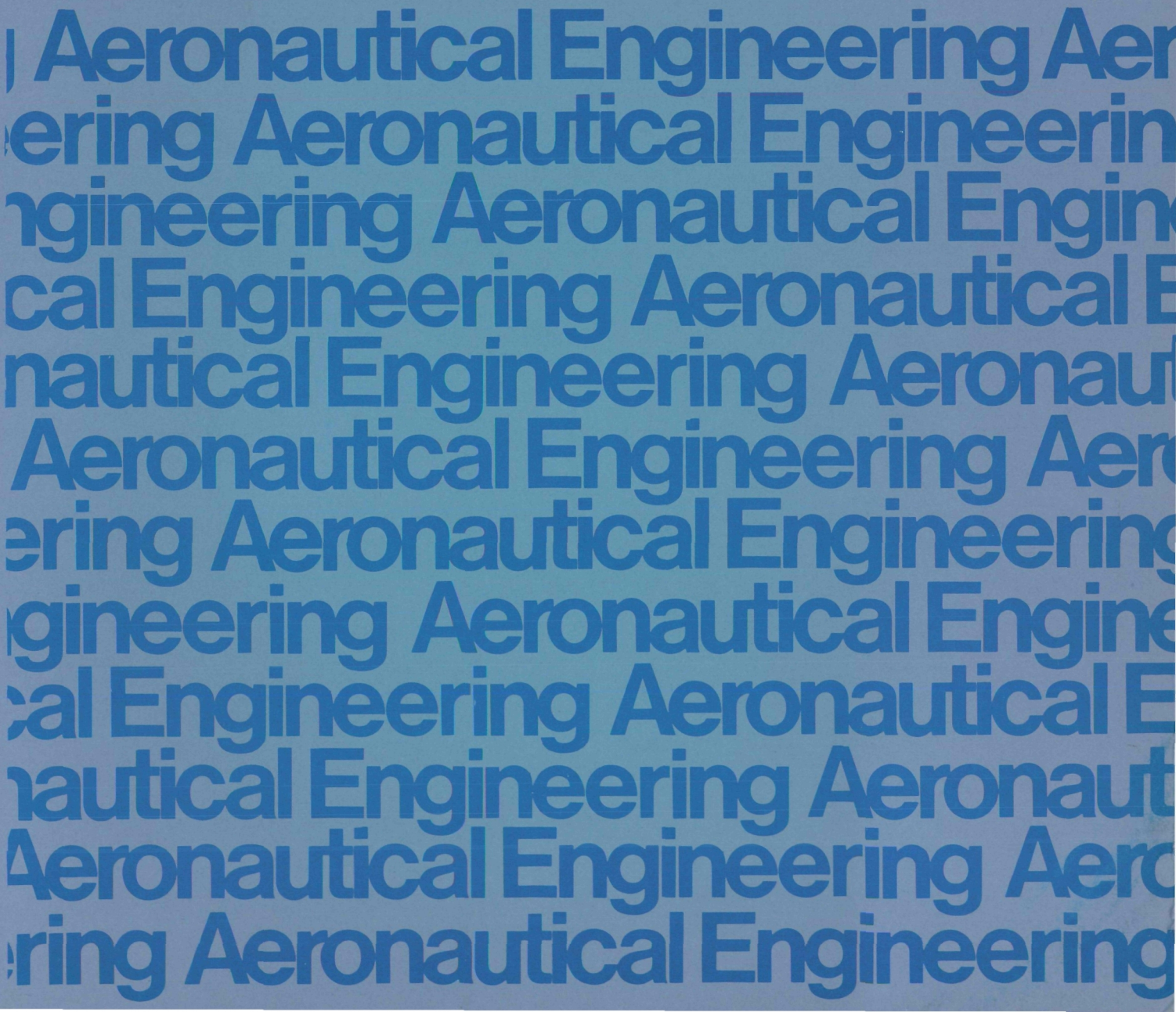

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NASA SP-7037 (110)

AERONAUTICAL ENGINEERING

A Continuing Bibliography

Supplement 110

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 May 1979 in

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

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This supplement to *Aeronautical Engineering -- A Continuing Bibliography* (NASA SP-7037) lists 504 reports, journal articles, and other documents originally announced in May 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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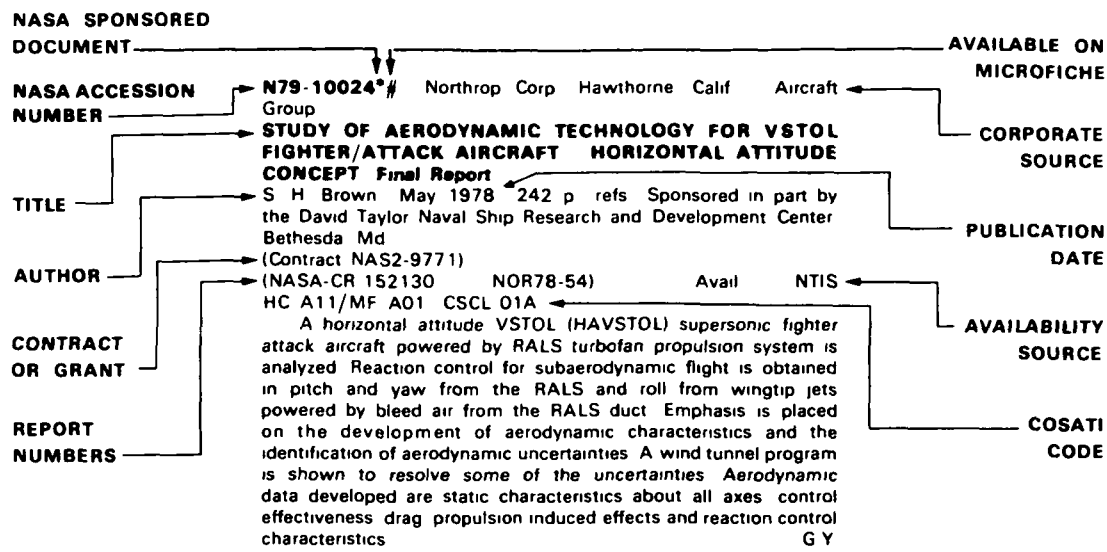

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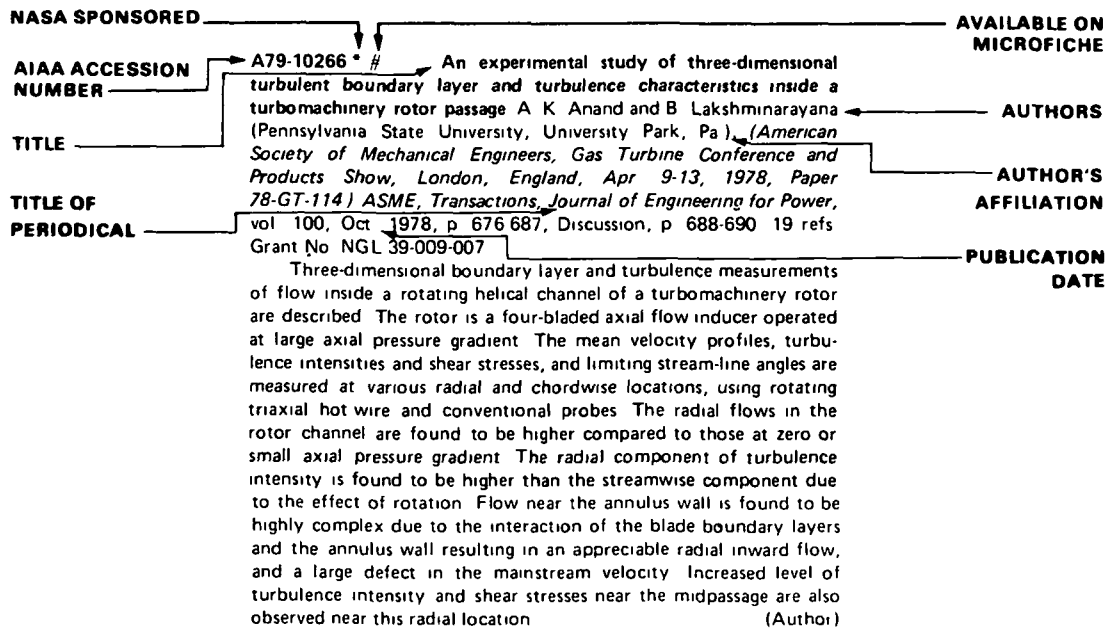

AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 110)

JUNE 1979

IAA ENTRIES

A79-24715 # **Modeling the X-band radar augmentation system of a high altitude supersonic target** W L Ko and R Mittra (Illinois, University, Urbana, Ill) In Antenna Applications Symposium, Urbana, Ill , September 20-22, 1978, Proceedings Urbana, Ill , University of Illinois, 1978 25 p Grant No DAAG29-77-G-0111

The objective of the HAST (high altitude supersonic target) radar augmentation system is to simulate real target variation in radar cross section (RCS) as a function of aspect angle In the present paper, detailed information is given on the individual radiation pattern modeling of the transmitting antenna system The procedure used to combine these individual patterns, taking into account the proper phase of each antenna, is outlined The simulated RCS is obtained by properly combining the data measured with the augmentation system off and the data generated from the analytical model A comparison of the measured RCS with augmentation system on and the simulated RCS shows that the analytical model of the augmentation system can accurately describe the aspect angle and the power level of the dominant radar returns from the scattering centers B J

A79-24716 # **RCS reduction of installed aircraft antennas** M S Sohel (General Dynamics Corp , Fort Worth, Tex) In Antenna Applications Symposium, Urbana, Ill , September 20-22, 1978, Proceedings Urbana, Ill , University of Illinois, 1978 12 p 8 refs

Techniques to predict and reduce radar cross-section of installed aircraft antennas are examined Their ranges of applications and limitations are outlined Only the classical theory predicts accurate RCS results and then only for simple shapes RCS varies widely due to aspect angles, polarizations and frequencies Assigning a single number for RCS of an antenna can be inaccurate at the desired aspect angle, polarization and frequency An equation to model the RCS of installed aircraft antennas is given Experimental results are needed to validate theoretical predictions (Author)

A79-24718 # **An IFF antenna with superior sidelobe and backlobe suppression characteristics** C W Westerman (Ford Aerospace and Communications Corp , Aeronutronic Div , Newport Beach, Calif) In Antenna Applications Symposium, Urbana, Ill , September 20-22, 1978, Proceedings Urbana, Ill , University of Illinois, 1978 15 p Grant No DAAH01-76-C-0583

When the sum beam sidelobes or backlobes of an IFF (identification friend or foe) antenna exceed the difference beam sidelobes or backlobes, punch-through is said to exist which causes interrogation in undesired directions Current IFF antennas using balanced array geometry typically suffer from backlobe punch-through because the difference pattern null is present both in the front and rear of the antenna This paper describes an 8-element stripline slot array with unsymmetrical array geometry which overcomes the backlobe punch-through problem Performance data are presented for the antenna which was developed as part of the IFF subsystem for use in the Chaparral Air Defense Weapon System B J

A79-24721 # **Aircraft antenna pattern measurements using near field techniques** J D Osborn (Martin Marietta Aerospace, Denver, Colo) In Antenna Applications Symposium, Urbana, Ill , September 20 22, 1978, Proceedings Urbana, Ill , University of Illinois, 1978 30 p 5 refs Contract No F33615-77-C 1070

Far field antenna patterns on operational aircraft are computed from near field measurements taken with a portable scanning system Measurement criteria are presented in conjunction with results from the Apollo Range Instrumentation Aircraft (A/RIA) antenna Parameters measured included patterns, gain, boresight alignment and radome effects Since the A/RIA antenna is larger than the maximum scan capability of 5 feet, techniques for effectively increasing the scan length are considered (Author)

A79 24726 # **A proposed integrated ECM system using the constant index lens antenna** E M Turner In Antenna Applications Symposium, Urbana, Ill , September 20 22, 1978, Proceedings Urbana, Ill , University of Illinois, 1978 15 p

It is demonstrated how the outstanding properties of the constant index lens can be used to design an integrated ECM or communications system which will have superior capability and flexibility and be light-weight, low-cost and readily installable on high performance aircraft The technique minimizes the incompatibilities of broadbandness versus low noise, omnidirectional coverage versus high gain, and large bandwidths versus selectivity Instantaneous readouts of frequency and angle of arrival are provided B J

A79-24771 * **A shock capturing application of the finite element method** C H Cooke (Old Dominion University, Norfolk, Va) and D K Blanchard (NASA, Langley Research Center, High Speed Aerodynamics Div , Hampton, Va) *International Journal for Numerical Methods in Engineering*, vol 14, no 2, 1979, p 271-286 Grant No NsG-1098

The paper is concerned with the development of finite element algorithms for the solution of viscous compressible flow problems with possible embedded shocks and recirculation regions As a first step, the calculation in Cartesian coordinates of uniform flow on a rectangular region which encounters an embedded oblique shock with known turning angle is considered A code is developed which is then used for computation of the boattail plume simulator problem in cylindrical coordinates Oblique shock calculations are performed and the results are compared with a known finite difference solution P T H

A79-24800 **The future of surveillance systems in civil aviation (L'avenir des systemes de surveillance dans l'aviation civile)** G Lefevre (Direction Generale de l'Aviation Civile, Service Technique de la Navigation Aerienne, Paris, France) *Navigation* (Paris), vol 27, Jan 1979, p 44-52 In French

The future of the current SSR (secondary surveillance radar) system for civil aviation has been put into question The present paper reviews the limitations of SSR and discusses three surveillance philosophies which may come to replace SSR the monopulse technique and the stochastic response secondary surveillance radar, the Discrete Address Beacon System and the Beacon Collision Avoidance System, and multifunction integrated systems B J

A79-24827 **Engine technology for production turbofan engines** B Walsh *Aviation Engineering and Maintenance,* vol 3, Feb 1979, p 28-31

Technologies sponsored by NASA for the improvement of the JT8D and JT9D turbofan engines used on commercial transports are discussed The four concepts in progress for the JT8D engine are (1) the development of an abradable trenched HP compressor blade resulting in a tighter blade clearance and an increase in the compressor's efficiency, (2) the modification of the turbine blade, (3) the replacement of the single pass blade with a two-pass root discharge blade with lower cooling air flow, and (4) the introduction of an advanced composite, the Kevlar PMR The concepts in progress for the JT9D are the design of a 3 8 aspect ratio fan blade for modifying aerodynamic airfoil, modification of first and second stage outer air seal supports, and coating of vane platforms and seal with Zirconia/NiCoCrAlY spray The new technologies are expected to provide fuel savings ranging from 0 8% to 1 5% A A

A79-24829 **Numerical study of unsteady flows of viscous incompressible fluids about airfoils by a combined method of order O/h2/ and O/h4/ (Etude numérique d'écoulements instationnaires de fluide visqueux incompressible autour de corps profilés par une méthode combinée d'ordre O/h2/ et O/h4/)** O Daube and T P Loc (Paris XI, Universite, Orsay, Essonne, France) *Journal de Mecanique,* vol 17, no 5, 1978, p 651-678 16 refs In French

A study of unsteady separated flows around bodies using the numerical solution of the Navier Stokes equations is presented The method is based on a combination of two finite difference schemes, one of second order accuracy, the other of fourth order accuracy Results obtained for unsteady flow around a circular cylinder are successfully compared with experimental data and with other numerical or semianalytical results The evolution of Von Karman vortices behind elliptic bodies is analyzed The time dependent flow structure is compared with experimental visualizations The evolution of the flow behind an elliptic cylinder for two different initial conditions is studied (Author)

A79-24958 **Reliability growth on B-52 FLIR system** J C Evans and S I Legreid (Hughes Aircraft Co , Culver City, Calif) In Reliability growth management, testing, and modeling, Proceedings of the Seminar, Washington, D C , February 27, 28, 1978 Mt Prospect, Ill , Institute of Environmental Sciences, 1978, p 18 22

The paper describes the application of a reliability screening and control program to an item of avionic equipment and the resultant reliability growth of that equipment The equipment, a B-52 forward looking IR (FLIR) sensor, was developed to provide IR imagery to the B-52 electrooptical viewing system Reliability data taken during the engineering development phase and on the first 100 production units are summarized It is shown that application of this reliability screening approach proves to be an extremely successful and cost-effective means for accelerating equipment reliability growths, as predicted The FLIR system passed a 1100-hr production reliability demonstration test with only six relevant failures against ten allowed Operational experience is equally impressive since the system exceeded required MTBF very early in its operational life S D

A79-24965 **Reliability growth planning to achieve RIW/ GMTBF requirements for an airborne radar** J B Hovis and D O Fieni (Westinghouse Electric Corp , Baltimore, Md) In Reliability growth management, testing, and modeling, Proceedings of the Seminar, Washington, D C , February 27, 28, 1978 Mt Prospect, Ill , Institute of Environmental Sciences, 1978, p 61-64 6 refs

A reliability engineering approach to meet reliability improvement warranty (RIW) requirements for the airborne fire control radar relies on a comprehensive design and test-analyze-and-fix (TAAF) program The starting point of the test program is a direct result of the effectiveness of the various reliability tools such as a failure mode and effects analysis (FMEA) and design checklist The final payoff is seen in the life-cycle costs reflected by the field MTBF The current field MTBF exceeds the predicted values derived from an inherent MIL-HDBK-217B prediction The guaranteed MTBF (GMTBF) imposed on the transmitter is not yet in effect However, the reliability growth performance of the unit seems to indicate that the specified value will be met S D

A79-25065 # **The influence of geometric asymmetry on the flow downstream of row of jets discharging normally into a free stream** D Crabb and J H Whitelaw (Imperial College of Science and Technology, London, England) *ASME, Transactions, Journal of Heat Transfer,* vol 101, Feb 1979, p 183-185

Wind tunnel measurements are presented which comprise values of mean velocity and the mass concentration of a tracer in the flow downstream of a row of jets issuing normally into a free stream The geometric configuration and velocity ratio are directly relevant to the combustion chamber of a gas turbine, and the results are obtained to quantify the influence of asymmetry in the hole arrangement on the downstream mean-flow properties The measurements are obtained with four locations of the central pipe, corresponding to zero eccentricity and to eccentricities of 0 5, 0 25 and 0 1 diameter, the precision of location of the central pipe is better than 0 005 diameter The results suggest that the asymmetries observed in the exit plane of gas turbine combustors are, at least in part, due to asymmetries in the location of the plunged primary and dilution holes S D

A79-25131 **Near-field analysis of helicopter rotating blades modulation interference** M K Moaveni and M Mohseni (Pahlavi University, Shiraz, Iran) *IEEE Transactions on Aerospace and Electronic Systems,* vol AES-15, Jan 1979, p 47-57 10 refs

A near-field analysis is carried out to obtain the level of modulation interference due to rotating blades in a helicopter-borne pulse Doppler radar system The interference power spectra are calculated for different values of antenna depression angle and helicopter (radar) speed at a constant helicopter altitude of 300 m Numerical results for the case of 1 kW radiated power show that blade interference level is about 5 to 8 dBW/Hz less than that of the direct ground clutter in the clutter region It extends, however, into the clutter-free region which may cause false alarms and degradation of the radar performance (Author)

A79-25139 **Radar system design for track-while-scan** R J Evans (Melbourne, University, Melbourne, Australia), C R Hewett (Royal Australian Air Force, Australian Embassy, Washington, D C), and F Barker (Plessey Radar, Ltd , Weybridge, Surrey, England) *IEEE Transactions on Aerospace and Electronic Systems,* vol AES-15, Jan 1979, p 125-133 5 refs

The problem of selecting search radar system parameters to achieve desired track-while-scan performance is investigated at a fundamental theoretical level The vehicle being tracked is modeled as an object traveling at a random velocity along a random highway The radar is modeled as a noisy sampler which occasionally drops samples The best achievable tracking performance in a least-squares error sense of this vehicle/sampler combination is analyzed in general and for a variety of specific situations (Author)

A79-25247 # **Characteristic aerodynamic coefficients at high Reynolds numbers (Charakterystyczne wspolczynniki aerodynamiczne przy duzych liczbach Reynoldsa)** J Staszek (Instytut Lotnictwa, Warsaw, Poland) *Technika Lotnicza i Astronautyczna,* vol 34, Jan 1979, p 25-28 6 refs In Polish

Recent wind tunnel tests and flight tests have confirmed the radical changes in the aerodynamic coefficients at high Reynolds numbers, especially in the transonic region Problems in extrapolating test results to higher Reynolds numbers are exemplified P T H

A79-25248 # **Introduction of electron beam welding in aircraft production (Wdrazanie spawania wiazka elektronow do produkcji lotniczej)** H Zatyka (Instytut Lotnictwa, Warsaw, Poland) *Technika Lotnicza i Astronautyczna,* vol 34, Jan 1979, p 29-33 15 refs In Polish

The results of initial attempts to develop applications of electron beam welding in aircraft production are discussed Examples of electron beam welds performed on various aircraft parts are shown, and some test methods are described Types of future experiments and weld studies to be carried out before full establishment of electron beam welding in the aircraft industry are identified P T H

A79-25249 # **Causes for the deterioration of splined connections in aircraft engines during service (Przyczyny uszkodzenia polaczen wielowypustowych w silnikach lotniczych w czasie ich eksploatacji)** M Stukonis (Instytut Techniczny Wojsk Lotniczych, Warsaw, Poland) *Technika Lotnicza i Astronautyczna,* vol 34, Jan 1979, p 34-37 5 refs In Polish

The in-service deterioration characteristics of splined connections for torque transmission in aircraft engines are investigated Data on the wear of the splines of torsion shafts in the gear box as a function of service time are studied It is found that conditions favorable to intense wear of the splines often exist at the contact surfaces in the presence of friction corrosion under the dominating influence of metal tacking or oxidation, depending on the load conditions, type of contact, and lubrication conditions P T H

A79-25296 **Overestimates of entrainment from wetting of aircraft temperature sensors in cloud** A J Heymsfield, J E Dye, and C J Biter (National Center for Atmospheric Research, Boulder, Colo) *Journal of Applied Meteorology,* vol 18, Jan 1979, p 92-95 8 refs NSF-sponsored research

Temperature measurements from aircraft, taken with a reverse flow and Rosemount probe, were compared in a penetration through a cloud to determine the effect of sensor wetting on the deduced entrainment The temperature measured using the Rosemount probe was depressed relative to that measured with the reverse flow probe, leading to an underestimate of the equivalent potential temperature and an overestimate of the deduced entrainment These results were used to identify possible errors in recent entrainment studies that used temperature as an indicator entrainment (Author)

A79-25313 **Recent advances in indirect lightning effects research** L C Walko, K J Maxwell, J G Schneider, and A V Serrano (Technology/Scientific Services, Inc , Dayton, Ohio) In International Symposium on Electromagnetic Compatibility, Atlanta, Ga , June 20-22, 1978, Proceedings New York, Institute of Electrical and Electronics Engineers, Inc., 1978, p 128-136 13 refs

Advances in lightning effects research are reported that include both test procedures and advances in data acquisition and analysis Advances in streamering tests, with which probable lightning reattachment points can be known more precisely, were made possible by the use of Tesla coils generating longer-duration high-voltage pulses that can sustain streamering on scaled down models of aircraft and full scale aircraft components A new improved lightning test simulation configuration has been developed, in which the return leads are situated farther from the fuselage and at the approximate height of the fuselage centerline Greater symmetry achieved in this way tends to minimize the influence of the return path Instead of an oscilloscope, the data acquisition system includes a signal processing system consisting of transient digitizer, minicomputer, CRT display, and graphic terminal A new frequency domain analysis approach is outlined. P T H

A79-25317 **Lightning protection with segmented diverters** J A Plumer (Lightning Technologies, Inc., Pittsfield, Mass.) and L C Hoots (Brunswick Corp , Marion, Va) In International Symposium on Electromagnetic Compatibility, Atlanta, Ga , June 20-22, 1978, Proceedings New York, Institute of Electrical and Electronics Engineers, Inc , 1978, p 196-203 13 refs Research supported by the Lockheed-Georgia Co , General Dynamics Corp , Brunswick Corp , General Electric Co , Douglas Aircraft Co , Lightning Technologies, Inc , and NOAA

One way of protecting radomes or other dielectric structures from lightning is through the use of segmented diverter strips These segmented strips provide many small air gaps that ionize and spark when an intense electric field is applied along the strip, as when a lightning leader approaches The diverter guides an external streamer to meet the leader before the internal streamer can puncture the radome wall Some tests were carried out to obtain data for lightning protection design with segmented diverters The goals were to compare the amount of voltage needed to flash over a segmented strip as compared with that needed to flash over an equal length of unprotected dielectric wall, to determine the effect of voltage rate of rise on strip breakdown voltage, and to determine optimal segmented diverter spacings These tests are described and their results are discussed P T H

A79-25319 **The impact of the total lightning environment on aircraft flight control systems** D W Clifford (McDonnell Aircraft Co , St Louis, Mo) In International Symposium on Electromagnetic Compatibility, Atlanta, Ga , June 20-22, 1978, Proceedings New York, Institute of Electrical and Electronics Engineers, Inc , 1978, p 211-217 12 refs

The extremely high peak currents (up to 200,000 A) associated with lightning, and rapidly changing magnetic fields appear to pose the most significant threat to aircraft electronic systems However, recently reported flight data, together with new information from laboratory tests, indicate that other aspects of the lightning flash, in particular electric field changes and radiated RF, may pose as much of a threat as the peak currents to modern well designed systems In the present paper, a 'total lightning threat scenario' is proposed that identifies the specific aspects of a lightning strike, which may affect avionics design and performance V P

A79-25321 **EMP coupling to a composite aircraft** R A Perala, K M Lee, and R B Cook (Mission Research Corp , Albuquerque, N Mex) In International Symposium on Electromagnetic Compatibility, Atlanta, Ga , June 20 22, 1978, Proceedings New York, Institute of Electrical and Electronics Engineers, Inc , 1978, p 233-237 7 refs Contract No F33615-77-C 5169

The present paper deals with external and internal coupling - two important factors in the exposure of an aircraft to a nuclear electromagnetic pulse (EMP) For an aircraft of advanced design, large portions of whose skin are made of a graphite epoxy composite material, numerical results are obtained for induced surface charges and currents (external coupling) and for skin-diffusion induced currents and voltages on typical cable runs inside the aircraft (internal coupling) It is shown that the hazard that may arise to aircraft electronics due to energy diffusion through a composite skin can be effectively eliminated by applying an aluminum flame spray coating to the skin V P

A79-25322 **Properties of induced transients associated with EM fields produced by lightning or other relatively slow rise-time EMP** R F Hess (Sperry Flight Systems, Phoenix, Ariz) In International Symposium on Electromagnetic Compatibility, Atlanta, Ga , June 20-22, 1978, Proceedings New York, Institute of Electrical and Electronics Engineers, Inc , 1978, p 238-242

When an aircraft encounters lightning, the resulting electromagnetic pulse (EMP) field produces subsystem wiring transients which contain several components A portion of the external EM environ-

ment associated with lightning penetrates to the aircraft interior and couples to the wiring which interconnects subsystem equipment An investigation is conducted regarding the influence of the time constants of the excitation waveform on the waveform of the induced transients It is found that even for the simple circuit configuration of a thin wire suspended in space, the induced response to EMP contains several components G R

A79-25323 FAA remote terminal system frequency assignment model C Cram (FAA, Systems Research and Development Service, Washington, D C) and T Hensler (U S Department of Defense, Electromagnetic Compatibility Analysis Center, Annapolis, Md) In International Symposium on Electromagnetic Compatibility, Atlanta, Ga , June 20 22, 1978, Proceedings
New York, Institute of Electrical and Electronics Engineers, Inc , 1978, p 278-281 U S Department of Transportation Contract No FA76WAI-612, Contract No F19628-78-C-0006 AF Project 649E

A system of interactive analysis models was developed for the Federal Aviation Administration (FAA) to provide automated, quick response capabilities for use by FAA frequency managers in solving frequency management problems This paper describes the frequency assignment model that was developed as part of the FAA's interactive system The model is used to make VHF (118-135 MHz) Air Traffic Control (ATC) frequency assignments The criteria used by the model, the operation of the model, and examples of the model's use are discussed in this paper (Author)

A79-25326 # Validation of IEMCAP using the B 52 F K Gardner and S A Davidson (USAF, Aeronautical Systems Div , Wright-Patterson AFB, Ohio) In International Symposium on Electromagnetic Compatibility, Atlanta, Ga , June 20-22, 1978, Proceedings New York, Institute of Electrical and Electronics Engineers, Inc , 1978, p 307-309

This study assessed the effectiveness of the Intrasystem Electromagnetic Compatibility Analysis Program (IEMCAP) in predicting antenna-coupled interference problems The B 52 aircraft is used in the case study The study concludes that IEMCAP does correctly predict a high percentage of actual interference problems (Author)

A79-25350 * Thermal response of composite panels D A Kourtides, W J Gilwee, Jr , and J A Parker (NASA, Ames Research Center, Moffett Field, Calif) *Polymer Engineering and Science,* vol 19, no 3, Feb 1979, p 226-231 10 refs

The thermochemical and flammability characteristics of laminating resins and composites currently in use and others being considered for use as aircraft interior panels are described The properties studied included (1) limiting oxygen index of the composite constituents, (2) fire containment capability of the composite, (3) smoke evolution from the composite, (4) thermogravimetric analysis, (5) composition of the volatile products of thermal degradation, and (6) relative toxicity of the volatile products of pyrolysis The performance of high-temperature laminating resins such as modified phenolics, polyimides and bismaleimides is compared with the performance of epoxies The relationship of increased fire safety with the use of polymers with high anaerobic char yield is shown Processing parameters of the state-of-the art epoxy resin and the advanced resin composites are detailed (Author)

A79-25368 # Objectives related to an enhancement of the effectivity of MALEV I (Aufgaben zur Erhohung der Effektivitat der MALEV I) E Vilmos (Ungarische Fluggesellschaft MALEV, Budapest, Hungary) *Technisch-okonomische Information der zivilen Luftfahrt,* vol 14, no 5, 1978, p 234-244 In German

The effectivity is obtained as the ratio of expenditure and result On the basis of an extension in the definition of effectivity, it is possible to relate an increase in effectivity to improved management leading to a better utilization of the given production factors An enhancement of the effectivity of the operation of an airline must be compatible with an increase in flight safety The reported investigation is particularly concerned with the obtained level of capacity utilization in the case of airliners Attention is given to developments regarding the yearly flight hours, the factors which have an effect on an extensive utilization, problems related to a suitable time interval selection for the study, the characteristics of the route network of the airline, the dependence of airline operation on the season, the characteristics of the employed aircraft types, the direct advantages of an increase in the extensive utilization of the transport capacity, and the conditions for an increase in specific flight-operational performance at MALEV G R

A79-25369 # Selective calling procedure in air traffic (Selektivrufverfahren im Luftverkehr) G Westphal (Gesellschaft fur Internationalen Flugverkehr mbH, Berlin, East Germany) *Technisch-okonomische Information der zivilen Luftfahrt,* vol 14, no 5, 1978, p 245-251 In German

The safety of air traffic requires the continuous guidance of aircraft by the air traffic control organization It is, therefore, necessary that the given communication channel is monitored without interruption on board of the aircraft Such monitoring activities, which involve also listening to calls between ATC and other aircraft, impose a great deal of psychic stress on the cockpit personnel Approaches for relieving the crew of a great part of this stress are considered The employment of the Selective Calling System (SELCAL) makes it possible that the cockpit personnel has to give attention only to calls directed to their aircraft Calls intended for an individual aircraft are recognized by means of a code used in the calling procedure The SELCAL device on board of the aircraft monitors the calling frequency and alerts the crew only when calls intended for their own aircraft are received A description is presented of the design of SELCAL units located on board of the aircraft and on the ground G R

A79-25370 # Control of the location of the center of gravity of loaded aircraft (Kontrolle der Schwerpunktlage beladener Flugzeuge) B Glockner (Gesellschaft fur Internationalen Flugverkehr mbH, Berlin, East Germany) *Technisch-okonomische Information der zivilen Luftfahrt,* vol 14, no 5, 1978, p 254-256 In German

One of the most basic requirements regarding flight safety is related to the correct location of the center of gravity of an aircraft Aircraft stability and controllability are directly affected by this location The optimization of center of gravity location as a function of flight altitude, flight Mach number, and flight weight can also have a favorable effect on flight economy by reducing the air resistance to a minimum value on the basis of small stabilizer setting angles A description is presented of a suitable approach for the determination of the center of gravity location of an aircraft The aircraft IL-62 is used as an example to illustrate the procedure for implementing the considered approach G R

A79-25371 # Statistics of disturbances and maintenance according to conditions at Interflug III - Technical requirements concerning the program for the processing of disturbance data by means of electronic data processing (Storstatistik und Zustandswartung bei der Interflug III - Technische Forderungen an das Programm zur Bearbeitung von Daten uber Storungen mittels EDV) J Liess (Gesellschaft fur Internationalen Flugverkehr mbH, Berlin, East Germany) *Technisch-okonomische Information der zivilen Luftfahrt,* vol 14, no 5, 1978, p 260-272 In German

The long-term storage of all data related to the operation of the airline makes it possible to obtain the numerical characteristics for extensive and intensive expansions on the basis of statistical studies and mathematical models Electronic data processing operations related to aircraft maintenance and repair are considered, taking into account procedures for the acquisition of the necessary data related to aircraft components and the aircraft themselves, data sets on magnetic-storage media, aspects of data coding, the data set for reports of operational disturbances, details regarding the information items to be recorded, the data set containing information regarding

the technical parameters of aircraft components, aspects of data flow procedures, and various data processing programs. G R

A79-25372 # **Aviation obstructions and the particular conditions for construction projects in the vicinity of airports (Luftfahrthindernisse und die besonderen Bedingungen fur das Bauen in der Umgebung von Flugplatzen).** E Harzbecker (Hauptverwaltung der zivilen Luftfahrt, Berlin, East Germany) *Technisch-okonomische Information der zivilen Luftfahrt,* vol 14, no 5, 1978, p 273-277 In German

Considerations regarding the safety of air traffic make it necessary to control construction activities in the vicinity of airports and air routes to avoid collision hazards produced by buildings and other structures which represent obstructions to the air traffic If existing constructions representing such obstructions cannot be removed, special steps must be taken to provide by means of signs and markings to pilots adequate warning of the existence of the flight obstructions. The approaches used in the German Democratic Republic for the demarcation of such obstructions are discussed, taking into account obstruction markings and lighting employed in the case of smokestacks and tall towers Legal restrictions concerning constructional designs and activities are also considered G R

A79-25482 **The prediction of fatigue crack growth under flight-by-flight loading** D Broek and S H Smith (Battelle Columbus Laboratories, Columbus, Ohio) *Engineering Fracture Mechanics,* vol 11, no 1, 1978, p 123-141 12 refs Navy-sponsored research

Techniques for dealing with random or quasi-random service-load histories were recently proposed In this paper, the adequacy of these new techniques for fatigue crack growth under flight-by-flight loading is examined The load spectrum used is a fighter spectrum in the form of a basic load sequence of 72,000 cycles for 6000 flight hours The experimental materials considered are Ti-6Al-4V mill-annealed plate and 7075-T73 aluminum alloy plate Two adjustable retardation models for crack growth analysis are discussed the Wheeler (1972) model and the Willenborg (1971) model The Wheeler model is preferable for accurate prediction of crack propagation under flight-by-flight loading because it can be adjusted independent of baseline crack growth data, whereas the Willenborg model can be adjusted only by selecting another set of crack growth data The only satisfactory way to apply a safety factor to crack growth predictions is to apply a factor to fatigue crack growth life S D

A79-25484 **Four lectures on fatigue crack growth** J Schijve (Delft, Technische Hogeschool, Delft, Netherlands) *Engineering Fracture Mechanics,* vol 11, no 1, 1978, p 167-177, 179-185, 187-221 58 refs

The cited lectures deal with fatigue crack growth and fracture mechanics, fatigue cracks, plasticity effects and crack closure, fatigue crack propagation, prediction and correlation, and fatigue crack growth under variable-amplitude loading Fatigue life is divided into a crack nucleation period and a crack propagation period, and the similarity approach for correlating fatigue data is introduced The role of crack closure in fatigue crack growth is analyzed Two prediction techniques (cycle-by cycle prediction and prediction by correlation) for fatigue crack propagation are described Stationary and nonstationary types of variable-amplitude loading are specified The significance of crack closure for understanding crack growth under variable-amplitude loading is emphasized Illustrative examples are presented throughout the text S D

A79-25485 **Fundamentals of design I - 'Whys' and 'wherefores' of wings** B R A Burns *Air International,* vol 16, Feb 1979, p 81-85

Wing design is discussed considering the effect of the aspect ratio, sweep, taper, thickness, camber, twist, and high lift devices on its performance For example at high subsonic speed there is a relationship between wing thickness/chord ratio and sweep allowing for the same design Mach number 30 deg sweep with 10% t/c and 40 deg sweep with 12% t/c being roughly equivalent The amount of nose and rear camber depends on the design lift value, with the best characteristics obtainable by leading-edge and trailing edge droop which is variable with incidence Minimum drag and maximum lift in subsonic flight is obtainable by deflecting leading edge droop and trailing edge flaps progressively as incidence increases Future combat planes are expected to combine automatic wing sweep with a more smoothly cambered wing section, making it possible for the aircraft to change its sweep as it accelerates or decelerates and camber its wing with increasing incidence for efficient operation in all flight conditions A A

A79-25491 **System for the display of extracted radar data on the basis of minicomputer-controlled display devices /DERD-MC/ for an employment in Air Traffic Control (System zur Darstellung extrahierter Radardaten auf der Basis minicomputergesteuerter Sichtgerate /DERD-MC/ fur den Einsatz in der Flugsicherung)** B E Schafer (Bundesanstalt fur Flugsicherung, Frankfurt am Main, West Germany) *Ortung und Navigation,* no 3, 1978, p 395-408 In German

The currently employed system for the display of extracted radar data (DERD-I) represents a first design stage The four regional ATC centers in West Germany employ identical systems Essential functions are related to the reception and the processing of digitized radar data, the synthetic representation of the air traffic situation on display devices, the display of additional information, such as maps and tables, and the processing of input data from the controller A number of disadvantages and restrictions concerning the DERD-I are to be eliminated with the aid of an improved system in which the display device is controlled by minicomputer Data processing operations are performed in a Central Computer Complex The improvements provided by the new DERD-MC system are discussed G R

A79-25492 **Navstar/GPS /Global Positioning System/ and electronic counter measures (Navstar/GPS /Global Positioning System/ und elektronische Stormassnahmen)** D Ernst (Bundesamt fur Wehrtechnik und Beschaffung, Koblenz, West Germany) *Ortung und Navigation,* no 3, 1978, p 409-426 In German

Certain weaknesses of the currently used radio navigation system Tacan are to be overcome with the aid of the satellite navigation system Navstar which is presently being developed in the U S These weaknesses include the susceptibility of Tacan against electronic counter measures (ECM) However, even Navstar remains vulnerable to ECM An investigation is conducted regarding the utilization of Navstar in the presence of ECM, taking into account the most effective approach which can be used by the enemy to disturb the navigational functions Attention is given to the Navstar transmitter, the basic structure of Navstar receivers, and the functioning of Navstar receivers under the conditions of EMC G R

A79-25505 # **Analysis of longitudinal natural vibrations of deformable aircraft by the finite-element method** Z Dzygadlo and J Blaszczyk *Journal of Technical Physics,* vol 19, no 2, 1978, p 223 234 9 refs

A finite-element dynamic model is used to analyze the vibration modes and frequencies of a deformable aircraft Calculations have been carried out for a hypothetical aircraft with constant mass and stiffness parameters along the length of the deformable units The method is applied to the natural vibrations of a training aircraft B J

A79-25517 # **Dynamics of controlled longitudinal motion of an airplane with a variable-geometry wing** Z Dzygadlo and J Maruszkiewicz *Journal of Technical Physics,* vol 19, no 3, 1978, p 371 382 7 refs

A method for controlling the perturbed longitudinal motion of a variable sweepback aircraft is proposed based on the assumption that the flight speed remains unchanged during the process of sweepback change and static equilibrium conditions are satisfied at the final moment of the sweepback process for a prescribed inclination of the flight trajectory The motion of the aircraft is analyzed numerically for increasing and decreasing sweepback The controlled motion of the aircraft is found to be characterized by small perturbations of flight parameters B J

A79-25541 # **Flight deck alarm systems.** E Edwards (Aston, University, Birmingham, England) *Aircraft Engineering,* vol 51, Feb 1979, p 11-14

Aircraft alarm systems are examined and a detailed checklist for their systematic evaluations is presented Various taxonomies relating to methods for the classification of alarms are noted, including degree of urgency, nature of event, nature of appropriate action, and sensory modality of alarm The human factors aspects of individual alarms are reviewed, indicating various problems and their possible solutions The design of total alarm systems is described in the light of suggestions for improving their efficiency A A

A79-25542 # **Safety of air transport** W Tye (Civil Aviation Authority, London, England) *Aircraft Engineering,* vol 51, Feb 1979, p 15-20

General issues and human factor questions relating to air safety are discussed The controllability of and constraints to safety, the balance between safety and cost, responsibility for deciding safety level, public attitude to safety, and the business of achieving high safety are taken into account Three categories into which the great part of human errors may be grouped are noted failure to apply the best strategy to the flight, failure to comprehend the situation, and failure to control the aircraft The causes of errors and their avoidance are considered in the context of matching the flight crew to the aircraft, designing to accomodate error, learning from occurrences, sub-standard airworthiness, the old-aircraft problem, and problems of warning systems It is concluded that it is preferable to put more effort in the area of warning design, minimizing thus false warnings, even at the expense of reliability of functioning when needed A A

A79-25618 # **Behavior of elastic systems in separated flow (Povedenie uprugikh sistem pri otryvnom obtekanii)** A S Vol'mir, V V Guliaev, and A T Ponomarev *Akademiia Nauk SSSR, Doklady,* vol 243, Dec 1, 1978, p 886 888 In Russian

A numerical approach is taken to the aeroelastic problem of the aerodynamic loading of a thin airfoil in separated flow The study is carried out in the context of nonlinear wing theory and takes account of disturbances introduced in the flow by the deformed structure The numerical model is based on the method of discrete vortices and the thin lifting surface scheme Total aerodynamic loading is determined with consideration of flow prehistory and deformations of the body Numerical results show that deformation of the body leads to a significant reduction in its oscillations B J

A79-25681 Adaptation of a digital airborne radar for use on the microphysics research aircraft R S Anderson (Meteorology Research, Inc , Altadena, Calif) and G M Naegele (National Center for Atmospheric Research, Boulder, Colo) In Conference on Radar Meteorology, 18th, Atlanta, Ga , March 28-31, 1978, Preprints . Boston, Mass , American Meteorological Society, 1978, p 370-375 U S Bureau of Reclamation Contract No 14-06-D-7699

A description is presented of a single range gate video integrator and the modifications made to the RDR-130 weather avoidance radar The modifications are related to the rectification of the cockpit display image to make it more representative and quantita tive in terms of the meteorology, steps taken to allow operation of a single range gate analog video integrator, and the acquisition of a complete digital record of the display image via an onboard computer-weather radar interface Attention is given to the radar characteristics, the integrator decoder, the memory decoder, the video integrator, circuit details, and aspects of digital image recording G R

A79-25689 Design considerations for the NOAA airborne meteorological radar and data system B L Trotter (NOAA, Environment Research Laboratories, Boulder, Colo) In Conference on Radar Meteorology, 18th, Atlanta, Ga , March 28-31, 1978, Preprints Boston, Mass , American Meteorological Society, 1978, p 405-408

Experience with the NOAA DC-6 and C130 aircraft had shown at the time of the acquisition of the two new NOAA WP3D aircraft that a definite need existed to develop a weather research radar and data system for the WP3D aircraft A description is presented of an airborne system that was designed to enhance the capabilities of the WP3D's which were scheduled for multidisciplinary research programs in the atmospheric sciences Expectations for use of the radar and data system are related to hurricane research, severe storm research, and basic research The described airborne system is currently operational on both of the NOAA WP3D aircraft The NOAA C130 aircraft has a nose radar that is identical to the ones installed in the nose of the WP3D's G R

A79-25718 * SIFT - Design and analysis of a fault-tolerant computer for aircraft control J H Wensley, L Lamport, J Goldberg, M W Green, K N Levitt, P M Melliar-Smith, R E Shostak, and C B Weinstock (SRI International, Menlo Park, Calif) *IEEE, Proceedings,* vol 66, Oct 1978, p 1240-1255 12 refs Contract No NAS1-13792

SIFT (Software Implemented Fault Tolerance) is an ultrareliable computer for critical aircraft control applications that achieves fault tolerance by the replication of tasks among processing units The main processing units are off-the-shelf minicomputers, with standard microcomputers serving as the interface to the I/O system Fault isolation is achieved by using a specially designed redundant bus system to interconnect the processing units Error detection and analysis and system reconfiguration are performed by software Iterative tasks are redundantly executed, and the results of each iteration are voted upon before being used Thus, any single failure in a processing unit or bus can be tolerated with triplication of tasks, and subsequent failures can be tolerated after reconfiguration Independent execution by separate processors means that the processors need only be loosely synchronized, and a novel fault-tolerant synchronization method is described (Author)

A79-25750 Aircraft fire protection and rescue procedures /2nd edition/ Edited by C E Williams and J W Laughlin Stillwater, Okla , Oklahoma State University, Fire Protection Publications (General Fire Service Training Manuals No 206), 1978 247 p $7 00

The manual informs all fire service personnel about problems that may arise should an aircraft disaster occur in their area Information on all general aircraft related methods of fire attack and rescue procedures is given In particular, the manual helps firefighters select techniques and procedures applicable to the facilities available to them Areas of interest include aircraft types, engines and systems, apparatus and equipment, airfield operations, and planning and communications Also discussed are forcible entry tools, explosive cargo and nuclear weapons, and post-incident operations S D

A79-25845 # **Dynamic data analysis** D S Pearson (Rolls-Royce, Ltd , London, England) *Transducer Conference, Wembley, Middx , England, June 26-28, 1978, Paper* 16 p

The requirements for basic dynamic transducers, objectives in their use, and simple logistics of the engine as well as information elements of a gas turbine development process are introduced Editing techniques are presented by complementary analysis methods through which pre-edited data may be converted selectively into engineering information in a compact and simple form Four case histories are used to illustrate the techniques, with the first two recording respectively frequency information derived from several strain gauges during uniform engine acceleration of a blade standard known to fail, and comparative 'g' amplitude data from an accessory gear-box having a major accessory mounted at extremes of an acceptable clamp tightness specification Cases three and four illustrate respectively distribution of stress, and an engine mounted accessory used to control the engine throttle A A

A79-25849 # **Recording methods for steady state and transient signals** E N Jones (Rolls-Royce, Ltd , London, England) *Transducer Conference, Wembley, Middx , England, June 26-28, 1978, Paper* 15 p

The paper presents data recording techniques in the testing of aircraft engines in transient and steady state regimes (take-off and cruising, and the transition between them) Parameters measured include gas or liquid pressure, gas or metal temperature, fuel flow, static or dynamic strain, vibration, speed, thrust, and sound pressure The centralized data processing system for high accuracy steady state data, the noncentralized system for wideband processing of steady state data and the transient data processing system are described and diagrams given The UV film recording system for transient data, and analog FM and direct recording tape recorders for dynamic data are discussed, with digital tape recorders in the minority It is projected that the role of on-line processing of test data will increase and the use of UV recorders will diminish, although analog recorders will continue to be employed A L W

A79-25850 # **Pressure measurement in air data instrumentation** A N Du Feu (Smiths Industries, Ltd , Aviation Div , Cheltenham, England) *Transducer Conference, Wembley, Middx , England, June 26 28, 1978, Paper* 18 p 5 refs

The study was concerned with pressure measurements insofar as they affect such key output quantities as altitude, calibrated air speed, and Mach number Absolute and differential pressures are determined for three ranges of tolerances greater than 0 5 mbar, between 0 5 and 0 2 mbar, and below 0 2 mbar Using these data, a fully automated pressure test module has been constructed with precise control of dynamic pressure characteristics, the ability to control environmental tests from the software, and the ability to interrupt the program, scan data, and execute additional tests from the keyboard and return to the program B J

A79-25853 * # **Technology for future air transports** J M Klineberg (NASA, Office of Aeronautics and Space Technology, Washington, D C) *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 15th, Washington, D C , Feb 6-8, 1979, Paper 79-0529* 10 p

The requirements and opportunities for technological development in transport aircraft of the next generation are reviewed, focusing primarily on conventional, subsonic aircraft Advances in computational aerodynamics and computer-aided design and manufacturing (in numerically controlled processes) are noted as well as improved wind tunnel testing and drag reduction techniques Advances in aeroelasticity prediction have made it possible to use flexible, high-aspect ratio wings without large weight penalties Weight reduction may be achieved by the use of composite aircraft structures and superplastic forming combined with diffusion bonding, however composites require improvement in manufacturing techniques and mechanical properties in order to gain general acceptance Propulsion systems can be improved in engine fuel efficiency, control, durability, environmental compatibility (exhaust and noise emissions), and fuel specifications In avionics, due to the growth of low-cost, miniaturized packages, opportunities exist in the fields of digital controls, navigation, guidance and communication Applications of new technologies to various aspects of flight safety are also outlined A L W

A79-25856 * # ***Lean combustion limits of a confined premixed-prevaporized propane jet*** K L Huck (NASA, Lewis Research Center, Cleveland, Ohio, Martin Marietta Aerospace, Bethesda, Md) *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 15th, Washington, D C , Feb 6-8, 1979, Paper 79-0538* 9 p 10 refs

An experimental study was carried out to determine the effects of jet velocity and confinement on lean premixed-prevaporized propane/air blowout limits The combustor consisted of a single hole flameholder within a quartz liner Five flameholder plates and two quartz liners were used Lean stability limits were mapped for confined propane jet in cylindrical combustor Three zones of flame stability were observed depending on the liner and jet Reynolds number and the combustor geometry At low Reynolds number the combustor was jet stabilized As the Reynolds number was increased the combustor became either recirculation zone stabilized, or for small recirculation zone step sizes, the combustor was wall stabilized The factors affecting stability seem to be the Reynolds numbers of the liner and inlet jet along with the flameholder step size Stability was achieved at both laminar and turbulent conditions S D

A79-25859 # **Control system time response optimization - A nonlinear programming approach** M R Pouliot (General Dynamics Corp , Electronics Div , San Diego, Calif) *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 15th, Washington, D C , Feb 6-8, 1979, Paper 79-0540* 10 p 13 refs

Typically, the time response of a flight control system is a function of variables such as amplifier gain constants or rate gyro sensitivity settings In this paper, a formal nonlinear programming procedure for choosing an optimal combination of these control variables is proposed and investigated To demonstrate this approach to control system analysis, a pitch orientation autopilot for a transport jet aircraft is used as an example This particular system is dependent upon two control variables Variation of these two parameters will produce an array of system responses A performance index is then formulated in terms of transient time response characteristics and minimized via the control variables to obtain the optimum system response Three parameters are used to define the performance index rise time, damping ratio, and peak overshoot For the basic system solution, rise time is minimized while inequality constraints are imposed upon both damping ratio and peak overshoot through the use of penalty functions A family of solutions are then generated, analyzed, and compared to other solutions derived via classical analysis techniques (Author)

A79-25861 * # **Characteristics of the wake of a lightly loaded compressor or fan rotor** B D Reynolds (Pennsylvania State University, University Park, Pa) *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 15th, Washington, D C , Feb 6-8, 1979, Paper 79-0550* 17 p 27 refs Contract No NsG-3012

An experimental investigation was carried out to evaluate the properties of the rotor fan or compressor wake in order to understand the structure of the wake This included a study of profile shape, decay characteristics, effects of rotation, and effects of varying blade loading on the wake Rotating triaxial hot-wire probe measurements were reported which represent the first systematic data in the near wake region of the rotor wake using this technique It is found that the radial, tangential, and axial components of mean velocities and turbulence intensities decay very rapidly near the rotor blade trailing edge, and that increased blade loading reduces the decay rates of axial and tangential mean velocity defects and radial velocities in the wake In particular, the presence of an almost constant wake width region for increasing axial distance shows the effects of three-dimensionality on the rotor wake flow Other conclusions are also given S D

A79-25862 # **Advances in avionics** G W Church (Bendix Corp , Avionics Div , Ft Lauderdale, Fla) *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 15th, Washington, D C , Feb 6-8, 1979, Paper 79-0562* 6 p

Advances in avionics are discussed with emphasis on microprocessor technology The general aviation computer programmer capable of restoring and recalling ten navigational frequencies, the electronic course deviation indicator working through a programmable memory, and the airborne weather radar displaying simultaneously weather and the route to be flown are considered Develop-

ments in integrated circuitry are described particularly noting the progressive reduction in their purchasing price (e g , circuitry that cost $10 eighteen years ago is purchasable today for only 30 cents) The introduction of electronic technologies into general aviation is taken into account, including microwave landing system, and flight director system The challenge to find ways for keeping the pilot in the logic loop despite his being surrounded with electronic logic far exceeding his own capacity is mentioned A A

A79-25863 * # **A visual investigation of the separation and subsequent transition near the leading edge of airfoils** A V Arena (Notre Dame, University, Notre Dame, Ind) *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 15th, Washington, D C , Feb 6-8, 1979, Paper 79-0552* 11 p 9 refs Grant No NsG-1419

Subsonic (5 to 30 m/sec) wind tunnels were used to measure pressure distributions at the leading edge and upper surface of airfoil models and to obtain high-speed movie photographs of smoke-visualized separation, transition, and reattachment phenomena Points of turbulent shear layer reattachment could be determined by using an oil-mixture coating on the surface Plots of the static pressure coefficient along the chord of several models are presented, and the measured separation, transition, and reattachment points are plotted against the chord Reynolds number V P

A79-25865 # **Helicopter rotor radius optimization** A M Ahsan (Rosemount, Inc , Eden Prairie, Minn) *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 15th, Washington, D C , Feb 6-8, 1979, Paper 79-0554* 9 p 6 refs

The study focuses on various methods of producing an optimum rotor radius, where the term optimum means reduction of helicopter rotor to the extent that it can perform effectively without losing much of its aerodynamic capabilities The ideal helicopter envisioned has to carry only two or three persons including the pilot To understand the basics of helicopter rotors, the study is divided into three parts The first part deals with the efficiency criteria of a helicopter rotor, namely the figure of merit The second part considers the aerodynamic characteristics of a helicopter rotor The third part examines minimum power requirements for an optimum rotor, both for hovering and forward flight regimes It is shown that by increasing the number of blades the rotor radius can be reduced for a fixed weight and air density, and that taking into account the tip loss factors and nonuniform downwash reduces the optimum rotor size The results match very closely with helicopter rotors in current use S D

A79-25866 # **General aviation aircraft in the 1990's** M S Harned (Cessna Aircraft Co , Wichita, Kan) *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 15th, Washington, D C , Feb 6-8, 1979, Paper 79-0560* 9 p

Demands and improvements in the field of general aviation aircraft during the 1990's are discussed Projected increases in affluence are expected to lead to a substantial growth in the personal ownership of aircraft noting the subsequent demands, especially in the safety domain where emphasis is placed in improving the areas of weather prediction, approach speed, pressurization and radar systems, and centerline thrust The need for fuel efficiency improvements is stressed, noting that by 1990 fuel will probably have more than doubled in price Composite materials such as the aramid and graphite fibers with epoxy bonds, highly reliable low-cost computers, large scale integration of semiconductors, and lean burning techniques with fuel injection are expected to be widely used in the general aviation aircraft Models of future general aviation aircraft are presented, including a turbocharged diesel-powered four-place family airplane Centrifugal compressors as well as the pusher propeller concept are taken into account A five-fold increase in general aviation business is predicted for the decade of the 90's A A

A79-25869 # **Lifting surface theory for skewed and swept subsonic wings** N T Frink *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 15th, Washington, D.C , Feb 6-8, 1979, Paper 79-0551* 11 p 11 refs Grant No DAAG-76-G-0318

A new method is developed for solving the lifting surface equation for thin subsonic wings which can also be interpreted as a vortex lattice method The downwash equation is transformed into double integrals involving Cauchy-type singularities in the chordwise and spanwise directions A technique developed by Lan for airfoil theory is used to reduce both integrals to a double summation This method properly accounts for the leading-edge singularity, Cauchy singularity, and Kutta condition The solutions generally compared well with other lifting-surface theories, but with much smaller computational times, and the method was found to be more accurate and converge faster than conventional vortex lattice methods (Author)

A79-25870 * # **NASA research on general aviation power plants** W L Stewart, R J Weber, E A Willis, and G K Sievers (NASA, Lewis Research Center, Cleveland, Ohio) *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 15th, Washington, D C , Feb 6-8, 1979, Paper 79-0561* 10 p 7 refs

Research activities within NASA to support general aviation industry in improving propulsion engines are described Near-term objectives include improvements of gasoline piston engines to achieve fuel savings and reduce emissions well below EPA levels To meet the longer term goals, advanced combustion research has been considered as essential in obtaining further improvements in BSFC (break specific fuel consumption) Modifications of an aircraft rotary engine were tested and it was found that by increasing the compression ratio and other refinements the BSFC was improved by 15% The applicability of available large turbofan engine technology to small engines in order to obtain significant reductions in noise and pollutant emissions is being tested Studies have been conducted at exploring the possibility of achieving high improvements in cost and performance for turboprop engines of less than 1000 horsepower A A

A79-25872 # **Slender wing in compressible flow (Tonkoe krylo v szhimaemom potoke)** E A Krasil'shchikova Moscow, Izdatel'stvo Nauka, 1978 226 p 91 refs In Russian

The book deals with the derivation of a mathematical theory of small disturbances generated in a compressible medium by the motion of a slender wing and by acoustic waves interacting with the wing A general method is proposed for studying the unsteady potential field from arbitrary unsteady motions of the wing The method is shown to be well suited for calculating flows past wings with supersonic leading edges In the study of two-dimensional unsteady fields, solutions to boundary value problems are obtained by a method based on the used integral equations in characteristic variables Quadrature solutions are obtained to two- and three-dimensional problems involving unsteady flows past an isolated wing and past wings interacting with acoustic waves incident on the wing V P

A79-25875 # **Redundant control systems for flight vehicles (Izbytochnye sistemy upravleniia letatel'nymi apparatami)** A D Epifanov Moscow, Izdatel'stvo Mashinostroenie, 1978 146 p 49 refs In Russian

In this book, the fundamentals of the theory of adaptive control systems are outlined, and vector-matrix equations for redundant systems of advanced digital flight control are derived Attention is given to the adaptation of strapdown redundant sensor inertial navigation systems to a digital computer and the evaluation of failure detection algorithms for such systems V P

A79-25876 **Recent General Electric engine development testing for improved service life** R C Turnbull (General Electric Co , Evendale, Ohio) *Society of Automotive Engineers, Aerospace Meeting, San Diego, Calif , Nov 27-30, 1978, Paper 780990* 22 p 5 refs

More exact simulation of engine in-service operating conditions by accelerated development test program improvements - T700/F101/F404/CFM56/CF6 - are reviewed for lessons learned towards earlier identification/solution of engine life extension problems Improved design features, improved analysis and test simulation of mission cycles, improved component test techniques and, in general, increased emphasis on demonstrating required minimum *service life prior to production are briefly discussed Possible future* direction of these efforts is indicated for consideration in General Engine Specification revisions (Author)

A79-25877 **The application of a design verification system and accelerated mission testing to gas turbine engine development** B J McDonnell (United Technologies Corp , Pratt and Whitney Aircraft Group, West Palm Beach, Fla) *Society of Automotive Engineers, Aerospace Meeting, San Diego, Calif , Nov 27-30, 1978, Paper 780991* 13 p

Advanced techniques for the design and development of high technology gas turbine engines are discussed, considering the improved design Verification System (DVS) and the Accelerated Mission Test (AMT) concept The first technique, originally developed by NASA for use in the space programs, provides the designer of a gas turbine engine with feedback data showing the relationship between his predictions and the actuals through two advanced tools the computer analytical prediction systems, and the high technology instrumentation Sputtered sensor, optical clearance vibration, fiber optics, and engine radiography techniques are employed in the instrumentation device While the DVS verifies that the basic design is *founded on sound assumptions, the AMT exposes the design to the* damaging portions of the mission duty cycle to prove by test that the hardware will operate satisfactorily for its predicted life under flight operation conditions The techniques are being applied to current and advanced engine programs with good success A A

A79-25878 **Planning the development and qualification process for the next generation of high technology aircraft engines** S M Hudson and W L McIntire (General Motors Corp , Detroit Diesel Allison Div , Detroit, Mich) *Society of Automotive Engineers, Aerospace Meeting, San Diego, Calif , Nov 27-30, 1978, Paper 780992* 14 p 13 refs

The concurrent requirements to maximize performance and minimize cost and program risk provide a great challenge for the weapon-system planner and the propulsion-system manager The propulsion-system development process consists of the definition of requirements, the selection of the appropriate technology, the design and fabrication of the configuration, the verification of characteristics, and the resolution of problems identified during the verification phase The development process must be structured to be consistent with the current procurement policies and be responsive to requirements of timing and funding constraints This paper addresses the development process for the high-technology aircraft engine in the light of recent military engine experience and the current policies and constraints (Author)

A79-25879 **Requirements and constraints in the development and qualification of gas turbine engines for the Navy** M E Dell (U S Naval Air Propulsion Test Center, Trenton, N J) and M D Mead (U S Naval Air Systems Command, Washington, D C) *Society of Automotive Engineers, Aerospace Meeting, San Diego, Calif , Nov 27-30, 1978, Paper 780994* 11 p

An improved approach to the development and qualification of aircraft turbine engines has been developed by the Navy The approach places emphasis on durability testing throughout the engine development program This testing is intended to assure that structural requirements have been achieved upon the introduction of new engines into service The approach utilizes three different types of durability tests each of which is intended to address a separate aspect of the overall durability problem (Author)

A79-25880 * **Prop-fan propulsion - Its status and potential** J F Dugan, Jr (NASA, Lewis Research Center, Cleveland, Ohio), B S Gatzen, and W M Adamson (United Technologies Corp , Hartford, Conn) *Society of Automotive Engineers, Aerospace Meeting, San Diego, Calif , Nov 27-30, 1978, Paper 780995* 22 p 43 refs

Studies have established that advanced turboprop (prop-fan) equipped aircraft will reduce fuel consumption by 15 to 30 percent compared to aircraft equipped with high-bypass turbofan engines of *equivalent technology A reduction in direct operating costs of* approximately 10 percent has been identified for commercial aircraft as well as approximately 20 percent lower gross weight airplane for long endurance military missions The prop fan propulsion system is being investigated as part of the NASA Aircraft Energy Efficiency program which includes both analytical studies and experimental tests The experimental work encompasses performance and acoustic *wind tunnel tests on several prop-fan models The prop-fan tech*nology status is reviewed in the major areas of performance, installed effects, cabin noise, blade structure and maintenance cost Also, further activities required to complete the technical validation of prop-fans are described (Author)

A79-25881 * **Propeller slipstream wing interactions at Mach no 0 8** D P Bencze, R C Smith (NASA, Ames Research Center, Moffett Field, Calif), H R Welge, and J P Crowder (Douglas Aircraft Co , Long Beach, Calif) *Society of Automotive Engineers, Aerospace Meeting, San Diego, Calif , Nov 27-30, 1978, Paper 780997* 11 p 11 refs

Configuration and results of a wind tunnel test of the *aerodynamic interactions between propeller slipstream and a super*critical wing at transonic Mach numbers are discussed The test was conducted over a free-stream Mach number range from 0 7 to 0 84, with the slipstream simulator and the wing-body model installed in the tunnel The angle of attack and the spanning lift coefficients were varied from 1 to 3 deg and from 0 4 to 0 7 deg respectively, while the slipstream swirl angle was varied from 0 to 11 deg with an upwash on the inboard side of the wing It was found that at a free-stream Mach number of 0 8 and a lift coefficient of 0 5, incremental drag results for 7 deg of swirl and a slipstream Mach number of 0 87 indicated a penalty equivalent to a 0 024 loss in propeller efficiency, whereas at 11 deg the drag increment was favorable Swirl had significant effects on the chordwise pressure distributions of the inboard section of the wing within the slipstream Neither surface nor wake pressures showed signs of significant flow separation induced by the slipstream A A

A79-25882 **TDS - A preliminary design system for turbines** R R Wysong (General Electric Co , Fairfield, Conn) *Society of Automotive Engineers, Aerospace Meeting, San Diego, Calif , Nov 27-30, 1978, Paper 780999* 21 p Contract No F33615-75-C-2073

The Turbine Design System (TDS) is a time sharing computer system developed for preliminary design and performance evaluation of axial flow turbines having up to ten stages TDS is an interactive, modularized system incorporating aerodynamic, heat transfer and structural analyses in a contiguous arrangement Each task-oriented module addresses one major facet of the design process This paper *discusses the overall system philosophy and organization, the input/* output data flow, the tasks performed, and the functional utilization of the system Selected results of a sample case are shown (Author)

A79-25883 **Integrally cast turbine rotor for high volume production** L A Junod and J R Arvin (General Motors Corp , Detroit Diesel Allison Div , Detroit, Mich) *Society of Automotive Engineers, Aerospace Meeting, San Diego, Calif , Nov 27-30, 1978, Paper 781000* 9 p

The goal is to design an integrally cast wheel with blades which can be produced from high volume production tooling An auto-

mated procedure is described to determine the optimum radial orientation, or 'stacking', of turbine rotor blade sections to give a design which satisfies both high production manufacturing and rotor structural requirements High production manufacturing requires that the spaces between blades be pulled away from the wheel in a generally radial direction to release the wax replica of the wheel from the tooling Structural requirements are expressed in terms of bending stress constraints A pullability index is defined to indicate the amount of interference to be encountered in removing the tooling This index is optimized with respect to the direction of removal of the tooling Bending stress requirements are simultaneously satisfied (Author)

A79-25884 An alternating direction explicit method for computing three-dimensional viscous flow fields in turbomachines L Walitt (Numerical Continuum Mechanics, Inc , Woodland Hills, Calif), C Y Liu (California, University, Los Angeles, Calif), and J L Harp, Jr (Thermo-Mechanical Systems Co , Canoga Park, Calif) *Society of Automotive Engineers, Aerospace Meeting, San Diego, Calif., Nov 27-30, 1978, Paper 781001* 26 p 21 refs

A numerical method has been developed to solve the steady three dimensional Reynolds-averaged Navier-Stokes equations by successive approximations The method is applicable to rotors of axial or radial compressors and turbines Viscous flow fields were calculated in the blading passages of an axial supersonic compressor cascade, a radial impeller and a backswept impeller Pressure measurements on the cascade blades agreed with corresponding computations Radial impeller calculations showed suction blade separation, while backswept calculations indicated shroud separation This paper describes the numerical method in detail, with results presented as numerical examples (Author)

A79-25885 * An in-place recalibration technique to extend the temperature capability of capacitance-sensing, rotor-blade-tip-clearance measurement systems J Barranger (NASA, Lewis Research Center, Cleveland, Ohio) *Society of Automotive Engineers, Aerospace Meeting, San Diego, Calif , Nov 27-30, 1978, Paper 781003* 14 p

It is known that capacitance-sensing, rotor-blade-tip-clearance measurement systems suffer from a strong dependency on probe tip temperature and humidity A novel in-place recalibration technique partly overcomes this problem through a simple modification of the electronics that permits a scale factor correction The technique is used to reduce the errors in a commercial system by more than 50 percent up to a temperature of 370 C (700 F) A probe design is proposed to further raise the maximum temperature capability of the measurement system (Author)

A79-25892 Environmental factors affecting the installation and operation of gas turbine engines in agricultural aircraft G M Hogg (Pratt and Whitney Aircraft of Canada, Ltd , Longueuil, Quebec, Canada) *Society of Automotive Engineers, Aerospace Meeting, San Diego, Calif , Nov 27-30, 1978, Paper 781010* 17 p 6 refs

The operational and economic environments associated with agricultural aircraft have dictated several changes to basic turbine engine installation procedures As the ingestion of chemicals can cause rapid distress in the engine hot section, intake systems are proposed Aircraft missions are analyzed, and the effect of high cycle time on major rotating components explained In addition, with jet fuel seldom available at remote fields, alternates such as diesel and gasoline - together with their limitations - are dealt with Operational data is reviewed, recent studies and developments outlined, and the future of the gas turbine engine in agricultural aircraft discussed (Author)

A79-25893 Methanol, ethanol and jet fuel emissions comparison from a small gas turbine J B Pullman (Santa Clara, University, Santa Clara, Calif) *Society of Automotive Engineers, Aerospace Meeting, San Diego, Calif , Nov 27-30, 1978, Paper 781013* 23 p 26 refs

A 60 hp gas turbine engine has been easily converted to operate on methanol and ethanol fuels No unusual fuel system hardware problems were experienced during 15 hours of testing with methanol and one hour of testing with ethanol Our computer model's predicted low emissions of NOx and CO for methanol were closely approximated after the installation of an air atomizing fuel nozzle Substantial NOx reductions also resulted from ethanol fuel Hydrocarbon unburned fuel emissions were increased with methanol and ethanol Agreement is found with five previously reported methanol gas turbine experiments which indicate from 60% to 80% NOx reductions in comparison with distillate-type fuels Combustor inlet temperature variation is considered as one cause of variability of reported CO emissions with methanol Droplet size effects and increased ignition delay are considered to adversely affect methanol's CO and hydrocarbon emissions Detailed emissions data for NOx, NO, NO2, CO and hydrocarbons are reported for several series of fuel nozzle tests with methanol, ethanol and Jet A fuels (Author)

A79-25894 Strike Drone - A defense suppression concept using unmanned cruise/loiter/attack vehicle F D Groutage (U S Naval Ocean Systems Center San Diego, Calif) *Society of Automotive Engineers, Aerospace Meeting, San Diego, Calif , Nov 27-30, 1978, Paper 781017* 27 p 12 refs

A concept for an advanced defense suppression system using an unmanned (bomb rack launched, 500 lb class air launched) vehicle with cruise/loiter/attack capabilities has been developed Guidance commands are provided by either a radiation sensor or a flight reference unit depending upon the phase of the trajectory (anti-radiation during attack/flight reference during cruise and loiter) Two airframe configurations (mono wing and cruciform) were analyzed for the three phases of the flight trajectory Overall systems requirements such as speed, weight, thrust levels, maneuverability, cross section and control configurations were formulated (Author)

A79-25895 Recognition of damage-tolerance in civil airworthiness standards. J E Dougherty (FAA, Washington, D C) *Society of Automotive Engineers, Aerospace Meeting, San Diego, Calif , Nov 27-30, 1978, Paper 781019* 6 p

Amendments relating to the structural fatigue evaluation requirements are described The amendments improve and update the airworthiness standards applicable to the type certification of civil transport category airplanes They take into account state-of-the-art developments and accumulated service experience The authority for and origin of the related rules is also briefly traced The interest in world-wide acceptance of these new standards is noted (Author)

A79-25896 Damage-tolerance practices applied to transport aircraft structures M Stone (Douglas Aircraft Co , Long Beach, Calif) *Society of Automotive Engineers, Aerospace Meeting, San Diego, Calif , Nov 27-30, 1978, Paper 781021* 7 p

Practices in the design and testing of jet transport aircraft structures to comply with damage tolerance regulations are listed, including the acquisition of loading spectra from aircraft mission profiles, the use of multiload path construction, the use of crack stoppers to limit crack growth and the detailing of design Results are then reported of an investigation of structural analysis programs used in design Crack propagation and residual stress analytical predictions of crack length and critical loads of a fatigue-cracked wing panel were verified by comparison with test results Future activities will include the development of a multiple crack analysis program and testing to obtain more complete crack propagation data, in order to enable the establishment of safe inspection periods A L W

A79-25897 Technology and the new look meet the F/A-18 radar reliability challenge F B Nelson and C F Farrell (Hughes Aircraft Co , Culver City, Calif) *Society of Automotive Engineers, Aerospace Meeting, San Diego, Calif , Nov 27 30, 1978, Paper 781024* 7 p

The Naval Air Systems Command's 'New Look Acquisition Fundamentals' program establishes requirements and incentives for achieving reliability and maintainability in contracted systems, as well as imposing stringent disciplines on design, testing, and manufacturing The paper discusses the application of the program requirements to the F/A-18 airborne radar system, especially as it relates to the simplifications in system architecture and hardware design necessary for increased reliability and maintainability The reliability specified for the F/A-18 radar is 106 hours Mean Time Between Failures (MTBF) Microminiaturized digital computers in control and signal processing have contributed to the replacement of dedicated analog circuits by more reliable digital software, and the application of these concepts to the F/A-18 radar is described The implementation of parts selection and derating, testing and production quality control disciplines is discussed, and the distribution of contract incentives indicated Thus far, increases in reliability and maintainability have been achieved and prospects are favorable A L W

A79-25899 Effects of fuel properties on soot formation in turbine combustion D W Naegeli and C A Moses (U S Army, Fuels and Lubricants Research Laboratory, San Antonio, Tex) *Society of Automotive Engineers, Aerospace Meeting, San Diego, Calif , Nov 27-30, 1978, Paper 781026* 11 p 25 refs Grant No DAAK70-78-C 0001, Contract No N00140-77-C-1345

A combustor rig instrumented for measuring flame radiation, exhaust smoke, and gaseous emissions is used to study the sensitivity of combustor performance to the physical and chemical properties of fuels used in turbine combustion These fuels include petroleum-base jet fuels, JP 5 syncrudes, water-fuel emulsions, and hybrid aromatic/methanol solutions Examination of the effects of aromatic content, ring carbon content, and hydrogen-to-carbon (H/C) ratio on the flame radiation and exhaust smoke reveals that H/C ratio is the most effective indicator of soot formation There is no observed effect of viscosity and end point on flame radiation and smoke It is suggested that the mechanism for soot formation in the turbulent diffusion flame of a turbine combustor is due to gas-phase reactions and essentially independent of molecular structure Water appears to play an important chemical role in soot reduction, probably as an additional source of hydrogen S D

A79-25900 Shale oil - The answer to the jet fuel availability question L C Angello, A V Churchill, C L Delaney, and H R Lander (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio) *Society of Automotive Engineers, Aerospace Meeting, San Diego, Calif , Nov 27-30, 1978, Paper 781027* 11 p

The Air Force began in 1974 a program to investigate the possibility of using alternative domestic liquid hydrocarbons, primarily shale oil, as sources for the standard jet fuel, JP-4, in order to ensure adequate fuel availability at an acceptable cost The paper discusses the results of this program and its future goals Results of processing studies on alternative hydrocarbon sources from shale oil are presented, it is found that shale oil processing resulted in specification turbine fuel when hydrotreated at 1500 psi, while coal liquids failed to meet specifications even when hydrotreated to 2200 psi Fuel derived from shale oil was also found to be economically competitive under proper conditions Results from shale oil-derived fuel combustion studies are presented, showing the effects of hydrogen and nitrogen content on combustor liner temperature, smoke and NOx emission A projection of future specifications of Air Force aviation fuels is then presented A L W

A79-25901 Life Cycle Cost in advanced technology engine development F W Tegarden and W W Shoemaker (General Electric Co , Advanced Engineering and Technology Programs Dept , Cincinnati, Ohio) *Society of Automotive Engineers, Aerospace Meeting, San Diego, Calif., Nov 27-30, 1978, Paper 781029* 13 p

A computerized Life Cycle Cost (LCC) model to be applied at advanced technology stages of aircraft turbine engine development in order to characterize trade-offs between cost and performance is presented The model employs parametric relationships between such factors as cost, performance, weight, life and maintainability and includes considerations of airframes and missions The data base contains cost, weight and performance data of a supersonic attack aircraft equipped with two advanced technology turbofan engines Program modules for research, development, testing and evaluation, acquisition, and operation and support cost areas are described and flow charts for each module and for the entire model are presented The model has been applied to six trade-off studies, treating component, maintenance, and flight time variations, and results are presented in terms of deviations from baseline costs A L W

A79-25902 Applying design-to-life cycle cost methods during engine advanced development J R Apel and D E Wiltse (Teledyne CAE, Toledo, Ohio) *Society of Automotive Engineers, Aerospace Meeting, San Diego, Calif , Nov 27-30, 1978, Paper 781030* 10 p 6 refs

In order to make better decisions during advanced development of turbine engines, life cycle cost (LCC) methodologies must adequately reflect the impact of engine design decisions on the total system LCC Two applications of Teledyne CAE's APSICOST Methodology are presented herein These demonstrate the integrated nature of turbine engine LCC analyses with total aircraft system LCC. It is recommended that a joint airframe/propulsion/government effort be undertaken to standardize methods for reflecting aircraft system LCC impacts in turbine engine advanced development activities (Author)

A79-25903 Turbine engine cost reduction using Life Cycle Cost techniques C E Curry, R V Earle, and G H Pedersen (General Motors Corp , Detroit Diesel Allison Div , Indianapolis, Ind) *Society of Automotive Engineers, Aerospace Meeting, San Diego, Calif , Nov. 27-30, 1978, Paper 781031* 9 p 8 refs Contract No F33657-77-C 0425

This paper describes the technical approach and development of methodologies used to conduct design trade studies from a Life Cycle Cost standpoint A discussion of computer program capability is followed by a general discussion of several engine design trade studies The potential for influencing engine design using a Life Cycle Cost methodology is emphasized (Author)

A79-25904 Life cycle cost in preliminary engine design J Vernon (United Technologies Corp , Pratt and Whitney Aircraft Group, West Palm Beach, Fla) *Society of Automotive Engineers, Aerospace Meeting, San Diego, Calif , Nov 27-30, 1978, Paper 781032* 7 p

The life cycle cost (LCC) effects of the F100-PW 100 engine design life and duty cycle on the F 15 weapon system LCC are analyzed The analysis reveals that (1) the preliminary design phase presents the first and most profitable opportunity to maximize the cost effectiveness of life-limited engine parts, (2) the weapon system life cycle and engine duty cycle must be accurately determined early in the engine design and continually updated in order to fully benefit from trade studies involving part life, cost, weight, and LCC, (3) the ratio of total engine operating hours to engine flight hours is far greater than generally thought, (4) small weight increases in life-limited parts often provide considerable LCC savings, (5) the trade between engine weight and manufacturing cost is a variable which depends on the actual part life and the engine life cycle, and (6) designing major parts for full engine life pays off in reduced weapon system LCC A A

A79-25905 Trade-off studies with an interactive engine/airframe life-cycle-cost model D H Comey, D G Culy, and J E Cassidy (AiResearch Manufacturing Company of Arizona, Phoenix, Ariz., Rockwell International Corp , Pittsburgh, Pa) *Society of Automotive Engineers, Aerospace Meeting, San Diego, Calif , Nov. 27-30, 1978, Paper 781033* 10 p

The purpose of this paper is to show the importance of interactive connections between the engine and airframe sections of an

aircraft life-cycle-cost model in performing trade-off studies A model is defined that can accept engine descriptions at the part level, and aircraft mission descriptions for each segment An important feature of the model is airframe and engine resizing as a result of changes in mission and engine design parameters Three different trade-off studies are shown to illustrate the versatility of this type of model The effects of not resizing the airplane and engine are also shown - (Author)

A79-25906 V/STOL aircraft engine and mechanical drive component integration S M Hudson and P E Beam, Jr (General Motors Corp , Detroit Diesel Allison Div , Detroit, Mich) *Society of Automotive Engineers, Aerospace Meeting, San Diego, Calif , Nov 27-30, 1978, Paper 781038* 15 p 7 refs

The paper addresses the general propulsion system requirements of V/STOL aircraft as they apply to mechanical drive components These requirements have been defined in some of the recent and continuing multimission subsonic aircraft design efforts and the studies of high-performance aircraft The mechanical drive components include gears, bearings, clutches, and shafting that interconnect the engines, lift and propulsion fans, and rotors in various V/STOL aircraft defined in recent system studies The design and the current state of development of individual mechanical drive components may influence the aircraft design Gearbox cases and structural requirements are also discussed, with special emphasis on organic composites for weight reduction, noise suppression and corrosion resistance improvement S D

A79-25907 Advanced overrunning clutch technology J G Kish (United Technologies Corp , Sikorsky Aircraft Div , Stratford, Conn) *Society of Automotive Engineers, Aerospace Meeting, San Diego, Calif , Nov 27-30, 1978, Paper 781039* 15 p 7 refs Grant No DAAJ02-74-C-0028

This paper summarizes the results of a 3 year research program to advance the state-of-the-art in helicopter free-wheel units (overrunning clutches) by permitting operation at 20,000 rpm By designing the free-wheel unit to operate at engine input speed instead of at the speed of the 2nd reduction where it is usually located, the torque, and hence size and weight of the unit, will be reduced High-speed designs, test results, and application of the designs to the UH-60A Black Hawk are presented for spring, sprag, and ramp roller types of overrunning clutches (Author)

A79-25908 Advanced technology applied to the CH-47D drive system S Binder and J C Mack (Boeing Vertol Co , Philadelphia, Pa) *Society of Automotive Engineers, Aerospace Meeting, San Diego, Calif , Nov 27-30, 1978, Paper 781040* 10 p 5 refs

The U S Army CH-47D helicopter modernization program incorporates improvements in all major subsystems The drive train has been redesigned to incorporate evolutionary improvements which will increase reliability, survivability, and maintainability This paper describes the background experience that led to the selection of VASCO X-2 high hot-hardness gear steel, it also discusses design improvements in the integration of components, in lubrication and diagnostic systems, in overrunning clutches, and in noise reduction New capabilities to predict and measure gear bending stresses and resonant frequencies have been developed and are described as part of a systems design approach (Author)

A79-25909 The Lynx transmission and Conformal gearing B A Shotter (Westland Helicopters, Ltd , Yeovil, Somerset, England) *Society of Automotive Engineers, Aerospace Meeting, San Diego, Calif , Nov 27-30, 1978, Paper 781041* 9 p

A description of the Lynx transmission is linked with the basic factors which determined its general form This gear system is compared with other alternatives and an improved Lynx system is also shown which gives even higher load capacity Some of the characteristics of the output stage Conformal gears are given, together with a description of a few of the development stages through which the gears have passed (Author)

A79-25915 Use of radio controlled models in the conceptual development of V/STOL aircraft R W Kress (Grumman Aerospace Corp , Business Development Dept , Bethpage, N Y) *Society of Automotive Engineers, Aerospace Meeting, San Diego, Calif , Nov 27-30, 1978, Paper 781050* 15 p

The effectiveness of using radio controlled models in aircraft development programs is examined The experience reviewed indicates that radio controlled models are statically correct for hover and provide a good indication of aircraft static stability and control In the case of hover, they are dynamically dissimilar from a rotational point of view, however, in the initial stages of airplane design, most of the key issues pertaining to V/STOL concepts are static rather than dynamic issues Also, the model response rates are much faster than full scale (roughly a 3 to 1 speedup) If flying with crude equipment proves possible, the chances of operating at full scale are probably excellent Another important factor is that radio controlled models are inexpensive V P

A79-25916 An unstable subsynchronous critical speed solution M Kershisnik (Sundstrand Corp , Rockford, Ill) and E Harding (General Dynamics Corp , Fort Worth, Tex) *Society of Automotive Engineers, Aerospace Meeting, San Diego, Calif , Nov 27-30, 1978, Paper 781055* 8 p

The occurrence of shaft failures in the engine start system (ESS) of the F-16 aircraft is discussed, and the solution to the problem is presented During the test stand testing of a two part high speed shaft and gearbox of the ESS it was found that the shaft exhibited a first bending synchronous critical speed just below or in the lower portion of the operating speed range of the gearbox, and a re-excitation of the same critical speed at a frequency below the rational speed in the upper portion of the operating speed range The subsynchronous re-excitation was attributed to the friction generated at the pilot/spline interfaces between the gearbox input shaft and the shaft coupled to it Since the unstable critical occurs above the first bending critical speed, the input shaft and power takeoff shaft were redesigned to raise the first bending critical to at least 15% above the ESS operating speed range, with the results from such figuration showing an absence of any critical speed response in the operational range A A

A79-25917 * Evaluation of the application of some gas chromatographic methods for the determination of properties of synthetic fuels A C Antoine (NASA, Lewis Research Center, Cleveland, Ohio) *Society of Automotive Engineers, Aerospace Meeting, San Diego, Calif , Nov 27-30, 1978, Paper* 45 p 6 refs

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 16 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 (Author)

A79-26130 # Aircraft static charging testing J Taillet (ONERA, Châtillon-sous Bagneux, Hauts-de-Seine, France) *(Conférence sur la Certification des Avions pour les Dangers dus a la Foudre et a l'Electricité Statique, Châtillon-sous-Bagneux, Hauts-de-Seine, France, Sept 11-13, 1978) ONERA, TP* no 1978 110, 1978 11 p 9 refs Research supported by the Direction des Recherches, Etudes et Techniques de l'Armement, Service Technique des Telecommunications de l'Air, and Avions Marcel Dassault-Breguet Aviation

Static charge accumulation on aircraft structures can produce three types of discharges sparks between conductors, streamers over insulating surfaces, and coronas at sharp points and edges All these discharges induce radioelectric noise on navigation/communication equipment, thereby reducing equipment performance and impairing flight safety The paper outlines the solutions proposed by ONERA to meet the requirements of safe protection In order to apply the test technique rapidly and efficiently, specific instruments are designed and implemented at ONERA, which will be commercially available in the near future A general description of their performance is given Finally, a practical application to real aircraft is described in some detail S D

A79-26246 The analysis and identification of flux-induced voltage transients on low-loss transmission lines with application to the Lightning-Transient-Analysis /LTA/ problem W S McCormick (Wright State University, Dayton, Ohio) *IEEE Transactions on Electromagnetic Compatibility*, vol EMC 21, Feb 1979, p 13-19 6 refs

One of the acknowledged lightning threats to aircraft is the induction threat in which a lightning-induced fuselage skin current inductively or capacitively flux couples through small dielectric 'holes' or apertures in the fuselage onto internal avionics cabling In order to optimize the circuit protection, it is necessary to identify both the nature and location of the flux excitation Using standard capacitor bank LTA testing, this paper advances a linear system-identification technique, based on the impulse response, that will define both the nature and location of the dominant excitations The technique is then successfully applied to the identification of the Yaw Damper Circuit of the USAF F-111 (Author)

A79-26354 # Visual simulation devices for flight training simulators (Imitatory vizual'noi obstanovki trenazherov letatel'nykh apparatov) V S Babenko Moscow, Izdatel'stvo Mashinostroenie, 1978 144 p 53 refs In Russian

The basic theoretical principles behind the visual simulation of flight environments are elaborated Detailed consideration is then given to the design and operation of three types of visual flight simulation systems systems which use optical memory devices, TV-based simulators, and simulators based on analog or digital image synthesis B J

A79-26355 # Aerodynamics of flame jets (Aerodinamika fakela) L A Vulis and L P Iarin Leningrad, Izdatel'stvo Energiia, 1978 216 p 101 refs In Russian

The work elaborates an aerodynamic theory of turbulent gaseous flame jets and presents new data on the influence of various combustion-regime parameters on flame characteristics A method for computing the characteristics of turbulent flame jets is outlined and applied to unmixed-gas flames and homogeneous flames The use of low-frequency oscillations in order to intensify and control the combustion process in turbulent flame jets is examined B J

A79-26400 * Elevated-temperature effects on strain gages on the YF-12A wing J M Jenkins, R A Field, and W J Sefic (NASA, Flight Research Center, Edwards, Calif) *(Society for Experimental Stress Analysis, Spring Meeting, Wichita, Kan , May 14-18, 1978) Experimental Mechanics*, vol 19, Mar 1979, p 81-86 12 refs

A general study is made of the effects of structural heating on calibrated-strain-gage load measurements on the wing of a supersonic airplane The primary emphasis is on temperature-induced effects as they relate to slope changes and thermal shifts of the applied load/strain relationships These effects are studied by using the YF-12A airplane, a structural computer model, and subsequent analyses Such topics as the thermal environment of the structure, the variation of load paths at elevated temperature, the thermal response characteristics of load equations, elevated-temperature load measurement approaches, the thermal calibration of wings, and the correlation of strains are discussed Ways are suggested to measure loads with calibrated strain gages in the supersonic environment (Author)

A79-26487 Quasi-natural numerical methods for the computation of inviscid potential or rotational transonic flows J A Essers (Liege, Universite, Liège, Belgium) *Applied Mathematical Modelling*, vol 3, Feb 1979, p 55-66 21 refs

A new fast time-dependent method for the computation of inviscid potential or rotational transonic flows is described The method is significantly faster than the classical time-dependent techniques, and is constructed in order to be especially very efficient at transonic and at low speed flow regimes It is applied to the computation of the transonic flow in a nozzle with small throat radius of curvature The results compare favourably with those of other computations and with experimental measurements (Author)

A79-26498 # A simulator study of aircraft ground-run handling in the Fosim Research Simulator - Some results and experiences S Luthander (LUTAB, Bromma, Sweden) In Extending the scope of flight simulation, Proceedings of the Fourth Symposium, London, England, April 19, 1978 Symposium sponsored by the Royal Aeronautical Society London, Royal Aeronautical Society, 1978 13 p

In the study described, an aircraft during ground run is treated as a road vehicle, and two-wheel analysis models with two degrees of freedom (side deviation and yaw angle) are employed Since the handling qualities during ground run depend on the vehicle's dynamic parameters, the relationship between the dynamic parameters and pilots ratings are studied in the simulation program, using the equations of motion of each of the degrees of freedom, written in a frequency response form The results of the simulation, concerning response problems and phase problems are plotted and discussed V P

A79-26527 F-16 high angle of attack testing P F Oestricher (General Dynamics Corp , St Louis, Mo) and R C Ettinger (USAF, Flight Test Center, Edwards AFB, Calif) *(Society of Experimental Test Pilots, Symposium, 22nd, Beverly Hills, Calif , Sept 27 30, 1978) Society of Experimental Test Pilots, Technical Review*, vol 14, no 2, 1979, p 1-10

The paper discusses some of the design features of the F 16 that give it some unusual high angle-of-attack handling features The F-16, in order to avoid large trim drag and maneuvering penalties, is balanced such that the static margin is negative subsonically and only mildly positive in supersonic flight The deep stall capability is the result of this relaxed longitudinal stability concept Angle-of-attack and structural limiting provide excellent protection up to reasonable airspeeds for symmetric maneuvers Full time aileron rudder interconnect enables rapid rolls with flaperon about the velocity vector at all reasonable airspeeds Pitch-roll coupling susceptibility was countered by the roll-rate limiter The yaw rate limiter essentially prevents erect spins The pilot rudder command limiter results in no roll-coupled departures during rudder only or rudder-assisted flaperon rolls P T H

A79-26529 F-18 status report J E Krings (McDonnell Douglas Corp , St Louis, Mo) *(Society of Experimental Test Pilots, Symposium, 22nd, Beverly Hills, Calif , Sept 27-30, 1978) Society of Experimental Test Pilots, Technical Review*, vol 14, no 2, 1979, p 21 25

The F-18 program employs a new concept in which a team of experimental test pilots under a team leader is active throughout the design stages of an airplane The F-18 design has been dominated by simulation, which has been the key to obtaining effective and efficient design At each plateau in the simulator design, Navy and Marine personnel were invited to evaluate the design and check that the design was heading in the right direction One of the many simulators is dedicated primarily to the first flight configuration P T H

A79-26530 Flight testing the Kfir Y Peer (Israel Air Force, Tel Aviv, Israel) *(Society of Experimental Test Pilots, Symposium, 22nd, Beverly Hills, Calif , Sept 27-30, 1978) Society*

of Experimental Test Pilots, Technical Review, vol 14, no 2, 1979, p 26-37

The Kfir is the result of replacing the Atar-9C engine of the Mirage with the J-79 engine and incorporating a canard configuration on the Mirage The autocommand is a 100% authority, electrical, fly-by-wire flight control system operating on the pitch axis of the aircraft alone It is a closed-loop control augmentation system with pilot stick force as input During initial testing, pilots found the low-speed flight uncomfortable as it demanded a positive stick push to lower the angle of attack (AOA) instead of natural stick relaxation The problem was solved by AOA feedback achieved by causing the control stick to trim forward in proportion to the increase in AOA A reduction in stick force per g without affecting loop stability was also accomplished Flight testing concentrated on air-to-air tracking The optimum parameter setting showed a definite advantage of pre-filter lead and the normal acceleration feedback filter P T H

A79-26531 **Small fan-jet engines** I E Speer (Garrett Corp , Los Angeles, Calif) *(Society of Experimental Test Pilots, Symposium, 22nd, Beverly Hills, Calif , Sept 27-30, 1978) Society of Experimental Test Pilots, Technical Review,* vol 14, no 2, 1979, p 43-51

The article reviews some of the thinking that went into choosing the cycle and sizing of the TFE731 engine and to evaluate some of the characteristics in light of what is now developing as a second generation of small fan-powered business aircraft The optimum long range cruise design point of the TFE731 was found to be at 40,000 ft at Mach 0 7 with a bypass ratio between 2 5 1 and 3 5 1 The first application of the TFE371 was for aircraft sized to a CJ610 turbojet, so the fan was sized at a thrust somewhat higher than the jet At the optimum cruise point the specific fuel consumption is about 68% of that of the jet The trend in business jets is toward higher altitude envelopes The design point for 40,000 ft extended to 50,000 ft is also relatively optimal, so no major design cycle change appears necessary for second-generation fans Reynolds number and engine drag effects would seem to dictate medium bypass ratio The lapse ratio with ambient temperature for a fan may limit performance, although at temperate latitudes no problem should be present at 50,000 ft P T H

A79-26532 **The Learjet Longhorn series - The first jets with winglets** N A Armstrong (Cincinnati, University, Cincinnati, Ohio) and P T Reynolds (Gates Learjet Corp , Wichita, Kan) *(Society of Experimental Test Pilots, Symposium, 22nd, Beverly Hills, Calif , Sept 27-30, 1978) Society of Experimental Test Pilots, Technical Review,* vol 14, no 2, 1979, p 57 66

The Gates Learjet Model 28 is similar to the Model 25 except for the addition of six-foot wing extensions and the winglets and the removal of the tip tanks Model 29 has the same aerodynamic configuration as Model 28, but has a larger fuselage fuel tank Cruise fuel flow reductions result from several factors (1) the aircraft can operate at higher altitudes due to added wing area, (2) for some payload and range the takeoff weight is lower because less mission fuel is needed, and (3) drag is reduced by removing the tip tanks, increasing the aspect ratio, and adding the winglets Some of the aerodynamic reasons for the effects of the winglets are briefly discussed An overall stabilizing effect of the winglets at about 6-8 deg sideslip is due to winglet stall P T H

A79-26533 **Airline approach to CAT III** J E Ellington (Delta Air Lines, Inc , Atlanta, Ga) *(Society of Experimental Test Pilots, Symposium, 22nd, Beverly Hills, Calif , Sept 27-30, 1978) Society of Experimental Test Pilots, Technical Review,* vol 14, no 2, 1979, p 79-109

It is stated that the way to approach CAT III operation is to present it to the line pilot in such a way that he will begin to build confidence that continues to build until he is ready and has a strong desire to execute an approach to the lower visibility minimums With this in mind, an outline of a CAT III training program is presented Training starts in the ground school phase, after which the pilot proceeds to the simulator phase and then to actual aircraft training P T H

A79-26534 * **Flying NASA's Terminal Configured Vehicle against the Microwave Landing System** L H Person, Jr and K R Yenni (NASA, Langley Research Center, Hampton, Va) *(Society of Experimental Test Pilots, Symposium, 22nd, Beverly Hills, Calif , Sept 27-30, 1978) Society of Experimental Test Pilots, Technical Review,* vol 14, no 2, 1979, p 110-123

A prototype Boeing 737 aircraft has been received for use in the Terminal Configured Vehicle (TCV) Program, the aim of which is to develop technology for advanced airborne systems and flight procedures to improve terminal area operations in the future ATC environment The paper discusses the TCV aircraft, its integrated digital electronic displays and flight controls, and the means by which the pilot interfaces with the aircraft to fly precise curved descending approaches under MLS guidance P T H

A79-26535 **Development of the L-1011 Flight Management System** D A Moor (Lockheed Aircraft Corp , Burbank, Calif) *(Society of Experimental Test Pilots, Symposium, 22nd, Beverly Hills, Calif , Sept 27-30, 1978) Society of Experimental Test Pilots, Technical Review,* vol 14, no 2, 1979, p 124-134

The paper discusses the development of the L 1011 Flight Management System, a fully automatic navigation and performance system coupled to existing L-1011 autopilot and autothrottles The system provides a means for automatic, precise control of airplane speeds and engine thrust during climb, cruise, and descent The steps taken to achieve the design goals and their modifications in order to ensure control stability are briefly described The FLM provides full-time performance management in areas of near neutral speed-thrust stability, reducing crew workload, and offering a large potential for fuel savings P T H

A79-26536 **The continuity factor in aircraft development** A M Johnston *(Society of Experimental Test Pilots, Symposium, 22nd, Beverly Hills, Calif , Sept 27-30, 1978) Society of Experimental Test Pilots, Technical Review,* vol 14, no 2, 1979, p 135-145

Some of the milestones in the development of the jet aircraft are noted Mention is made of the Bell XP-59 (1945), the Bell L-39 (1945), the rocket-powered XS-1 (1946), the XB-47 and YB-47, the B-52, the 'dash 80', and the 727 and 737 The significant technical advances incorporated by these aircraft are identified The discussion is oriented to bring to light the 'continuity factor', that is, the sequential application of tested and desirable technologies P T H

A79-26537 **The U-2 story** K W Weir (Lockheed Aircraft Corp , Burbank, Calif) *(Society of Experimental Test Pilots, Symposium, 22nd, Beverly Hills, Calif , Sept 27-30, 1978) Society of Experimental Test Pilots, Technical Review,* vol 14, no 2, 1979, p 186-192

The paper gives an account of the development of the U-2 aircraft for reconnaissance missions Basically, the U-2 began as an F-104 with high-aspect ratio wings attached and equipped with a nonafterburning P & W J-57 engine The flight control system is a conventional unboosted system using a yoke rather than a stick Some of the demanding and delicate operations at high-altitude high-speed flights are briefly described Modifications of the recent U 2R are mentioned P T H

A79-26544 * # **Turbulence characteristics in the near wake of a compressor rotor blade** B Lakshminarayana and B Reynolds (Pennsylvania State University, University Park, Pa) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La , Jan 15-17, 1979, Paper 79-0280* 13 p 13 refs Grant No NsG-3012

This paper is concerned with the turbulence properties in the near wake of a rotating compressor blade The variation of the axial,

tangential and radial intensities as well as stresses across the wake and its decay characteristics were measured with a triaxial hot wire probe rotating with the rotor downstream of an axial flow compressor The turbulence intensities decay very rapidly in the near wake region The radial component of intensity is found to be higher than the tangential and axial components This is a consequence of the effect of rotation on the turbulence structure A qualitative analysis is carried out to predict the effect of rotation on the turbulence structure These are in general agreement with the measured data (Author)

A79-26545 * # Unsteady pressures on a NACA 64A010 airfoil - Experimental and theoretical results J A Davis and S L Petrie (Ohio State University, Columbus, Ohio) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 17th, New Orleans, La , Jan 15-17, 1979, Paper 79-0330* 11 p 13 refs Grants No AF-AFOSR-76-3021, No NsG 2298

Transonic testing of an NACA 64A010 airfoil at the Ohio State University Aero-Astro Research Laboratory is described, and results of fixed angle of attack and pitch oscillation experiments are discussed The operating range was Mach 0 20 to 1 07 with available total pressures of 140,000 N/m2 to 620,000 N/m2 The airfoil model was mounted on roller bearings installed in the solid sidewalls of the tunnel test section The equipment included transducers to measure unsteady pressures, and static pressure taps obtaining steady-state data The data gathered at Mach 0 8 gave an indication of the influence of the natural shock instability and shock-induced flow separation on the unsteady pressures, with the location of the peak disturbance level shifting forward in the comparison of 0 to 2 deg pitch angle data The oscillating airfoil data is examined in terms of harmonic content and the in-phase and out-of phase components It is concluded that the experimental data has good qualitative comparison with methods accounting for shock interaction A A

A79-26546 * Effect of a chromium-containing fuel additive on hot corrosion C E Lowell and D L Deadmore (NASA, Lewis Research Center, Cleveland, Ohio) *Corrosion Science,* vol 18, 1978, p 747 749, 751 759, 761-763 8 refs

Four cast superalloys (one cobalt-base and three nickel-base) were tested at 900 C for 100 h in Mach 0 3 combustion gases 5 ppm of synthetic sea salt were added to the gases in the combustion chamber Several types of thermal cycle and washing procedures were employed Similar tests were made with the addition of 300 ppm of a chromium-containing fuel additive In both sets of tests the extent of hot corrosion was evaluated by specific weight change and metal recession In general, the chromium additive in the fuel reduced the extent of hot (salt) corrosion but did not eliminate it The percentage reduction of hot corrosion attack was similar for all four alloys As great a reduction of hot corrosion was achieved by reducing the number of thermal cycles during the test from 100 to 5 or 6 The effect of washing the alloys every ten cycles as opposed to the end of the test was erratic, some alloys were attacked slightly more, others somewhat less A NiCrAlY coating was found to be more effective in reducing hot corrosion than either the fuel additive or the washing schedule (Author)

A79-26592 The application of computer aided techniques to project design D Howe (Cranfield Institute of Technology, Cranfield, Beds , England) *Aeronautical Journal,* vol 83, Jan 1979, p 16-21

The paper discusses the application of computer aided techniques in aircraft design to the project design phase, in which the detailed specifications are interpreted to define the component parts of the system and the aircraft configuration is established Various aspects of project design are considered and it is noted that the process depends heavily on the availability of large amounts of statistical data and allows for the application of numerical analysis Possible design areas in which to employ computers are discussed, including weight, drag and stability and control modules and the optimization of multiple dependent parameters The use of computers is limited by the validity of the initial data, the size of the program and the lack of flexibility in baseline design, however interactive techniques can overcome many of these limitations Computer programs presently in use in project design include engineering technologies, design analysis and configuration packages, as parts of larger computerized design systems A L W

A79-26593 Theoretical lower limits of forebody drag T Morel (GM Research Laboratories, Warren, Mich) *Aeronautical Journal,* vol 83, Jan 1979, p 23-27 5 refs

The lower limits to which forebody pressure drag may theoretically be reduced by the elimination of flow separation are considered The analysis treats a potential incompressible flow about a body which is symmetrical about its centerline and has fore-and-aft symmetry, and is placed in the center of a constant area duct It is found that for semi-infinite bodies with constant cross-sectional area, the pressure drag coefficient is zero, as demonstrated by Prandtl and Tietjens (1934), while for shorter bodies with variable area the pressure drag coefficient must be less than zero Approximate integral analysis is used to calculate the pressure drag coefficient for given velocity profiles and results suggest that a proportionality may be expected between the forebody drag and the dimensionless potential flow velocity overshoot at the body surface in the plane of fore-and aft symmetry These results tend to be supported in a comparison with exact solutions for Rankine bodies A L W

A79-26594 The 1-4-1 system of jack movements for the flexible liners of supersonic wind tunnels A C McIntosh (Cranfield Institute of Technology, Cranfield, Beds , England) and J Pike (Royal Aircraft Establishment, Bedford, England) *Aeronautical Journal,* vol 83, Jan 1979, p 28-31

In order to improve the flow angle and Mach number distribution in a flexible-plate supersonic wind tunnel, a method has been proposed in which the wind tunnel liner is caused to make small displacements by the movement of the jacks supporting it Methods employing a single jack movement to measure the Mach number disturbance to the flow caused by the liner displacement have been found to cause extensive rippling to the liner, making it difficult to obtain accurate measurements of the direct effect of the displacement on the flow The 1-4-1 system of movements of three adjacent jacks, which overcomes these difficulties, is presented The 1-4-1 system consists of moving the jacks on either side of a central jack through a quarter of the movement executed by the central jack, leading to a situation in which the portion of the liner two jacks removed from the central jack undergoes no deflection Experiments have shown that the 1-4-1 system causes a lesser Mach disturbance than a single jack movement, thus making the disturbance easier to trace A L W

A79-26597 * # Laser aircraft A Hertzberg, K Sun (Washington, University, Seattle, Wash), and W S Jones (Lockheed Research Laboratories, Palo Alto, Calif) *Astronautics and Aeronautics,* vol 17, Mar 1979, p 41-49 22 refs Grant No NGL 49-002-044

The concept of a laser-powered aircraft is discussed Laser flight would be completely compatible with existing airports and air-traffic control, with the airplane using kerosene only power, up to a cruising altitude of 9 km where the laser satellite would lock on and beam laser energy to it Two major components make up the laser turbofan, a heat exchanger for converting laser radiation into thermal energy, and conventional turbomachinery The laser power satellite would put out 42 Mw using a solar powered thermal engine to generate electrical power for the closed-cycle supersonic electric discharge CO laser, whose radiators, heat exchangers, supersonic diffuser, and ducting will amount to 85% of the total subsystem mass Relay satellites will be used to intercept the beam from the laser satellite, correct outgoing beam aberrations, and direct the beam to the next target A 300-airplane fleet with transcontinental range is projected to save enough kerosene to equal the energy content of the entire system, including power and relay satellites, in one year A A

A79-26598 # **Laser propulsion** R F Weiss, A N Pirri, and N H Kemp (Physical Sciences, Inc , Woburn, Mass) *Astronautics and Aeronautics,* vol 17, Mar 1979, p 50-58 30 refs

Progress in laser-propulsion component technology is discussed, together with an assessment of future expectations The thruster design concepts are described, considering the continuous wave (CW) laser-powered devices relying on an aerodynamic window to introduce a steady laser beam into the 'combustion' chamber, and the repetitively pulsed (RP) laser-powered devices whose unsteady gasdynamics allow windowless operation CW- and RP rocket engines are described, noting that in both cases a considerable amount of research and systems analysis remains to be performed before optimum prototype designs can be specified Investigations concern ing laser propulsion for drag make up, orbit and plane changes, as well as interplanetary missions are taken into account, as is a study of four generic systems for transporting payloads from LEO to GEO It is concluded that the solar power satellite and laser propulsion are expected to depend upon each other for full maximum exploitation and cost-effectiveness A A

A79-26626 Aerodynamic Decelerator and Balloon Technology Conference, 6th, Houston, Tex , March 5-7, 1979, Technical Papers Conference sponsored by the American Institute of Aeronautics and Astronautics New York, American Institute of Aeronautics and Astronautics, Inc , 1979 380 p Members, $35 , nonmembers, $45

A foam impact attenuation system is considered along with simulation studies of the flight dynamics of gliding parachute systems, the practical aspects of reefing cutter design, balloon concepts for scientific investigation of Mars and Jupiter, the development and testing of a shipboard launched balloon system, the propagation of stress/strain pulses in woven textiles, biaxial stress measurements on cloth samples and bias constructed parachute models, and a fabrication and quality assurance procedure to assure a symmetrical lifting parachute Attention is also given to the mechanical properties of polyethlene balloon films and forming conditions of their tubular film process, and experimental technique for data acquisition from parachutes in flight, the determination of meaningful performance parameters from bench tests of barometric staging units, and data management in the decelerator industry G R

A79-26627 # **Foam Impact Attenuation System** S R Mehaffie (USAF, Flight Dynamics Laboratory, Wright Patterson AFB, Ohio) In Aerodynamic Decelerator and Balloon Technology Conference, 6th, Houston, Tex , March 5-7, 1979, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 1-10 8 refs (AIAA 79 0416)

A ground impact attenuation system for aerospace vehicles based on foamed-in-place polyurethane foam has been developed The concept was reduced to practice and developed to the prototype stage during a three year, in house, Air Force investigation beginning in 1975 A series of 91 full scale tests of the FIAS (Foam Impact Attenuation System) against the requirements of the AQM 34V remotely piloted vehicle demonstrated the systems's performance with a 60-sec operating time Subsequent work has produced a foam dispensing system capable of achieving a FIAS deployment time of 5 sec Spinoffs from this program have created new concepts in deployable composite structures (Author)

A79-26628 # **Simulation studies of the flight dynamics of gliding parachute systems.** T F Goodrick (U S Army, Natick Research and Development Command, Natick, Mass) In Aerodynamic Decelerator and Balloon Technology Conference, 6th, Houston, Tex , March 5 7, 1979, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 11-16 (AIAA 79-0417)

A six-degree of freedom flight simulation program is described which models the flight dynamics of a gliding airdrop system utilizing gliding canopies such as the Parafoil The program allows study of response to manual and automatic control inputs utilizing flexible output formats Examples are given of program applications for analysis of dynamic stability and two types of turn control for the Parafoil (Author)

A79-26631 # **Development and testing of a shipboard launched balloon system** K L TeKrony (Raven Industries, Inc , Sioux Falls, S Dak) In Aerodynamic Decelerator and Balloon Technology Conference, 6th, Houston, Tex , March 5 7, 1979, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 38 44 (AIAA 79-0420)

A balloon system has been developed and tested which permits inflation and launch in winds up to 45 knots within the limited confines on board Navy ships The system consists of a launch platform and balloon system The launch platform provides orientation and constraint for the balloon system during inflation and until launch The balloon system consists of tandem balloons, flight sequencing devices, a 15 pound payload and associated containers The tandem balloons consist of a smaller reinforced tow balloon and a main balloon which is protected within the packing container until shortly after launch After in-flight deployment, the main balloon inflates during ascent through a transfer fitting located between the two balloons (Author)

A79-26635 # **Design specifications for the capped balloons with special reference to their survival in the equatorial tropopause** G S Gokhale (Tata Institute of Fundamental Research, Bombay, India), R T Redkar, M N Joshi, S Sreenivasan, and J V S Rao (Tata Institute of Fundamental Research, Hyderabad, India) In Aerodynamic Decelerator and Balloon Technology Conference, 6th, Houston, Tex , March 5-7, 1979, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 69-75 (AIAA 79-0426)

On the basis of detailed analysis of cap lengths of balloons flown from high latitudes, design specifications are drawn for gore length to be covered with cap material, sufficient to cover the inflated portion of the balloon, while it is passing through the critical tropopause region for zero-circumferential stress, zero-superpressure and flat top design balloon and for the conditions prevailing in the equatorial tropopause Reference is made to the capped balloons flown from Balloon-Facility in India (17 5 deg N, 78 6 deg E) which had inadequate gore lengths covered with caps and which had considerably high rate of tropopause failures Reference is also made to the Brazilian Campaign (23 deg S) conducted by the French Group, wherein 100% success was obtained with capped balloons, which had appropriate gore lengths covered with cap as per the design specifications (Author)

A79-26636 # **Fabrication and quality assurance procedure to assure a symmetrical lifting parachute** R E Rychnovsky (Sandia Laboratories, Livermore, Calif) In Aerodynamic Decelerator and Balloon Technology Conference, 6th, Houston, Tex , March 5-7, 1979, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 76-79 Contract No AT(29-1)-789 (AIAA 79-0427)

For lifting parachutes used to deliver payloads at high velocities, parachute symmetry is very important The forces generated by the high-velocity delivery create unacceptably high roll moments unless the parachute is very symmetrical Because these strict symmetry requirements were new to the parachute industry, fabrication and quality assurance procedures had to be developed Five 13 foot lifting parachutes were fabricated using the new procedures the first two had major discrepancies and the final three had minor discrepancies The rolling moments of these parachutes, which were lower than the moments of lifting parachutes that had been fabricated without these controls, met the roll moment requirements for the lifting parachute system being developed The procedures developed could also be used for conventional ribbon parachutes to increase the speed and accuracy of fabrication (Author)

A79-26638 # **Design criteria for and development of Kevlar ribbon parachutes** W R Pinnell (USAF, Flight Dynamics Labora

tory, Wright Patterson AFB, Ohio) In Aerodynamic Decelerator and Balloon Technology Conference, 6th, Houston, Tex , March 5-7, 1979, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 89-99 5 refs (AIAA 79-0430)

A test effort to validate criteria and to establish performance parameters for conical ribbon parachutes fabricated from textile materials based on the DuPont para aramid fiber marketed as Kevlar-29 is reported Criteria for selection of material strength for major parachute components are discussed relative to test results Effects of reefing on drag area and opening shock factors are experimentally developed and compared to similar data for nylon parachutes A two-stage reefing system was demonstrated and drag area (sq ft) values for various reefing ratios were established All test items were 15 3 ft nominal diameter 20 degree conical continuous ribbon parachutes Data gathered during 18 drop tests from F 4 aircraft and 13 tests utilizing a rocket powered sled are presented and these two test methods are compared Test Mach numbers ranged from 21 to 98 at the test item line stretch condition Drop test altitudes ranged from 5300 to 41,400 ft MSL and sled data were collected at an altitude of 4070 ft Maximum opening forces as high as 29,000 lb were recorded (Author)

A79-26641 # **Design and development of the 24-foot diameter hybrid Kevlar-29/nylon ribbon parachute** W B Pepper, Jr (Sandia Laboratories, Albuquerque, N Mex) In Aerodynamic Decelerator and Balloon Technology Conference, 6th, Houston, Tex , March 5-7, 1979, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 119-126 5 refs Research supported by the U S Department of Energy (AIAA 79-0433)

A total of 70 tests, including static, rocket sled-launched, rocket-boosted and aircraft drops, have been used to develop the 24-ft-diameter hybrid Kevlar-29/nylon ribbon parachute for recovery of the 765-lb store The parachute has been deployed successfully over the environmental temperature range of -65 F to +160 F and has operated successfully over the design range of deployment speeds from 330 KCAS to Mach 1 2 at sea level (Author)

A79-26649 # **The influence of ballonet motions on the longitudinal stability of tethered aerostats** J Delaurier (Toronto, University, Toronto, Canada) In Aerodynamic Decelerator and Balloon Technology Conference, 6th, Houston, Tex , March 5-7, 1979, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 174-182 12 refs Research supported by the National Research Council of Canada (AIAA 79-0445)

To date, tethered-aerostat stability analyses have assumed the ballonet air to be 'frozen' with respect to the rest of the aerostat Also, it was assumed that the least stable, and hence most important, longitudinal mode of motion was the first mode, where the cable's and aerostat's motions are so coupled as to approximate an 'upside-down pendulum' The present analysis shows that when motion of the internal air and gas is allowed, a third mode appears whose stability may be equal to, or less than, that of the first mode, for current aerostat designs The degree of the third-mode's stability is primarily controlled by the ballonet's fore-and-aft constraint and damping, current design practices applied to larger and higher altitude aerostats could give rise to systems with serious stability problems at lower altitudes However, this investigation also shows that moderate increases in constraint and damping, which should be achievable by ballonet redesign, would strongly stabilize the third mode (Author)

A79-26650 # **Recovery system preliminary design - A simplified approach to determining drogue chute staging, timing, and altitude requirements** M W Higgins (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio) In Aerodynamic Decelerator and Balloon Technology Conference, 6th, Houston, Tex , March 5-7, 1979, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 183-191 (AIAA 79-0446)

An analytical technique designed to assist a recovery system designer in arriving at a reasonable recovery system design is presented, discussed and applied to two problems commonly faced by designers The technique allows a designer to arrive at an initial recovery system design given the initial and final dynamic pressures, the total weight, the parachute opening shock factor and the maximum allowable design limit load The technique currently assumes a subsonic, vertically descending payload being decellerated by a fast inflating parachute Potential means of reducing or eliminating the effects of these assumptions will be discussed (Author)

A79-26651 # **A simple physical model of a descending parachute** D J Cockrell and J A Eaton (Leicester, University, Leicester, England) In Aerodynamic Decelerator and Balloon Technology Conference, 6th, Houston, Tex , March 5-7, 1979, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 192-194, 375 5 refs Research supported by the Ministry of Defence (AIAA 79 0447)

Appreciation of the ways in which variation of parachute geometric parameters, such as rigging line length and canopy porosity, can affect descent performance is limited because of the complexity of the necessary predictive computer models In this paper a simple physical model, to supplement rather than to supplant existing complex models, is developed The model is constructed diagrammatically, establishing the linear second-order simultaneous equations which describe the longitudinal oscillations Some consideration is given to motion about the axis of symmetry Conclusions are drawn about effects which various geometric parameters have on the dynamics of the system and comparisons are drawn between responses from this and from more sophisticated models (Author)

A79-26652 # **Flight simulation of a vehicle with a two stage parachute system** P R Schatzle and W H Curry (Sandia Laboratories, Albuquerque, N Mex) In Aerodynamic Decelerator and Balloon Technology Conference, 6th, Houston, Tex , March 5 7, 1979, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 195 203 7 refs Research supported by the U S Department of Energy (AIAA 79-0448)

A quick response, 9-DOF (degree-of-freedom) hybrid computer code has been developed to simulate the flight of an aircraft delivered, parachute retarded vehicle The mathematical model and its implementation are discussed The particular case of a vehicle with a first stage lifting parachute and second-stage descent parachute is investigated Results compare well with those obtained from an existing 12-DOF digital code and from full-scale flight test (Author)

A79-26653 # **Parachute inflation control using an attached apex drogue** B W Roberts (Sydney, University, Sydney, Australia) In Aerodynamic Decelerator and Balloon Technology Conference, 6th, Houston, Tex , March 5 7, 1979, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 204-210 7 refs (AIAA 79-0449)

The inflation time of a given parachute can be increased by the use of skirt hesitators, reefing lines, apex stretch fabric or similar techniques On the other hand the inflation time can be reduced by the use of pocket bands or central rigging lines Yet little use has been made of a drogue attached to the apex in order to increase the inflation time This drogue increases the rigging line tension during the early stages of the inflation and thereby increases the inflation time It also reduces the fabric loading by an order of magnitude The technique has been studied in depth using computer procedures, while rocket sled tests show some interesting flight trends (Author)

A79-26654 # **A first-order theory for the effects of line ties on parachute deployment** K E French (Lockheed Missiles and

Space Co , Inc , Sunnyvale, Calif) In Aerodynamic Decelerator and Balloon Technology Conference, 6th, Houston, Tex , March 5-7, 1979, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 211 214 (AIAA 79-0450)

Line ties temporarily restrain a fold or folds of a parachute until deployment The use of ties extends the time required for deployment and reduces the relative velocity between the chute and its attached forebody prior to line stretch This paper develops a first-order theory for calculation of the effects of line ties on chute deployment time and relative velocity Solutions are presented graphically in terms of the dimensionless parameters of the problem for a pilot-extracted-and deployed parachute for the case of fore body velocity constant during deployment Solutions are also given for the case of forebody acceleration constant during deployment The problem of incorporating tie test data into parachute system design is briefly discussed (Author)

A79-26655 # **Parachute partial inversions** R B Calkins (USAF, Aeronautical Systems Div , Wright-Patterson AFB, Ohio) In Aerodynamic Decelerator and Balloon Technology Conference, 6th, Houston, Tex , March 5-7, 1979, Technical Papers

New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 215 219 (AIAA 79-0451)

Parachute inversions have long been a problem with some types of parachute The present paper deals with the causes, misconceptions, symptoms, and cures of inversion A discussion of motion-picture studies of partial inversion provides some insight into the phenomenon and its causes This knowledge could lead to potential solutions and to better parachute designs V P

A79-26659 # **A new life saving application for the parachute** E D Vickery (Sky Sports, Inc , Ellington, Conn) In Aerodynamic Decelerator and Balloon Technology Conference, 6th, Houston, Tex , March 5 7, 1979, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 245 249 (AIAA 79-0456)

In the past few years the rapid growth of the hang-gliding sport, accompanied by equally rapid improvements in glider performance and pilot skills, has created a need for a parachute back-up system The paper outlines a brief history of hang gliding, categories of accidents, parachute requirements, problems relative to the glider configuration which require solutions, parachute configurations and attachment systems to prevent fatalities, and usage of the parachute as a life-saving device It is concluded that the parachute has proven to be an efficient lifesaver in the new aviation application S D

A79-26660 # **Factors and tradeoffs affecting ram-air parachutes designed for civilian personnel applications** M W Higgins (USAF, Life Support Systems Program Office, Wright Patterson AFB, Ohio) In Aerodynamic Decelerator and Balloon Technology Conference, 6th, Houston, Tex , March 5-7, 1979, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 250-260 7 refs (AIAA 79-0457)

A brief outline is presented of the sport parachute market size and composition over the period 1971-1978 which is marked by the large scale introduction to and utilization of ram air parachutes Then the study identifies the major parachute performance require ments of each competitive event, and determines the areas where ram-air parachutes appear to meet the performance requirements Attention is given to identifying some of the ram air parachute design factors and subsystems that affect the performance require-ments, with particular reference to weight and volume, deployment, inflation, glide, and handling characteristics The discussion presented provides the user with some background information on the development and performance of the ram-air parachute S D

A79-26661 # **Commercial parachutes** J D Reuter (Pioneer Parachute Co , Manchester, Conn) In Aerodynamic Decelerator and Balloon Technology Conference, 6th, Houston, Tex , March 5 7, 1979, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 261-268 (AIAA 79-0458)

This paper discusses certain aspects of commercial emergency parachutes and hardware Current technology and existing regulations would permit the manufacture of emergency parachutes as small as 19 feet in diameter, but opening shock forces must be attenuated Inverted inflation is the most common cause of emergency parachute malfunctions A significant reduction in this type of anomaly is possible by use of a simple skirt-wrap arrangement A light-weight commercial separable riser link is found to have adequate structural margins if properly installed and tightened (Author)

A79-26662 # **Longitudinal oscillation damping for fully-inflated parachute canopies** D J Cockrell, J A Eaton (Leicester, University, Leicester, England), and C J Morgan In Aerodynamic Decelerator and Balloon Technology Conference, 6th, Houston, Tex , March 5-7, 1979, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 269-273 Research supported by the Ministry of Defence (AIAA 79-0459)

Two factors contributing to the damping of a parachute's oscillations are considered, the first dependent on the moment of the aerodynamic force developed on the canopy about the system's body axes origin, the second on the additional drag which results from the variation in linear velocity over the canopy caused by the angular velocity of oscillation This second contribution is shown to be of the same order of size as the former An estimate of its size is made, experimental techniques for its measurement described and suggestions made as to how it may be incorporated into parachute descent performance computer models (Author)

A79-26663 # **The validity of the Leicester computer model for a parachute with fully-deployed canopy** J A Eaton and D J Cockrell (Leicester, University, Leicester, England) In Aerodynamic Decelerator and Balloon Technology Conference, 6th, Houston, Tex , March 5-7, 1979, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 274-279 15 refs Research supported by the Ministry of Defence (AIAA 79-0460)

Measures taken to validate a computer model of a parachute with fully deployed canopy are described By a sensitivity analysis parameters which affect stability are identified Drop tests of prototype and large-scale models under wind-free conditions, devised to provide flight data for comparison with predictions, are outlined along with a description of the instrumentation Ways in which information is obtained on inertial effects, instantaneous local angles of attack and on the relevance of data derived from wind-tunnel tests on rigid-canopy models are considered Included is a note on the effect of Reynolds number on the oscillatory motion of parachutes (Author)

A79-26671 # **Hardware options for gliding airdrop guidance systems** T F Goodrick (U S Army, Natick Research and Development Command, Natick, Mass) In Aerodynamic Decelerator and Balloon Technology Conference, 6th, Houston, Tex , March 5-7, 1979, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 345-350 7 refs (AIAA 79-0471)

Two aerospace electronics firms were asked to survey the market for components suited to the requirements for guiding cargo airdrop systems utilizing high-performance gliding canopies Systems which can be produced in modules to achieve the full range of performance from radial homing to full state guidance are identified and described along with systems capable of other partial state guidance schemes in addition to radial homing and which provide full state data with the addition of separate range measurement components Thus the availability of components that can be integrated into suitable guidance systems is demonstrated S D

A79-26673 # **Development and initial test results of parachutes with automatic inflation modulation /AIM/** D B Webb (Irvin Industries Canada, Ltd., Fort Erie, Ontario, Canada) In Aerodynamic Decelerator and Balloon Technology Conference, 6th, Houston, Tex., March 5-7, 1979, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc., 1979, p. 363-374. 5 refs (AIAA 79-0467)

The paper discusses the development program required to investigate new canopy control methods and to eventually produce a final improved personnel canopy. This development program is referred to as the automatic inflation modulation (AIM) concept. It is shown that fast, controlled, and consistent opening of the canopies can be achieved with the Webb chute device. Significant load alleviation and square wave type force/time traces are obtained at high deployment speeds with the use of a unidirection stretch fabric. Variable automatic reefing of the canopy and consequent longer development times can be obtained with the pull-down vent-line option of the Webb chute device. S.D.

A79-26725 **Air fleet and facility planning via optimal control models.** V. V. S. Sarma (Indian Institute of Science, Bangalore, India) and K. Ramchand (Central Servicing Development Organization, Kanpur, India) *IEEE Transactions on Systems, Man, and Cybernetics*, vol. SMC-9, Mar. 1979, p. 131-142. 15 refs

A study is presented which is aimed at developing techniques suitable for effective planning and efficient operation of fleets of aircraft typical of the air force of a developing country. An important aspect of fleet management, the problem of resource allocation for achieving prescribed operational effectiveness of the fleet, is considered. For analysis purposes, it is assumed that the planes operate in a single flying-base repair-depot environment. The perennial problem of resource allocation for fleet and facility buildup that faces planners is modeled and solved as an optimal control problem. These models contain two 'policy' variables representing investments in aircraft and repair facilities. The feasibility of decentralized control is explored by assuming the two policy variables are under the control of two independent decisionmakers guided by different and not often well coordinated objectives. (Author)

A79-26753 **Digital target extraction at civil air traffic control radar installations in the Federal Republic of Germany and possibilities for its further development from the point of view of the Federal Institute of ATC (Die digitale Zielextraktion an zivilen Flugsicherungsradaranlagen in der BRD und Moglichkeiten fur ihre Weiterentwicklung aus der Sicht der BFS)** B. Cloos (Bundesanstalt fur Flugsicherung, Frankfurt am Main, West Germany) In Symposium on Radar Technology, 3rd, Hamburg, West Germany, September 14-16, 1977, Reports. Dusseldorf, Bucherei der Ortung und Navigation, 1978, p. 25, 27-37, 39-46. In German

The digital target extractor of the German Federal Institute of ATC constitutes an evaluation system for primary and secondary radar video signals which has the function to recognize real and suppress false targets. The target data are processed and compressed in preparation for a narrow-band data transfer and an automatic evaluation of the data as a basis for the display of the air traffic conditions. The radar data of 10 digital target extractors are currently used in four control centers of the Federal Institute of ATC and in two EUROCONTROL centers. Most control centers use purely synthetic displays. Certain problems regarding the operation of the digital target extractors are discussed together with possible improvements. G.R.

A79-26754 **New approaches concerning the implementation of radar target extractors with the aid of very fast microprogrammable data processors (Neue Wege der Realisierung von Radarzielextraktoren mit Hilfe von sehr schnellen mikroprogrammierbaren Datenprozessoren)** W. Luschnitz (Telefunken AG, Ulm, West Germany) In Symposium on Radar Technology, 3rd, Hamburg, West Germany, September 14-16, 1977, Reports. Dusseldorf, Bucherei der Ortung und Navigation, 1978, p. 47, 49-69. In German

An employment of microprocessors for target-extraction applications appears desirable in connection with a number of advantages related to their use. These advantages include an establishment of standard hardware items, the achievement of flexibility on the basis of programming, improved maintenance characteristics, and improvements regarding the storage requirements for spare parts. However, the operational requirements make it necessary to employ microprocessors with high operating speeds. The functional operations must, therefore, be designed in such a way that they can be performed by a fast microprogrammable microprocessor. A description is presented of the properties which a microprocessor must have for the considered applications, taking into account details of its use and the design of suitable extractor processing procedures. It was found that requirements for instruction times of about 100 nanoseconds could not be satisfied by a commercially available microprocessor. A suitable microprocessor was, therefore, developed. G.R.

A79-26759 ***Concept of modular software for the stepwise* construction of radar data processing systems with minicomputers, taking into account as example the Airtrack System (Konzeption modularer Software fur den stufenweisen Aufbau von Radardatenverarbeitungssystemen mit Minicomputern /am Beispiel des Airtrack-Systems/)** G. A. Liebelt (Telefunken AG, Ulm, West Germany) In Symposium on Radar Technology, 3rd, Hamburg, West Germany, September 14-16, 1977, Reports. Dusseldorf, Bucherei der Ortung und Navigation, 1978, p. 191, 193-207, 209-218. In German

The considered system concept is based on the possibility of a stepwise construction of air traffic control systems in the case of gradually increasing performance requirements or increasing automatization. A basic system with a central target data processing computer is in the case of increasing processing requirements extended with the aid of autarkic subsystems. The characteristics of the application software make it possible to place in the case of system extensions modules in the process computers of the subsystems. The system concept of the new air traffic control system Airtrack is used to illustrate the hardware configuration and software structure involved. G.R.

A79-26760 **Hardware and software structure of a coordination system for air traffic control on the basis of flight plan data (Hard- und Softwarestruktur eines Koordinationssystems fur die Flugsicherung auf der Grundlage von Flugplandaten)** J. Zurn (Telefunken AG, Ulm, West Germany) In Symposium on Radar Technology, 3rd, Hamburg, West Germany, September 14-16, 1977, Reports. Dusseldorf, Bucherei der Ortung und Navigation, 1978, p. 219-245. In German

The coordination system provides communication possibilities for several users among each other with the aid of computer-controlled table display devices. A control computer processes flight plans and indicates them in the form of 'electronic control strips' on data display devices. The display devices have a touch input feature. The system is so conceived that it can also operate without automatic radar data input. A special touch function for an input of data regarding the times at which an aircraft passes over defined reporting points is used to update flight plan data. G.R.

A79-26761 **Problems of computer-aided tracking, giving particular attention to radar which can be electronically turned (Probleme der rechnergestutzten Zielverfolgung unter besonderer Berucksichtigung des elektronisch schwenkbaren Radars)** G. van Keuk (Gesellschaft zur Forderung der astrophysikalischen Forschung, Forschungsinstitut fur Funk und Mathematik, Werthhoven, West Germany) In Symposium on Radar Technology, 3rd, Hamburg, West Germany, September 14-16, 1977, Reports. Dusseldorf, Bucherei der Ortung und Navigation, 1978, p. 246-259. 5 refs. In German

Aspects of signal acquisition and sensor data processing are examined and aspects of track-while-scan operation in the case of conventional radar and a radar with the considered design features are compared. A description is presented of computer controlled

tracking in the case of the ELRA system which has been designed in connection with efforts to develop an electronically controlled radar system The requirements of the ELRA radar system are satisfied with the aid of tracking algorithms of higher precision employed in a phased array radar using adaptive computer controlled target tracking G R

A79-26828 Residual-stress formation during the thermal hardening of components in gas-turbine engines B A Kravchenko, G N Gutman, and G N Kostina *(Problemy Prochnosti,* May 1978, p 12-15) *Strength of Materials,* vol 10, no 5, Jan 1979, p 507-511 Translation

Thermal strengthening (i e , heating followed by intensive cooling) is an effective technique for components designed for high temperature operation In the present paper, the residual stresses generated by this treatment in gas turbine engine components are calculated for various types of cooling with allowance for the real strain curve of the material The influence of the scale factor is examined V P

A79-26830 Operational experience with linked-blade high-output gas-turbine A A Mukhin, A A Kovalev, A N Vedin, and A A Simakov *(Problemy Prochnosti,* May 1978, p 18-21) *Strength of Materials,* vol 10, no 5, Jan 1979, p 514-517 Translation

The technical state of the contact surfaces of shrouded turbine blades was studied to determine the appropriate overhaul period Graphs showing the arrangement of the blades and shrouds are given, along with plots of the shroud tightness vs the mode of engine operation, plots of the stress vs the shroud clearance, plots of the maximal clearance in test stand and in flight conditions, and plots of the shroud clearance vs the blade pitch The vibration frequencies are analyzed as a function of the clearance The influence on wear of various coatings and of the working temperature of the blade material is studied V P

A79-26838 Thermal cycling endurance problems in gas-turbine parts N D Kuznetsov *(Problemy Prochnosti,* June 1978, p 3-7) *Strength of Materials,* vol 10, no 6, Feb 1979, p 621-625 7 refs Translation

The present review of gas turbine disk and blade failures points toward a major contribution of thermal cycling to the failure of these and other engine components The complexity of the action of thermal cycling loads is demonstrated on the basis of an airliner engine Methods of evaluating the thermal fatigue strength of gas-turbine engines are examined, and the need for the development of mathematical models that would take into consideration all the factors affecting thermal cyclic fatigue is pointed out V P

A79-26841 Prediction of gas-turbine alloy creep characteristics I P Bulygin, E R Golubovskii, and I I Trunin *(Problemy Prochnosti,* June 1978, p 19-21) *Strength of Materials,* vol 10, no 6, Feb 1979, p 636-638 Translation

Experimental creep data obtained in the present study for the heat resistant cast nickel alloy ZhS6U are shown to correlate well with values calculated on the basis of the equation describing the creep rate as a function of the load and temperature The value of the creep strain computed over the time to failure are shown to lie within confidence bounds obtained for a confidence probability of 0 95 with allowance for experimentally determined variance values V P

A79-26865 # **Plane problems of aerothermooptics (Ploskie zadachi aerotermooptiki)** N E Galich (Leningradskii Politekhnicheskii Institut, Leningrad, USSR) *Inzhenerno-Fizicheskii Zhurnal,* vol 36, Feb 1979, p 320-326 11 refs In Russian

The development of thermogasdynamic waveguides is of importance to optical communication links In the present paper, the propagation of light in nonuniformly heated laminar subsonic gas streams is analyzed with a view toward using them to control light beams An exact solution to the problem of refraction in a two-dimensionally nonuniform medium is obtained, showing that the ratio of the refractive index gradients has a decisive influence on the angle of refraction The propagation of light near a heated isothermal plate situated in a uniform gas stream is examined, and the influence of the thermal flux on light intensity is identified V P

A79-26871 # **FAA air traffic control automation - Programs and trends** S B Poritzky and A G Zellweger (FAA, Washington, D C) In Radio Technical Commission for Aeronautics, Technical Symposium and Annual Assembly Meeting, Washington, D C , November 16, 17, 1978, Proceedings Washington, D C , Radio Technical Commission for Aeronautics, 1978, p 29-42

It is pointed out that the cost of air traffic control (ATC) will rise dramatically if the increasing demand is to be well served One of the major cost elements in operating the ATC system will be, as it is today, the FAA workforce The controller/aircraft ratio is going to remain high as long as every ATC transaction with an IFR aircraft is personally handled by a controller Technology alternatives in the aircraft and on the ground offer the opportunity of a less labor-intensive system Thus, FAA is actively pursuing technology alternatives with the objective of lowering projected ATC system costs The FAA's near-term major systems development activities include programs designed to aid en route and terminal controllers with their planning and separation tasks Attention is given to prospects for automation, automated en route ATC, automated terminal service, ideas regarding a replacement computer system, and collision avoidance systems G R

A79-26874 # **Avionics systems needed to optimize V/STOL potential** D A Petersen (U S Army, Avionics Research and Development Activity, Fort Monmouth, N J) In Radio Technical Commission for Aeronautics, Technical Symposium and Annual Assembly Meeting, Washington, D C , November 16, 17, 1978, Proceedings Washington, D C , Radio Technical Commission for Aeronautics, 1978, p 121-127

It is pointed out that the existing terminal area air traffic control and landing systems are unsuitable for the full utilization of the V/STOL potential The superior maneuvering, slow speed, and steep approach capabilities of V/STOL aircraft offer the potential for flying tighter patterns with closer separations under conditions of high traffic density in the terminal areas The V/STOL aircraft is generally used for short, high priority missions (averaging 20 to 30 minutes) in which fuel can be traded for payload Another topic considered concerns avionic system integration with the airframe Digital technology, particularly in the LSI and microprocessor areas, has evolved to the point that the operational problems are amenable to solution through application of digital techniques at the system level New hardware developments are also examined, taking into account navigation systems, displays, and wire and obstacle avoidance systems G R

A79-26875 * # **Cockpit displays and the growing role of the pilot in the ATC system** E G Lyman (NASA, Aeronautical Man-Vehicle Technology Div , Washington, D C) In Radio Technical Commission for Aeronautics, Technical Symposium and Annual Assembly Meeting, Washington, D C , November 16, 17, 1978, Proceedings Washington, D C , Radio Technical Commission for Aeronautics, 1978, p 129-135

It is pointed out that advances in avionics and computer technology have reached the point where serious attention may be given to structuring a new controlled air traffic environment The principal feature of such an environment is related to the capability of pilots to perform certain active ATC functions from the cockpit The main function is concerned with the ability to maintain safe

separation from other aircraft under all meteorological conditions Technical features available to permit such a functional change include such concepts as the Discrete Address Beacon System, a full capability Beacon Collision Avoidance System, data links, computer generated displays, and flight management computers G R

A79-26876 * # **A comparison of linear acoustic theory with experimental noise data for a small-scale hovering rotor** F Farassat (Joint Institute for Advancement of Flight Sciences, Hampton, Va), C E K Morris, Jr (NASA, Langley Research Center, Hampton, Va), and P A Nystrom (NASA, Langley Research Center, Joint Institute for Advancement of Flight Sciences, Hampton, Va) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 5th, Seattle, Wash , Mar 12-14, 1979, Paper 79 0608* 10 p 18 refs Army-supported research, Grant No NsG-1474

Linear acoustic calculations based on full aerodynamic data as input are presented and compared with measured cases reported by Boxwell et al (1978) The full aerodynamic data are obtained using three programs giving radial loading, chordwise loading, and chordwise position of transition It is shown that in the theoretical results the most significant noise source mechanism is due to blade thickness Thus the conclusions of Boxwell et al as to the importance of nonlinearities around the blades are upheld These conclusions concern the width, shape and the level of the acoustic pressure calculated from linear acoustic theory Some of the approximations involved in the application of acoustic analogy using quadrupole sources are discussed It is necessary that the near- and far field problems of rotating blades be treated together as shown for the case of an oscillating sphere S D

A79-26877 * # **Measured and predicted noise of the AVCO-Lycoming YF-102 turbofan engine** B J Clark, J G McArdle, and L Homyak (NASA, Lewis Research Center, Cleveland, Ohio) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 5th, Seattle, Wash , Mar 12-14, 1979, Paper 79-0641* 9 p 8 refs

Acoustic testing of the AVCO Lycoming YF 102 turbofan engine was done on a static test stand at Lewis Research Center in support of the Quiet Short Haul Research Aircraft (QSRA) acoustic design Overall noise levels are dominated by the fan noise emanating from the exhaust duct, except at high power settings when combination tones are generated in the fan inlet Component noise levels, calculated by noise prediction methods developed at Lewis Research Center for the ANOP program, are 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 (Author)

A79-26879 * # **Wave propagation in ducts using the finite element method** R K Majjigi (General Electric Co , Cincinnati, Ohio), R K Sigman, and B T Zinn (Georgia Institute of Technology, Atlanta, Ga) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 5th, Seattle, Wash , Mar 12-14, 1979, Paper 79 0659* 9 p 12 refs Grant No NsG-3036

The paper outlines a comparative study designed to assess and compare the accuracy of the finite element method (FEM) for linear and quadratic elements as applied to problems in duct acoustics The acoustic disturbances are assumed to be irrotational and isentropic so that the problem can be formulated in terms of the acoustic velocity potential It is shown that for the case of plane wave propagation in a hard-walled annular cylinder, the accuracy of the FEM solution can be increased at higher frequencies by using quadratic triangular elements instead of linear triangular elements Evidence is presented to enhance the confidence in applying the developed FEM by comparing results with those obtained by other independently developed numerical approaches such as an integral equation technique and a finite difference method S D

A79-26881 * # **Full-scale engine tests of bulk absorber acoustic inlet treatment** L J Heidelberg and L Homyak (NASA, Lewis Research Center, Cleveland, Ohio) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 5th, Seattle, Wash , Mar 12-14, 1979, Paper 79-0600* 10 p 6 refs

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 Far-field 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, 11 8 lb/cu ft, had a somewhat broader attenuation bandwidth The comparison of the best bulk and SDOF treatments showed the bulk to have a greater attenuation bandwidth At the design frequency both types of treatment had almost equal performance (Author)

A79-26882 # **A finite element subvolume technique for structural-borne interior noise prediction** J F Unruh (Southwest Research Institute, San Antonio, Tex) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 5th, Seattle, Wash , Mar 12-14, 1979, Paper 79-0585* 10 p 23 refs

Finite element structural and finite-element acoustic representations of a flexible structure and receiving (enclosed) acoustic volume are used to formulate the equations of motion for a coupled structural acoustic system in a study of structural borne noise The number of coupled equations is reduced prior to forced harmonic response analysis by expanding the structural equations of motion in terms of their normal mode eigenvectors, and the interior acoustic nodal equations are reduced to modal form via an acoustic subvolume technique A test fixture is developed to experimentally obtain hardwall acoustic modes, coupled structural-acoustic modes and interior sound pressure levels for forced harmonic input in a geometrically complex shaped enclosure Through comparison with experimental results, the acoustic subvolume analysis technique is shown to be an accurate analysis tool for predicting structure borne noise, while it reduces the computational effort required for finite element acoustic analysis S D

A79-26885 * # **Sound radiation from hyperboloidal inlet ducts** Y C Cho *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 5th, Seattle, Wash , Mar 12-14, 1979, Paper 79-0677* 10 p 15 refs Grant No NGR-09-010 085

This paper presents rigorous solutions for the problem of sound radiation from various inlet ducts including hyperboloidal (or hyperbolic) inlet ducts and circular ducts with wide flange The numerical results include the complex conversion (or reflection) coefficients and the radiation directivity for the various incident wave modes - spinning modes as well as axisymmetric modes The analysis utilizes hyperboloidal wave functions which are defined here as a class of eigensolutions of the wave equation for oblate spheroidal coordinates, and is valid for the whole frequency range including frequencies above and below the cutoff frequencies of duct modes involved (Author)

A79-26887 # **Discrete noise spectrum generated by an acoustically excited jet** V Kibens (McDonnell Douglas Corp , St Louis, Mo) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 5th, Seattle, Wash , Mar 12-14, 1979, Paper 79-0592* 9 p 16 refs

The shear layer of an axisymmetric air jet (Re = 50,000) was perturbed using a symmetrical acoustic excitation chamber surrounding the nozzle at a frequency fe = fs, where fs is the shear-layer instability frequency The excitation organized the large scale structures in the shear layer into a sequence of three successive vortex-

pairing stages at fixed streamwise locations, producing the subharmonic frequencies fe/2, fe/4, and fe/8 The pressure spectra in the near field and the acoustic spectra in the far field contained peaks at the frequencies corresponding to the rate of formation of large-scale turbulent structures through vortex pairing The broadband noise of the excited jet was reduced by as much as 10 dB compared with the nonexcited jet (Author)

A79-26893 * # **The application of finite element techniques to acoustic transmission in lined ducts with flow** R J Astley (Canterbury, University, Christchurch, New Zealand) and W Eversman (Missouri Rolla, University, Rolla, Mo) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 5th, Seattle, Wash , Mar 12 14, 1979, Paper 79-0660* 13 p 11 refs Grant No NsG-7192

The finite element method (FEM) is used to analyze the propagation of sound in two-dimensional nonuniform ducts carrying a compressible subsonic mean flow Galerkin and residual least squares (RLS) methods with natural and forced boundary conditions are considered The accuracy of FEM results for the eigenvalue and transmission problems is assessed by comparison with alternative numerical schemes for nonuniform ducts The results presented and those from associated investigations indicate that modal coupling is a significant feature of the acoustic field, especially at high Mach numbers A multimodal model therefore appears to be essential if any reliable conclusions are to be drawn in the context of turbofan inlet regions Improvements to the eigenvalue scheme following the implementation of higher-order Hermitian elements indicate a similar modification for the transmission problem S D

A79-26894 # **Direct experimental verification of the theoretical model predicting rotor noise generation** S Lévy, J Lam bourion, C Malarmey, B Rafine (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France), and M Perulli (ONERA, Châtillon-sous Bagneux, Hauts-de Seine, Compiègne, Universite de Technologie, Compiègne, France) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 5th, Seattle, Wash , Mar 12-14, 1979, Paper 79-0658* 10 p 9 refs

The well known theoretical model predicting the space structure of acoustic waves generated by a rotor can be directly verified by measuring pressure fluctuations on rotating blades Such a comparison was obtained for the first time on an ONERA experimental ducted fan Time variations of squared amplitudes of lines are studied If various blade loading harmonics are considered along with an acoustic tone, it appears that correlation coefficients reach appreciable values only for source frequencies generating propagating waves, while they remain very weak for evanescent modes (Author)

A79-26895 * # **The annoyance of multiple noisy events** A Ahumada, Jr (Stanford University, Stanford, Calif) and D C Nagel (NASA, Ames Research Center, Moffett Field, Calif) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 5th, Seattle, Wash , Mar 12-14, 1979, Paper 79 0653* 7 p 9 refs

A total of 24 subjects (17 M, 7 F) was tested in an experimental study of annoyance rating of multiple noisy events (30 sets of noise bursts) The scaling technique known as functional measurement was used to determine whether annoyance integrates additively over events and if so, to measure the power law exponent which relates the levels of the events to the additive scale values To this end, groups of three noises were presented at three levels in a factorial arrangement to check the additivity hypothesis and to estimate the scaling function Also, a series of sets of noises of constant level but varying in set size were considered The functional measurement of annoyance ratings of sets of three simulated flyovers showed that the integration of annoyance can be represented as an additive process in terms of scale values that are power functions of the sound power with a power-law exponent near 0 7 S D

A79-26896 # **Propagation of buzz-saw noise in a nonuniform medium** M S Tsai (Boeing Commercial Aeroplane Co , Seattle, Wash) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 5th, Seattle, Wash , Mar 12-14, 1979, Paper 79-0639* 8 p 11 refs

The Whitham's wavefront expansion technique is used to analyze the propagation of buzz-saw noise in the contoured inlet of the jet engine When the gradient of the axial mean flow velocity along the duct axial direction of the propagation of buzz-saw noise becomes more positive or the blade spacing becomes narrower, then more energy is dissipated As the power setting goes higher, the energy at the inlet opening spreads over a wider range of radiation angles and shifts to small radiation angles to the duct axis (Author)

A79-26905 # **Sound absorption caused by vorticity shedding, demonstrated with a jet flow** D W Bechert (Deutsche Forschungs- und Versuchsanstalt fur Luft- und Raumfahrt, Institut fur Turbulenzforschung, Berlin, West Germany) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 5th, Seattle, Wash , Mar 12-14, 1979, Paper 79-0575* 11 p 44 refs

From previous measurements it has become evident that a low frequency sound wave can be absorbed significantly when transmitted through a nozzle and a jet flow The basic underlying physical phenomenon is, that acoustic energy is converted into energy of fluctuating vorticity, which is shed from the nozzle edge In the meantime, different theories have become available which already yield an excellent quantitative description of this effect These theories are discussed, and the simplest of them, a multipole analysis, is derived It is demonstrated that this absorption effect is not restricted just to jet flows and occurs also in flows through apertures or through blade rows A variety of applications is shown including a jet noise muffler and a new non-reflective termination (Author)

A79-26907 * # **On sound radiation from the trailing edge of an isolated airfoil in a uniform flow** J C Yu (NASA, Langley Research Center, Hampton, Va) and M C Joshi (Joint Institute for Advancement of Flight Sciences, Hampton, Va) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 5th, Seattle, Wash , Mar 12-14, 1979, Paper 79-0603* 18 p 24 refs

An experimental investigation has been conducted to determine the physical process of the noise production from the trailing edge of an isolated two-dimensional airfoil embedded in a low turbulence uniform mean flow The Reynolds number of the airfoil based on chord was greater than 1,000,000 and that the boundary layer was fully turbulent at the trailing edge Smoke injection technique and spark shadowgraphy were used to study the structural features of the boundary layer Two point joint statistical analyses were made on the surface pressure, the radiated sound and the relationship between the two quantities Operating conditions included two free stream velocities and two angles of attack for both a naturally developed and an artificially tripped boundary layer Flow visualizations revealed the existence of large scale coherent motions in the outer region of the boundary layer The observed coherent motions had scales of the order of boundary layer thickness and a convection velocity near the free stream velocity The production process of the airfoil trailing edge noise was determined to be the convection of the large scale coherent eddies over the trailing edge of the airfoil The noise field so generated was found to be rather coherent and dipole-like (Author)

A79-26908 * # **An experimental study of USB flap noise reduction through mean flow modification** M C Joshi (Joint Institute for Advancement of Flight Sciences, Hampton, Va) and J C Yu (NASA, Langley Research Center, Acoustics and Noise Reduction Div , Hampton, Va) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 5th, Seattle, Wash , Mar 12-14, 1979, Paper 79-0607* 11 p 15 refs

The effect of mean flow modification on the noise production of upper surface blown flaps has been studied experimentally Mean

velocity profile at the nozzle exit was modified from the usual 'top-hat' shape to 'Gamma' and 'L'-shaped profiles The 'L'-modification caused noise reduction around and above the peak frequency of the 'top-hat' spectrum when compared on an equal thrust per exit area basis Modification to 'Gamma'-shaped profile resulted in a shift of the spectrum to lower frequencies and a lower overall noise reduction These modifications alter the development of the large scale disturbances in the upper shear layer and trailing edge wake of the wall jet geometry (Author)

A79-26909 # **Considerations for the design of inlet flow conditioners for static fan noise testing** R B Ginder, R C Kenison, and A D Smith (National Gas Turbine Establishment, Farnborough, Hants , England) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 5th, Seattle, Wash , Mar 12-14, 1979, Paper 79-0657* 9 p 10 refs

Reductions in distortion tone level of up to 10 dB have already been achieved with a hemispherical honeycomb flow conditioner Ways of achieving further reductions are investigated in acoustic and aerodynamic tests on flow conditioner elements Turbulence reduc tion measurements indicate that adding a gauze downstream of the honeycomb is much more effective than increasing the cell depth Some tests concerning the importance of the duct boundary layer region which shed further light on earlier work are discussed Aspects relevant to outdoor full-scale engine tests are emphasized and some preliminary results from such tests are given (Author)

A79-26911 * # **Effects of inflow distortion profiles on fan tone noise calculated using a 3-D theory** H Kobayshi (NASA, Lewis Research Center, Cleveland, Ohio, National Aerospace Laboratory, Tokyo, Japan) and J F Groeneweg (NASA, Lewis Research Center, Turbomachinery Noise Section, Cleveland, Ohio) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 5th, Seattle, Wash , Mar 12-14, 1979, Paper 79-0577* 11 p 12 refs

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 rotor 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)

A79-26912 # **Diagnostic evaluation of jet noise suppression mechanisms** P R Gliebe (General Electric Co , Aircraft Engine Group, Cincinnati, Ohio) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 5th, Seattle, Wash , Mar 12-14, 1979, Paper 79-0674* 11 p 11 refs U S Department of Transportation Grant No OS-30034 DOT Task 3

A unified aeroacoustic jet noise prediction method has been developed, based on the modeling of principal noise generation and emission mechanisms from first principles It is demonstrated herein that this jet noise prediction method is a useful diagnostic tool for assessing the relative importance of the various mechanisms for a given nozzle type The relative contributions of (1) turbulent mixing noise suppression, (2) shock cell broadband noise suppression, (3) convective amplification suppression, and (4) fluid shielding attenuation have been evaluated for a high element number multi-chute suppressor, to arrive at a plausible explanation for how multi-element suppressors suppress jet noise This explanation, an alternative view to historical conceptions of jet noise suppression, suggests an approach to designing low noise suppressor nozzles (Author)

A79-26915 # **Interior noise path identification in light aircraft using multivariate spectral analysis** L Keefe (Wyle Laboratories, Hampton, Va) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 5th, Seattle, Wash , Mar 12-14, 1979, Paper 79-0644* 9 p 7 refs

The interior noise at the copilot's position in a light aircraft has been modelled as the single output of a multiple input system consisting of five vibrating fuselage panels located in the propeller plane adjacent to the copilot Using the techniques of multivariate spectral analysis, residual interior noise spectra were calculated in an attempt to rank the panels by their effect on interior levels The analysis revealed that no more than 35% of the noise energy could be traced to these panels, and that it was their collective, coherent motion, rather than that of any one, which radiated the sound Difficulties in applying these spectral techniques and interpreting their results were traced to numerical errors during processing and the lack of a clear physical analogue to the mathematical condition ing process Suggestions for surmounting both these problems are presented (Author)

A79-26917 * # **The effect of throttling on forward radiated fan noise** P R Gliebe (General Electric Co , Aircraft Engine Group, Evendale, Ohio) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 5th, Seattle, Wash , Mar 12-14, 1979, Paper 79 0640* 12 p 14 refs NASA sponsored research

A study was undertaken to evaluate the effect of operating line throttling on inlet arc noise from high speed fans Experimental measurements on a 1/4-scale fan stage tested in an anechoic chamber, with and without inlet turbulence control devices, were utilized to assess the effect of constant speed throttling on the forward arc radiated noise characteristics Different effects were observed in different speed ranges with different types of inflow turbulence control These effects were correlated with some of the current theories on fan noise generation mechanisms, and partial success was achieved in attempting to relate the various theoretical models to the observed trends The results of this study have an important bearing on estimating the noise characteristics of new fan designs from scaling the measured characteristics of previously tested fans (Author)

A79-26918 # **The sound power spectrum of shock-free jets** C L Morfey and G P Howell (Southampton, University, Southampton, England) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 5th, Seattle, Wash , Mar 12-14, 1979, Paper 79-0595* 12 p 28 refs Research supported by Rolls Royce, Ltd

Sound power data from a program of jet mixing noise experiments, conducted using 2 in dia nozzles, are presented in normalized 1/3-octave form for a range of Strouhal numbers Forward and rear arc contributions to the power are given separately In addition, the power radiated into the geometric acoustics cone of silence is evaluated and is found to dominate the rear arc power at Strouhal numbers below 1/2, once the jet velocity exceeds the ambient sound speed The implications of the data are discussed in terms of radiation from wave-like large-scale structures in the turbulent jet Finally, the possible back-reaction of the sound field on the jet flow is discussed for subcritical jets (jet Mach number less than 1) (Author)

A79-26919 # **Coaxial jet noise in flight** V M Szewczyk (Rolls-Royce, Ltd , Derby, England) *American Institute of Aeronautics and Astronautics Aeroacoustics Conference, 5th Seattle, Wash , Mar 12-14, 1979, Paper 79 0636* 10 p 12 refs

The effect of flight on full scale coaxial jet noise is presented Several recommendations concerning future flyover exercises are made regarding the importance of microphone placement, airframe noise, atmospheric section data and engine/aircraft performance data Careful noise data comparisons show how the flight velocity index is now close to the model simulation values particularly when account is taken of internal noise, aircraft installation effects and the distributed nature of mixing noise Significant reductions at 90 deg and in the rear arc occurs but the popular forward arc lift is shown to be caused by an intrusive level of airframe noise (Author)

A79-26920 * # **Airframe noise measurements on a small-scale model of a supersonic transport concept in an anechoic flow facility** J S Preisser (NASA, Langley Research Center, Hampton, Va) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 5th, Seattle, Wash , Mar 12-14, 1979, Paper 79-0666* 10 p 15 refs

Airframe noise has been measured on a 015 scale model of an advanced supersonic transport concept (AST 100) in an anechoic flow facility The model was equipped with leading- and trailing edge flaps, nose and main landing gears, and engine nacelles Each of these components was deployed, individually and collectively, to deter mine their contribution to the noise field Results are presented which show that in the clean configuration the aircraft displays a symmetric dipole directivity, whereas in the more complex landing approach configuration the directivity peaks in the forward quadrant It was found that the landing approach noise was due chiefly to the landing gear, the trailing edge flaps, and the aeroacoustic interac tion between the two (Author)

A79-26923 * # **Noise from struts and splitters in turbofan exit ducts** M R Fink (United Technologies Research Center, East Hartford, Conn) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 5th, Seattle, Wash , Mar 12-14, 1979, Paper 79-0637* 10 p 13 refs Contract No NAS3 17863

An analytical method for calculating noise radiation from isolated airfoils in turbulent flow was combined with a method for calculating transmission of sound through a subsonic exit duct and with an empirical far field directivity shape This combination provides a method for predicting engine internally generated noise from radial struts and stators and annular splitter rings Calculated sound power spectra, directivity, and acoustic pressure spectra are compared with data These data were for noise caused by a fan exit duct splitter ring, large-chord stator blades, and turbine exit struts However, the lack of turbulence intensity and scale length measurements for these flow ducts prevented an absolute validation of the prediction method (Author)

A79-26924 * # **Twin jet shielding** S P Parthasarathy, R F Cuffel, and P F Massier (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 5th, Seattle, Wash , Mar 12-14, 1979, Paper 79-0671* 14 p 5 refs Research sponsored by the Lockheed-California Co

For an over-the-wing/under-the-wing engine configuration on an airplane, the noise produced by the upper jet flow is partially reflected by the lower jet An analysis has been performed which can be used to predict the distribution of perceived noise levels along the ground plane at take-off for an airplane which is designed to take advantage of the over/under shielding concept Typical contours of PNL, the shielding benefit in the shadow zone, and the EPNL values at 3 5 nautical miles from brake release as well as EPNL values at sideline at 0 35 nautical miles have been calculated This has been done for a range of flow parameters characteristic of engines producing inverted velocity profile jets suitable for use in a supersonic cruise vehicle Reductions up to 6 0 EPNdB in community noise levels can be realized when the over engines are operated at higher thrust and the lower engines simultaneously operated with reduced thrust keeping the total thrust constant (Author)

A79-26925 * # **Reduction of rotor-turbulence interaction noise in static fan noise testing** R A Kantola and R E Warren (GE Corporate Research and Development Center, Schenectady, N Y) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 5th, Seattle, Wash , Mar 12-14, 1979, Paper 79-0656* 18 p 22 refs Contract No NAS3-17853

Three effective inlet cleanup methods are described A flared reverse cone inlet is used to eliminate wakes from the fan casings and/or probe supports Boundary layer suction is employed ahead of the fan rotor and on the outer flare of the cone to reduce the boundary layer turbulence and remove any residual wakes To reduce the midstream turbulent intensity and length scales, a turbulence control structure is used which is constructed with both a layer of honeycomb and a fine mesh screen The effects of these cleanup methods are quantified by measuring the far-field noise in an anechoic chamber, using a high-speed 20-in -diam fan of the current high passband type The changes in the turbulent field impinging on this rotor are quantified by mapping the streamwise and transverse turbulent properties (spectra, intensity and length scale) with crossed hot film probes It is convincingly shown that it is possible to clean up the inlet flow of a static fan noise test facility to a point where the static acoustic data simulate flight data S D

A79-26926 * # **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 (NASA, Lewis Research Center, Cleveland, Ohio) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 5th, Seattle, Wash , Mar 12-14, 1979, Paper 79-0654* 11 p 9 refs

Two inflow control devices, (ICD's) one in-duct and the other external to the duct, were tested on a JT15D engine to determine their ability to remove inflow turbulence without altering the sound transmission to the far field The objective of the program was to develop means of accurately simulating flight fan noise on ground static test stands The results generally indicated that both the in-duct 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 in-duct ICD caused attenuation under most conditions (Author)

A79-26927 * # **Some effects of applying sonic boom minimization to supersonic cruise aircraft design** R J Mack and C M Darden (NASA, Langley Research Center, High Speed Aerodynamics Div , Hampton, Va) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 5th, Seattle, Wash , Mar 12-14, 1979, Paper 79-0652* 8 p 16 refs

This paper presents a discussion of an aircraft shaping method to control sonic boom over pressure levels along with the analysis of wind-tunnel data which validated the method The results indicate that the sonic boom minimization method can guide the design team choices of aircraft planform and component arrangement toward a low boom-level configuration while permitting sufficient freedom and flexibility to satisfy other design criteria Further, it is shown that off-design flight conditions do not drastically change the over-pressure sonic boom shape and strength (Author)

A79-26928 # **An airborne reference noise source for studying airplane flyover noise propagation and measurement** C R Hogstedt and E M Lowder (Douglas Aircraft Co , Long Beach, Calif) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 5th, Seattle, Wash , Mar 12-14, 1979, Paper 79-0650* 8 p

To improve the repeatability of airplane flyover noise measurements, an Airborne Reference Noise Source (ARNS) was developed to study noise propagation and measurement variables ARNS is a high-amplitude noise generator mounted under a light airplane The purpose is to approximate the significant portion of a fan-jet spec trum during a flyover, but with the advantages of being inherently stable in output and economical to operate As ARNS is flown at various altitudes, ground and airborne noise and weather data are recorded The resultant data are analyzed for correlation between changes in weather and measurement parameters and changes in noise levels (Author)

A79-26929 # **An acoustic problem in anechoic chambers arising from exhaust noise testing** B A Turner (National Gas Turbine Establishment, Farnborough, Hants, England) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 5th, Seattle, Wash, Mar 12-14, 1979, Paper 79-0649* 7 p

In anechoic chambers built for evaluating the noise of engine exhaust systems, gross distortions in sound level have been found in the forward arc of jets with internally-generated tones A series of experiments has isolated the lip of the exhaust collector as the source of the distortions As a consequence of the strong downstream directivities of jet and core noise, high sound levels are incident on the collector lip and it requires only a small fraction of this sound to be scattered into the forward arc for the noise levels there to be affected The problem was solved by improving the acoustic design of the lip (Author)

A79-26930 # **Experiments concerning the anomalous behaviour of aero-engine exhaust noise in flight** W D Bryce (National Gas Turbine Establishment, Farnborough, Hants, England) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 5th, Seattle, Wash, Mar 12-14, 1979, Paper 79 0648* 13 p 32 refs

The problem of explaining the changes of engine exhaust noise in going from static to flight conditions has puzzled research workers for some years This paper reviews briefly the various programmes of experimental research which have been carried out on this topic at NGTE over the last five years and highlights the results from some recent model-scale experiments It is concluded that, together with the characteristics established for jet and core noise in flight, acoustic and aerodynamic effects arising from the installation of engines in aircraft constitute necessary, perhaps sufficient, features of the required explanation (Author)

A79-26931 * # **Turboprop interior noise studies** E H Dowell (Princeton University, Princeton, N J) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 5th, Seattle, Wash, Mar 12-14, 1979, Paper 79-0647* 19 p 14 refs Grant No NsG 1253

The modal theory of acoustoelasticity is applied to the determination of the sound levels caused by a prescribed external sound excitation which is transmitted through a cylindrical shell A circumferential traveling pressure wave excitation is studied as representative of a propeller sound field It is shown how other excitations such as point mechanical loading, plane wave and reverberation random may be synthesized by superposition of circumferential waves Representative numerical results illustrate the importance of structural and acoustic frequency matching in the determination of interior sound levels and clarify the role of the cylindrical shell ring frequency An exploratory study of a double wall geometry is conducted (Author)

A79-26932 * # **Characteristics of propeller noise on an aircraft fuselage related to interior noise transmission** J S Mixson, C K Barton (NASA, Langley Research Center, Hampton, Va), A G Piersol, and J F Wilby (Bolt Beranek and Newman, Inc, Canoga Park, Calif) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 5th, Seattle, Wash, Mar 12-14, 1979, Paper 79-0646* 13 p 13 refs

Exterior noise was measured on the fuselage of a twin-engine, light aircraft at four values of engine rpm in ground static tests and at forward speeds up to 36 m/s in taxi tests Propeller noise levels, spectra, and correlations were determined using a horizontal array of seven flush-mounted microphones and a vertical array of four flush-mounted microphones in the propeller plane The measured levels and spectra are compared with predictions based on empirical and analytical methods for static and taxi conditions Trace wavelengths of the propeller noise field, obtained from point-to-point correlations, are compared with the aircraft sidewall structural dimensions, and some analytical results are presented that suggest the sensitivity of interior noise transmission to variations of the propeller noise characteristics (Author)

A79-26933 * # **Noise transmission - Turboprop problem** R Vaicaitis (Columbia University, New York, N Y), M Slazak, and M T Chang *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 5th, Seattle, Wash, Mar 12-14, 1979, Paper 79-0645* 11 p 26 refs Grant No NsG-1450

An analytical model is presented to predict low frequency (1000 Hz and below) noise transmission into aircraft Noise transmission is determined by solving the acoustic wave equation for the interior noise field, the equivalent 'smeared' monocoque shell equation for overall fuselage vibrations and skin-stringer panel equation for local vibrations of panels and stringers The solution to this system of equations is obtained by using a Galerkin-like procedure The modes and frequencies for skin stringer panels are determined by a transfer matrix method Results include noise transmission through discretely stiffened panels and cabin noise due to turbulent boundary layer and propeller passage harmonics for a turboprop type aircraft (Author)

A79-26935 # **An experimental study of the influence of flight-stream turbulence on jet mixing noise** D J Way (National Gas Turbine Establishment, Farnborough, Hants, England) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 5th, Seattle, Wash, Mar 12-14, 1979, Paper 79-0617* 11 p 16 refs

Experimental tests, aimed at highlighting aeroengine installation effects, have been conducted using a model scale jet with a flat plate of about 3 nozzle diameters square positioned to one side of the jet pipe and perpendicular to the flight stream The presence of this plate increased the jet noise measured in flight by up to 20 dB, apparently as a consequence of the wake turbulence being shed into the jet flow The magnitude of this aerodynamic installation effect is found to correlate with the ratio of the flight speed to the jet velocity, and to be independent of the jet temperature (Author)

A79-26936 * # **Effects of simulated forward flight on jet noise, shock noise and internal noise** K K Ahuja, H K Tanna, and B J Tester (Lockheed-Georgia Co, Marietta, Ga) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 5th, Seattle, Wash, Mar 12 14, 1979, Paper 79-0615* 11 p 12 refs Contract No NAS3 20050

Inflight simulation experiments are conducted in an anechoic free-jet facility to examine the flight effects on various combinations of jet noise, shock noise and internal noise The jet mixing noise component reduces with forward velocity at all angles and frequencies When jet mixing noise is contaminated with internal noise, forward motion provides a noise reduction in the rear arc and a noise increase in the forward arc, with little change at 90 deg The results are similar for shock-containing jets It is found that the existing anomalies between full-scale flight data and model-scale flight simulation data could well be due to the contamination of the flight data by internal noise (Author)

A79-26937 # **Flight effects on noise generated by the JT8D engine with inverted primary/fan flow as measured in the NASA-Ames 40- by 80-foot wind tunnel** F G Strout (Boeing Commercial Airplane Co, Seattle, Wash) and A Atencio, Jr (U S Army, Air Mobility Research and Development Laboratory, Moffett Field, Calif) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 5th, Seattle, Wash, Mar 12-14, 1979, Paper 79-0614* 10 p

A JT8D-17R engine with inverted primary and fan flows was tested under static conditions and in the NASA-Ames 40- by 80 foot wind tunnel to determine static and flight noise characteristics The major purpose of the program was to evaluate flight effects on noise generated by the inverted flow profile of a large scale engine This jet noise suppressor concept is of particular interest to advanced supersonic transport engine cycle studies where high jet velocities create a serious noise problem during takeoff operation The engine with inverted flow was tested with conical, plug, 20-lobe nozzles, and an acoustic shield Wind tunnel results show that forward velocity causes a significant reduction in peak PNL suppression but only modest reductions in peak OASPL and EPNL suppression The flight

EPNL suppression ranged from 4 0 EPNdB for the basic inverter to 7 5 EPNdB for the inverter with 20-lobe nozzle and acoustic shield When compared with the JT8D engine with internal mixer, the inverted flow configuration provides more EPNL suppression under both static and flight conditions (Author)

A79-26938 # **An investigation of model helicopter rotor blade slap at low tip speeds** J E Hubbard, Jr and W L Harris (MIT, Cambridge, Mass) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 5th, Seattle, Wash , Mar 12-14, 1979, Paper 79-0613* 8 p 13 refs Grant No DAAG29 C-027

An investigation of helicopter blade slap was performed on a 1 27 meter diameter model rotor with a NACA 0012 blade section, -8 deg linear twist in an open jet wind tunnel enclosed in an anechoic chamber The effects of number of blades, blade pitch, advance ratio, and shaft angle on the generation and intensity of blade slap have been investigated The effect of each parameter was determined by varying the parameter of interest while keeping the others constant The directivity associated with blade slap at low tip speeds was measured in a direction perpendicular to the tunnel wind axis The results of this investigation are based on a subjective definition of blade slap (Author)

A79-26939 * # **An acoustical study of the XV-15 Tilt Rotor Research Aircraft** A Lee (Lockheed Missiles and Space Co , Inc , Sunnyvale, Calif) and M Mosher (NASA, Ames Research Center, Moffett Field, Calif) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 5th, Seattle, Wash , Mar 12-14, 1979, Paper 79-0612* 7 p

Acoustic data were obtained during a full-scale test of the XV-15 Tilt Rotor Research Aircraft in the Ames 40- by 80-Foot Wind Tunnel The XV-15 has two 25-ft-diameter, three-bladed rotors at the tips of a 32-ft span wing The rotors are used as lifting rotors, as propellers, and in various intermediate stages Acoustic waveforms, dBA, and spectra as functions of different rotor conditions are presented and discussed The noise level was found to be sensitive to change in rotor-disk angle of attack in the helicopter configuration Much higher noise levels and harmonic contents were found in the helicopter mode than in the airplane mode The measurements are compared with existing theoretical predictions which include wind-tunnel wall reflections (Author)

A79-26940 * # **Radiation of an acoustic source near the trailing edge of a wing in forward motion** L Ting (New York University, New York, N Y) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 5th, Seattle, Wash , Mar 12-14, 1979, Paper 79-0605* 10 p 8 refs Grant No NsG-1469

The acoustic sources simulating engine or jet noise are located near the trailing edge During landing or take-off operations the flap angle is not small Solutions for the scattering of the acoustic sources, monopoles, dipoles or quadrupoles, by the wing with the flap at finite angle are constructed for the case that the acoustic wave length is much larger than the length of the flap but may be of the same order as the chord For each given geometry of the flap and the position of the singularities, critical orientations of the dipoles and the quadrupoles are defined along which the noise becomes 'suppressed', i e , the far field pressure becomes one order smaller (Author)

A79-26941 * # **Separation of core noise and jet noise** S P Parthasarathy, R F Cuffel, and P F Massier (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 5th, Seattle, Wash , Mar 12-14, 1979, Paper 79-0589* 8 p Contract No NAS7-100

A method of identification and measurement of core noise and jet noise separately has been developed based on cross-correlation of signals from microphones located at widely separated angles in the far field of a jet The different coherent properties of core noise and jet noise are used in this method to achieve this separation Experimental data obtained in a small scale facility is analyzed to demonstrate that this method can be used successfully to separate the mean square pressures of core noise and jet noise (Author)

A79-26942 # **Combustion noise prediction update** P Y Ho and V L Doyle (General Electric Co , Aircraft Engine Group, Cincinnati, Ohio) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 5th, Seattle, Wash , Mar 12 14, 1979, Paper 79-0588* 7 p 25 refs

A parametric expression for the prediction of direct combustion noise is presented It correlates the combustion noise with combustor steady-state parameters for a variety of existing conventionally designed gas turbine engines Recent work, particularly on the low emission combustor programs, (i e radial staged, double annular design, etc), has introduced certain new concepts and techniques in detailed combustor design Some severe noise escalation was reported for the change from the conventional configuration although these low emission combustors were generally operated at the same overall engine conditions and were physically interchangeable within the same installation With the use of the effective combustor discharge temperature, as proposed in this update, good agreement was obtained between the data and the predicted result (Author)

A79 26943 * # **Master Plan for prediction of vehicle interior noise** E H Dowell (Princeton University, Princeton, N J) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 5th, Seattle, Wash , Mar 12-14, 1979, Paper 79-582* 22 p 171 refs Grant No NsG 1253

Substantial advances have been made in improving the analytical methods available for prediction of interior noise and providing an experimental data base for their assessment and validation A review of recent accomplishments, including representative results, is presented in the context of a Master Plan It is suggested that modal representations of structural walls and acoustic cavities provide a useful conceptual and computational theoretical framework for including the mass, stiffness and damping of both the structure and acoustic cavity Geometrical details and acoustic damping (absorption) are included in a rigorous manner Future efforts, both near term and long term, are identified which are required to complete the Master Plan and provide the noise control practitioner with access to these improved methods (Author)

A79-26944 * # **Analysis of radiation patterns of interaction tones generated by inlet rods in the JT15D engine** M F Heidmann, A V Saule, and J G McArdle (NASA, Lewis Research Center, Cleveland, Ohio) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 5th, Seattle, Wash , Mar 12-14, 1979, Paper 79-0581* 14 p 10 refs

A79-26945 * # **Unsteady stator response to upstream rotor wakes** G F Franke (Allis-Chalmers Corp , York, Pa) and R E Henderson (Pennsylvania State University, University Park, Pa) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 5th, Seattle, Wash , Mar 12-14, 1979, Paper 79-0579* 14 p 18 refs Navy-supported research, Grant No NGR-39-009-275

The results are presented of an investigation of the unsteady pressures generated on a stator due to its interaction with the wakes shed by an upstream rotor The influence of stator solidity, incidence flow angle and rotor/stator spacing are discussed The results show that the major influence is due to stator solidity, particularly at large values of incidence angle Comparisons of the measured data with an existing unsteady cascade analysis show similar trends in the chordwise variation of the predicted and measured unsteady pressure difference across the blades Comparisons with an isolated airfoil analysis indicate the influence of solidity and unsteady blade-to-blade interaction All comparisons were conducted for an incompressible flow with a reduced frequency of approximately 5 0 (Author)

A79-26946 # **Aerodynamic and acoustic comparisons of scaled-down and actual engine jets** G Elias (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France) and C Schmidt (SNECMA, Paris, France) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 5th, Seattle, Wash., Mar 12-14, 1979, Paper 79-0574* 7 p 5 refs

With a view to better understand the acoustical differences between the jet of an actual engine and its scaled-down model, a test program has been carried out jointly by ONERA and SNECMA on a J-85 engine with convergent nozzle and a model of this nozzle Results, obtained in both subcritical and supercritical conditions, concern (1) the mean aerodynamic flow, (2) the turbulence level and spectrum, (3) the space-time correlation function of turbulence, (4) the azimuthal structure of the near field and the near field-turbulence correlations In the analysis of these results, the differences observed in turbulence measurements close to the nozzle exit, and their similarity in the downstream region, are emphasized (Author)

A79-26966 **Filter weight minimization for rectified superconducting alternator power supplies** T A Stuart (Toledo, University, Toledo, Ohio) and M W Tripp (Detroit Edison Co., Detroit, Mich.) In PESC '78, Power Electronics Specialists Conference, Syracuse, N Y, June 13-15, 1978, Record New York, Institute of Electrical and Electronics Engineers, Inc., 1978, p 168-177 6 refs Grants No AF-AFOSR-76-2997, No AF-AFOSR-77-3413

The paper describes the minimum weight design of the output filter of a phase-controller rectified superconducting alternator for power supply By means of an approximation of the constant flux linkages for the rotor windings, it is possible to derive a set of nonlinear simultaneous equations that can be solved numerically When these equations are solved, an expression for the instantaneous output voltage can be obtained, and the harmonics of the instantaneous output voltage are obtained from its Fourier series Then the filter can be designed to provide a specified amount of harmonic attenuation Fault current calculations are expedited by the method of constant flux linkages also Once the energy densities and filtering requirements are specified, the required values of the energy and current density for minimum filter weight can be determined P T H

A79-26980 **Application of fracture mechanics to design** Edited by J J Burke (U S Army, Army Materials and Mechanics Research Center, Watertown, Mass.) and V Weiss (Syracuse University, Syracuse, N Y) New York, Plenum Press (Sagamore Army Materials Research Conference Proceedings, No 22), 1979 344 p $39 50

Test methods for fracture mechanics design data are considered along with pressure vessels, structures, rotating components, and recent improvements in electron fractographic analyses Attention is given to fracture toughness testing, methods for dynamic fracture resistance testing, the analysis of fatigue crack growth rate data, proof test criteria for thin walled pressure vessels, practical fracture mechanics applications to design of high pressure vessels, the application of fracture mechanics to pipeline design, fracture design for structural steels, the application of fracture mechanics to prevention and control of subcritical crack growth and fracture in advanced high-performance ship structures, a fracture mechanics evaluation of generator rotors, practical applications of fracture mechanics to turbine engine rotors, and fracture mechanics and fail-safe design for helicopter rotor structures G R

A79-26986 **Fracture mechanics and fail-safe design for helicopter rotor structures** M J Rich (United Technologies Corp., Sikorsky Aircraft Div., Stratford, Conn.) In Application of fracture mechanics to design New York, Plenum Press, 1979, p 303-320 19 refs

Fracture mechanics analysis is now being extensively employed in design for fail-safety of metal alloy helicopter rotor system components The importance of fracture mechanics analysis has been to temper the use of high strength alloys by requiring properties which provide a high residual strength and greater residual life Controlled fracture, with reliable inspection methods, appears to be the key for fail-safe design A combination of 'safe-life' and 'fail-safe' design philosophies offers a lighter weight solution for increased safety The new advanced composite materials appear to offer even greater reliability by virtue of their much lower rate of crack propagation However, fracture mechanics analysis will now have to emphasize the residual strength aspect for composites due to their relatively lower fracture toughness G R

A79-27000 # **Experimental investigation of the effect of surface discontinuity on step-backward flow** M I I Rashed (Cairo University, Cairo, Egypt), R M El-Taher, and M A Ghazy (King Abdulaziz University, Jeddah, Saudi Arabia) *Journal of Engineering Sciences*, vol 4, Nov 1978, p 143-152 10 refs

The effect of geometrical changes upstream of separation of the flow past an ogive slender body on the flow in the neighborhood of a backward-facing step was investigated experimentally Geometrical changes upstream of separation were produced by a movable plate changing the form of a surface discontinuity Pressure distributions along the surface of the back facing step and longitudinal mean and fluctuating velocity components across transverse section of the model surface were measured at Reynolds number of 873,000 at mean flow velocity of 30 18 m/sec and freestream turbulence level of about 0 3% It was found that the largest base pressure corresponds to a small step surface discontinuity The surface discontinuity generally decreased the pressure of the back-facing step bottom surface A large step surface discontinuity distorted the velocity profile and increased the turbulence intensity in the mixing layer downstream The turbulence intensity in the back-facing step flow due to shallow cutouts was larger than that due to a step discontinuity of the same dimensions P T H

A79-27062 **Nonsteady flow of an incompressible liquid over slender permeable profiles** I I Efremov (Akademiia Nauk Ukrainskoi SSR, Institut Gidromekhaniki, Kiev, Ukrainian SSR) *(Prikladnaia Mekhanika,* vol 14, June 1978, p 103 109) *Soviet Applied Mechanics,* vol 14, no 6, Dec 1978, p 635 640 Translation

Rakhmatulin's hypothesis concerning flow past porous bodies (1950) in combination with a scheme of vortex wake generation is used to derive an integrodifferential equation describing the unsteady aerodynamic (e g , gust) loading of a deformable infinitely thin airfoil The vortex wake in the case of aperiodic motions is considered finite Attention is given to the development of the lift force, and it is shown that the irrotational part of the lift force depends on the higher derivatives of velocity with respect to time B J

A79-27093 **Future avionics - Keeping capability up, costs down** B Walsh *Military Electronics/Countermeasures,* vol 5, Feb 1979, p 26, 28, 30, 31

Factors contributing to the rise in avionics costs are discussed, and current and projected Air Force initiatives to reduce acquisition and support costs are reviewed While new technology offers many benefits, the funds needed to acquire and support new and existing avionics are limited, especially as inflation continues to erode the purchasing power of finite defense dollars Further, several cycles of technology-enhanced systems create the proliferation problem where a number of earlier generation systems remain in the operational inventory along with the resources needed to support them The AF Regulation 800-28 (implemented 1978), designed to provide policies and guidelines for lowering avionics costs, includes a detailed treatment of various practical activities, such as the creation of a

living data base and definition of required planning processes A master plan that will include information on how the Air Force plans to develop, acquire, maintain, and modify avionics equipment over the next 15 years is being formulated A A

A79-27121 # ***Inside noise of C-1 cargo aircraft and the noise reduction performance by interior materials*** O Fujiwara and N Muroya (Japan Air Self Defense Force, Aeromedical Laboratory, Tachikawa, Japan) *Japan Air Self Defence Force, Aeromedical Laboratory, Reports,* vol 19, Sept 1978, p 75-85 5 refs In Japanese, with abstract in English

Aircraft interior noise levels during flight were recorded along with their spectra, and syllabic articulation tests were performed to evaluate the noise reduction performance of the new interior materials of the C-1 cargo aircraft The new materials attenuated the noise by more than 2-3 dB(A) over the old ones The syllabic articulation scores were improved by about 17% The noise level improvement was not always noticeable subjectively P T H

A79-27129 **Advanced en route air traffic control automation** B M Horowitz (Mitre Corp , Bedford, Mass) In EASCON '78, Electronics and Aerospace Systems Convention, Arlington, Va , September 25-27, 1978, Record New York, Institute of Electrical and Electronics Engineers, Inc , 1978, p 48-51 U S Department of Transportation Contract No FA70WA-2448

In the current en route air traffic control (ATC) system air traffic controllers are responsible for deriving instructions for pilots which will expedite the flow of traffic and maintain separation between aircraft These instructions are issued by voice over the radio This paper discusses the separation and flow functions with regard to some possible advanced automation system concepts aimed at increasing the productivity of the en route ATC system Here, productivity is a term used to mean the total number of aircraft that can be simultaneously handled by a given number of controllers Thus, if traffic grows but controller staffing remains constant, productivity has been increased (Author)

A79-27135 **TASAR, a thinned adaptive synthetic aperture radar** R S Berkowitz and E N Powers (Pennsylvania, University, Philadelphia, Pa) In EASCON '78, Electronics and Aerospace Systems Convention, Arlington, Va , September 25-27, 1978, Record New York, Institute of Electrical and Electronics Engineers, Inc , 1978, p 135 142 9 refs

Valley Forge Research Center (VFRC) is studying a high resolution airborne radar technique This system employs a synthetic aperture, but it differs from conventional approaches in that adaptive beamforming is used to organize the array, and a highly thinned array is synthesized through the use of a limited number of randomly spaced sample points These two characteristics lead to greatly reduced computational requirements and reduced tolerances on the geometry of the array The VFRC program has involved both design studies and experimentation System concepts and the required algorithms are discussed Also the design of the experimental hardware and the expected results of the first experiments are described (Author)

A79-27139 # **Operational evaluation of an Air Traffic Control Radar Beacon System open array antenna** C A Miller and W G Collins (FAA, Washington, D C) In EASCON '78, Electronics and Aerospace Systems Convention, Arlington, Va , September 25-27, 1978, Record New York, Institute of Electrical and Electronics Engineers, Inc , 1978, p 176-185 7 refs

The open array antenna described provides a shaped elevation pattern with sharp underside cutoff This cutoff reduces ground illumination and associated nulls in the interrogator surveillance pattern and also reduces the effective radiated power directed at low-angle reflecting surfaces which are sources of false targets in the air traffic control environment A theoretical comparison of the open array with the existing standard antenna shows that a 6-8 dB reduction in illumination of reflecting surfaces at the horizon is possible when the two antennas are adjusted to provide equivalent surveillance coverage in reflective-ground environments The results of evaluations at three operational sites show that from 40 to 90 percent of the reflection false targets were eliminated by the array with coverage better than that available from the standard antenna The reflecting surfaces that generated significant numbers of false targets with the open array were large structures that extended 1-2 deg above the antenna Auxiliary techniques are sometimes required to control this false target residue (Author)

A79-27144 # **SEATRACKS - A millimeter wave radar fire control system** G E Layman (U S Navy, Naval Surface Weapons Center, Silver Spring, Md) In EASCON '78, Electronics and Aerospace Systems Convention, Arlington, Va , September 25-27, 1978, Record New York, Institute of Electrical and Electronics Engineers, Inc , 1978, p 211-216

The advantages and limitations of millimeter wave radar for shipboard fire control applications are discussed Emphasis is placed on the development of the SEATRACKS (small elevation angle track and surveillance) feasibility radar system The system concept combines a low elevation surveillance system with 35-GHz monopulse tracking radar in a single system Its advantages are noted, including narrow beamwidth, precision tracking, good performance in clutter and multipath environments, and good jamming immunity B J

A79-27145 **Estimation of target elevation angle from 2-D radars** E N Khoury In EASCON '78, Electronics and Aerospace Systems Convention, Arlington, Va , September 25-27, 1978, Record New York, Institute of Electrical and Electronics Engineers, Inc , 1978, p 217-226 5 refs Navy-supported research

Unstabilized 2-D (range, azimuth) shipboard radars measure target azimuth in a plane which is rolled and pitched with respect to a horizontal coordinate system centered at the antenna This procedure produces azimuth bias errors which are functionally related to the ship's roll, pitch, and heading, as well as the target azimuth and elevation angles The present paper demonstrates the advantages of implementing a 3-loop filter for 2-D unstabilized radars in order to stabilize the data and to obtain an elevation estimate The advantages are discussed in terms of increased estimation accuracy and reduced fire control acquisition times B J

A79-27203 # **Laminar boundary layer with foreign gas injection on a conical body** K Matsuno (National Aerospace Laboratory, Chofu, Tokyo, Japan) and R Kawamura (Tokyo, University, Tokyo, Japan) *Tokyo, University, Institute of Space and Aeronautical Science, Report* no 565, vol 43, Dec 1978, p 247-270 19 refs

The theory of laminar boundary layer with foreign gas injection on a nonaxisymmetric conical body at supersonic flight is discussed Emphasis is placed on estimating the mutual influence of mass injection and the cross-flow (or 'secondary flow') on the local heat transfer and skin friction, with the over-all flowfield equations solved by using the small perturbation method Solutions were compared with experimental data, and the effects of mass injection on the boundary layer characteristics examined The following results were obtained (1) the major effect of mass injection is to reduce the local heat transfer and skin friction, (2) the maximum value of the cross-flow velocity component increases with increasing mass injection rates, and (3) in the case of noncircular cones, such as the elliptic cone, at angles of attack, no points at which the local heat transfer and the meridional skin friction have maximum values coincide with the windward side at which the peak pressure occurs A A

A79-27297 **GASP IV simulation model for the composites and bonding production facility** D W Starks (McDonnell Aircraft Co , St Louis, Mo) In Winter Simulation Conference, Miami Beach, Fla , December 4-6, 1978, Proceedings Volume 2 Piscataway, N J , Institute of Electrical and Electronics Engineers, Inc , 1978, p 843-848

This article describes the operation of the composites and bonding production facility of McDonnell Aircraft Company in St Louis

It explains why a simulation of this area was needed, gives an overview of the simulation, and describes how the industrial engineers use the results of the simulation (Author)

A79-27313 **Potential uses of rapidly solidified alloys in gas turbine engines.** A R Cox (United Technologies Corp , Pratt and Whitney Aircraft Group, West Palm Beach, Fla) and E C van Reuth (Defense Advanced Research Projects Agency, Arlington, Va) In Rapidly quenched metals III, Proceedings of the Third International Conference, Brighton, England, July 3-7, 1978 Volume 2 London, Metals Society, 1978, p 225-231 5 refs ARPA Order 3152

The extension of rapid solidification processing to superalloy compositions allows alloy modifications to be made which are characteristically outside the range possible by current superalloy process methods Eutectic regions are eliminated in gamma-gamma prime alloys, so that higher additions of gamma-prime partitioning elements can be added P T H

A79-27319 **Why doesn't aircraft accident investigation prevent accidents** G B Parker (Southern California, University, Los Angeles, Calif) *(International Society of Air Safety Investigators, International Seminar, 9th, Seattle Wash , Oct 1978) SAFE Journal,* vol 9, Spring 1979, p 5-9 13 refs

Accident statistics in general aviation are analyzed, together with a discussion of the root causes A general aviation statistics list covering accidents from 1967 through 1977 shows that the accident rate has dropped from 27 6 accidents per 100,000 flight hours a year to 11 8 It is pointed out, however, that no reduction in fatal accidents has been observed A list of accident statistics by category, including instructional, business, corporate, aerial application, and air taxi flying, indicates that pleasure flying accounted for the 52 5% of the accidents in 1976 A comparison of the pleasure flying accident rate with the U S Air Force accident rate for 1976 shows that the first was 7 28 times higher than the latter It is argued that pilot errors and adverse weather conditions, which account for the bulk of aircraft accidents, are conditions and not root causes Social, emotional and other stresses, as well as lack of proper pilot education on weather and safety, and deficiencies in forecasting and operations procedures are some of the root causes suggested A A

A79-27352 # **The coming of age of digital electronics in commercial transports** J McWha and L R Smith (Boeing Commercial Airplane Co , Seattle, Wash) In Atlantic Aeronautical Conference, Williamsburg, Va , March 26-28, 1979, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 1-8 8 refs (AIAA 79-0686)

As in every other sphere of industry, digital technology has gradually found a place in commercial aviation The new generation of airplanes will depend heavily on digital signal processing for sensor, computer, and display systems Benefits of these new systems will be improved performance, reliability, and self test capability, resulting in lower cost-of-ownership This paper presents the layman with some background on the increasing use of digital systems in current transports and a preview of some of the systems in development for new commercial transports, particularly the Boeing 767 Some of the anticipated benefits of the new systems are discussed The problems to be faced during certification of flight critical digital systems are briefly addressed (Author)

A79-27353 # **Development of modern airfoil sections for high subsonic cruise speeds.** B Eggleston (de Havilland Aircraft of Canada, Ltd , Downsview, Ontario, Canada), D J Jones, and G M Elfstrom (National Research Council, Ottawa, Canada) In Atlantic Aeronautical Conference, Williamsburg, Va , March 26-28, 1979, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 9-16 19 refs (AIAA 79-0687)

Some recent Canadian work on the design and test of airfoils for high subsonic aircraft is reviewed Comparisons of theory and experiment are presented for two 16% thick airfoils One airfoil was designed using numerical optimization while the other was designed by inverse methods with refinements to improve performance The inverse design airfoil improved maximum lift coefficients 20% at all Mach numbers tested (0 2-0 80) and demonstrated that a concave pressure recovery was not detrimental Anticipated improvements due to natural laminar flow were not realized at high subsonic Mach numbers and high Reynolds numbers (20 x 10 to the 6th) (Author)

A79-27354 # **Crashworthiness tests on model aircraft fuselage structures** R C Tennyson, J S Hansen, H Teichman (Toronto, University, Toronto, Canada), F Cicci, and M Ioannou (de Havilland Aircraft of Canada, Ltd , Structural Research Group, Toronto, Canada) In Atlantic Aeronautical Conference, Williamsburg, Va , March 26-28, 1979, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 17 26 13 refs National Research Council of Canada Grant No A-9185, Canadian Transportation Development Agency Grant No 01SU,T8200-7-7536 (AIAA 79 0688)

This report presents results from our continuing program involved with the crashworthiness impact tests on scale model aluminum fuselage structures Level and oblique angle drop tests have been conducted for varying wing loads, descent velocities and angles of incidence Dynamic measurements of strain and g loads at discrete locations have been obtained together with high speed photographs of the failure modes for comparison with a lumped mass-stiffness model of the structure using a finite element approximation The range of tests include lightly loaded structures right through to catastrophic collapse of the fuselage (Author)

A79-27355 # **Design against fatigue - Current trends** W T Kirkby, P J E Forsyth, and R D J Maxwell (Royal Aircraft Establishment, Farnborough, Hants , England) In Atlantic Aeronautical Conference, Williamsburg, Va , March 26-28, 1979, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 27-39 6 refs (AIAA 79 0689)

The current state-of-the art in design against fatigue of aircraft structures is reviewed An outline is given of the design philosophies which have evolved to meet the fatigue problem over the past three decades Problems of design and operation are summarized with reference to fatigue loads, design trends and developments (e g , active control technology and in-service load measurement), design methods (e g , the finite element method), and fatigue design with metallic as well as with composite materials B J

A79-27356 # **New technology in commercial aircraft design for minimum operating cost** D J Stewart and B S Campion (British Aerospace, Weybridge, Surrey, England) In Atlantic Aeronautical Conference, Williamsburg, Va , March 26-28, 1979, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 40 51 (AIAA 79-0690)

Potential gains from the application of various forms of advanced technology to commercial aircraft are examined in terms of direct operating cost (DOC) and fuel consumed It is found that substantial DOC and fuel reductions can be obtained even relative to the standard of the most recent short/medium haul aircraft to enter service These gains result mainly from the utilization of advances in wing design, stability augmentation, load alleviation, and composite materials For the most advanced designs, high aspect ratios are required for minimum DOC and may approach the limit of practicability for a number of technical reasons B J

A79-27357 # **Transonic wing design for transport aircraft** G Krenz (Vereinigte Flugtechnische Werke Fokker GmbH, Bremen West Germany) In Atlantic Aeronautical Conference, Williamsburg

Va , March 26-28, 1979, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 52-61 (AIAA 79-0692)

An aerodynamic design philosophy based on pressure distribution types in chord- and span-wise directions is presented A two-dimensional airfoil section development forming the basis of wing design is outlined illustrating progressive improvements in section performance during wind tunnel tests The basic section was employed to design two wings with inboard shapes corresponding to different design concepts Consideration is given to the shock development over both wings along with a comparison of drag characteristics A weak forward shock at the inboard wing results in lower drag as compared to a pronounced double-shock system B J

A79-27358 # **Compromise between economic concerns and application of new technologies in the definition of a new airplane project** G Cormery (Societe Nationale Industrielle Aérospatiale, Paris, France) In Atlantic Aeronautical Conference, Williamsburg, Va , March 26-28, 1979, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 62-71 (AIAA 79 0693)

Some remarks are presented on tradeoffs between costs and the need to introduce advanced technologies in aircraft development programs A critical discussion is presented on optimization and assessment criteria, including minimization of DOC or TOC, maximization of life cycle profitability, minimization of LCC for military aircraft, and minimization of fuel consumed An approach to solving the general tradeoff problem is presented B J

A79-27359 * # **Advanced supersonic technology and its implications for the future** C Driver (NASA, Langley Research Center, Hampton, Va) In Atlantic Aeronautical Conference, Williamsburg, Va , March 26 28, 1979, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 72-78 18 refs (AIAA 79-0694)

A brief overview of the NASA Supersonic Cruise Research (SCR) program is presented The SCR program has identified significant improvements in the areas of aerodynamics, structures, propulsion, noise reduction, takeoff and landing procedures, and advanced configuration concepts These improvements tend to overcome most of the problems which led to the cancellation of the National SST program They offer the promise of an advanced SST family of aircraft which are environmentally acceptable, have flexible range-payload capability, and are economically viable The areas of technology addressed by the SCR program have direct application to advanced military aircraft and to supersonic executive aircraft B J

A79-27360 # **How to get the world airborne** W M Hawkins (Lockheed California Co , Burbank, Calif) In Atlantic Aeronautical Conference, Williamsburg, Va , March 26-28, 1979, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 79 87 (AIAA 79-0695)

Ways to accelerate the spread of air transportation in developing countries are discussed Consideration is given to the cost of new transportation systems, the character of the new market, the necessary hardware, whether emphasis should be placed on cargo or passengers, and how such programs should be started B J

A79-27361 # **Ski-jump - A great leap for tactical airpower** J W Fozard (British Aerospace, Weybridge, Surrey, England) In Atlantic Aeronautical Conference, Williamsburg, Va , March 26 28, 1979, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 88-104 12 refs (AIAA 79-0696)

The ski-jump concept involves the launching of a V/STOL jet from an upward-inclined ramp This paper reviews the ski-jump launching principle and gives consideration to ramp constraints, and operational implications for land and ships It is noted that the originality of the ski-jump launch lies not so much in the performance gain as in its utter simplicity and absence of penalty for the vectored thrust fighter using it B J

A79-27362 # **New airborne armament systems** Y Thiriet (Avions Marcel Dassault Breguet Aviation, Saint-Cloud, Hauts-de-Seine, France) In Atlantic Aeronautical Conference, Williamsburg, Va , March 26-28, 1979, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 105-113 (AIAA 79-0697)

New aircraft weapon systems are reviewed with attention given to the need for multimission armament at the design stage and the problem of armament qualification Particular consideration is given to store carriage qualification, store separation qualification, adapted launchers, and aiming systems. B J

A79-27363 # **Supersonic combat aircraft design** J Fletcher and B R A Burns (British Aerospace, Warton Div , Preston, Lancs , England) In Atlantic Aeronautical Conference, Williamsburg, Va , *March 26-28, 1979, Technical Papers New York,* American Institute of Aeronautics and Astronautics, Inc , 1979, p 114-122 (AIAA 79-0699)

Some aspects of the state of the art of supersonic combat aircraft design are reviewed with attention to design for high agility, design for high mobility, operations in the face of persistent airfield attack, operations in a highly hostile airborne environment, and overall system versatility These requirements imply the need for a wide versatility and adaptability in the final weapons system, as an absolute minimum the designer must attempt to avoid any undue sensitivity to a change in operating factors It is suggested that transformation of a fighter to a bomber or vice versa should be a natural mutation and that the final cost will be smaller if the appropriate variations have been accounted for in the beginning B J

A79-27364 # **Perspectives of technological development for helicopters** G Beziac (Societe Nationale Industrielle Aérospatiale, Division Helicopteres, Marignane, Bouches-du-Rhône, France) In Atlantic Aeronautical Conference, Williamsburg, Va , March 26-28, 1979, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 123-135 (AIAA 79-0701)

The paper surveys the present technical status of the helicopter and estimates the possible technological improvements of each aircraft component A computer program based on theoretical modeling of weights, engine fuel consumptions and parasitic drags is used to define the general characteristics and essential performance data of the helicopter which will be in production in the year 2000 (Author)

A79-27365 # **Evaluation of IFR handling qualities of helicopters using the NAE airborne V/STOL simulator** S Kereliuk and M Sinclair (National Aeronautical Establishment, Flight Research Laboratory, Ottawa, Canada) In Atlantic Aeronautical Conference, Williamsburg, Va , March 26-28, 1979, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 136-145 (AIAA 79-0702)

The NAE airborne simulator is being used in a series of experiments to study the validity of the flying qualities requirements laid down in the FAA's Interim Standard for helicopter IFR (instrument flight rules) certification and in recent revisions to that document The aim of the experiments is to bridge the gap between these FAA criteria and the substantial base of helicopter and V/STOL handling qualities data which has already been established Consideration is given to a preliminary phase of the flight test program in which some simple helicopter configurations were evaluated in simulated two-pilot and single-pilot IFR environments B J

A79-27366 # **Future advanced technology rotorcraft** M V Lowson and D E H Balmford (Westland Helicopters, Ltd , Yeovil, Somerset, England) In Atlantic Aeronautical Conference, Williams-

burg, Va , March 26-28, 1979, Technical Papers
New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 146-157 13 refs (AIAA 79-0705)

Rotorcraft technology has advanced significantly in the last decade, primarily in the areas of aerodynamics, dynamics, structures and materials Further advances in technology, particularly in digital avionics, are in prospect Advances in all these areas are described, and the potential benefits to future helicopters are examined Possible designs for future civil and military helicopters taking advantage of the technology advance are presented The relevance of the technology to other configurations of rotorcraft is discussed It is concluded that the benefits now in prospect for the helicopter could make the development risk of novel rotorcraft configurations unattractive, except for new operational roles such as the remotely piloted helicopter (Author)

A79-27367 # **Some new approaches for wind-tunnel testing through the use of computers** P Poisson-Quinton (ONERA, Châtillon sous Bagneux, Hauts-de-Seine, France) In Atlantic Aeronautical Conference, Williamsburg, Va , March 26-28, 1979, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 158 171 9 refs (AIAA 79-0707)

New approaches for wind-tunnel testing methods designed by ONERA are described The operating conditions, design objectives, system architecture, and software considerations of the computer system installed in the ONERA F1 pressurized low speed tunnel are taken into account A new rig designed for the large S1 Modane tunnel to study difficult subsonic flight regimes, including ground or gust effect, is considered, as is a new transonic test section for reducing transonic wall interference A special automatic rig installed in the S2 Modane tunnel to examine quickly the trajectory of stores separating from an aircraft so as to eliminate the possibility of danger is discussed in detail together with an active control system for flutter suppression on a dynamic model tested at transonic regime A A

A79-27368 # **Recent developments in active control technology** W Kubbat and O Sensburg (Messerschmitt-Bolkow-Blohm GmbH, Airplane Div , Ottobrunn, West Germany) In Atlantic Aeronautical Conference, Williamsburg, Va , March 26-28, 1979, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 172 182 22 refs (AIAA 79-0708)

The paper reviews today's spectrum of active control technology (ACT) These tools, which are ranging from relaxed static stability, direct force control, post stall up to the control of elastic modes are described, together with examples of application Major application possibilities are pointed out Recent and current German experimental ACT-programs are briefly described, together with their status and many test results (Author)

A79-27369 # **Findings of the Ottawa-Montreal STOL demonstration service** B B Myers (Transport Canada, Research and Development Centre, Montreal, Canada) In Atlantic Aeronautical Conference, Williamsburg, Va , March 26-28, 1979, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 183-191 (AIAA 79-0710)

The application of Short Take-Off and Landing (STOL) technology to intercity transportation has been a subject of considerable controversy In an attempt to break this type of deadlock the Canadian government undertook to demonstrate a STOL intercity service The Montreal Ottawa route was chosen following the study of several Canadian locations Attention is given to aspects of planning and implementation, project costs, airtransit operations, passenger acceptance, air carrier cost, air carrier revenues, facilities costs, STOL system potential, energy considerations, and questions of community reaction G R

A79-27370 # **Enhanced capabilities of future fighters as a result of HiMAT** G Fair and M R Robinson (Rockwell International Corp , Los Angeles, Calif) In Atlantic Aeronautical Conference, Williamsburg, Va , March 26-28, 1979, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 192-198 (AIAA 79-0698)

Studies conducted by Government and industry indicate that air-to-air fighters will be needed in substantial numbers The ability to meet the simultaneous requirements of high aircraft performance, substantial quantities, and low cost will depend to a large extent on technology applications The Highly Maneuverable Aircraft Technology (HiMAT) program sponsored by NASA and the Air Force was directed toward accelerated low-cost development and flight demonstration of advanced technologies for significantly increased maneuverability and combat effectiveness in future fighters The HiMAT program includes building two remotely piloted research vehicles, which are scale models of the advanced fighter design G R

A79-27371 * # **XV-15 Tilt Rotor Research Aircraft - Program report** J P Magee (NASA, Ames Research Center, U S Army, Aeromechanics Laboratory, Moffett Field, Calif) and K G Wernicke (Bell Helicopter Textron, Fort Worth, Tex) In Atlantic Aeronautical Conference, Williamsburg, Va , March 26-28, 1979, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 201-210 15 refs (AIAA 79-0704)

This paper is a status report of the NASA/Army XV-15 Project The basic tilt-rotor concept and the XV-15 Tilt-Rotor Research Aircraft are discussed and some results of full-scale wind-tunnel tests in the Ames 40 by 80-Foot Wind Tunnel are presented Flight test data are included to give preliminary performance, noise, and vibration data in hover and as far into transition flight as are available at the time of presentation Information concerning vehicle aerodynamics and airloads obtained as a result of both wind-tunnel and flight tests are provided with some conclusions as to the ramifications of the data in terms of design criteria and configuration layout (Author)

A79-27388 **How to add satellite navigational accuracy and stability to existing offshore NAV Systems** P J Icenbice, Jr (JMR Instruments, Inc , Chatsworth, Calif) In Oceans '78 The ocean challenge, Proceedings of the Fourth Annual Combined Conference, Washington, D C , September 6 8, 1978 Washington, D C , Marine Technology Society, New York, Institute of Electrical and Electronics Engineers, Inc , 1978, p 478 484

This paper describes how to employ the accuracy and reliability of the NNSS (TRANSIT) satellite receiver data, as an input to improve the accuracy of a 'NAV' SYSTEM which has multiple input data ports The multiple sensor data from ten or more inputs are accepted by the covariance matrix computational microprocessor, along with the position fix signals from the JMR-2 Doppler Survey Receiving Sub-system These data are processed to provide multiple outputs for navigation, survey, control and data logging The helmsperson is provided with a display and the data are recorded on tape Since different applications require different sensors, this universal design is capable of accepting signals from many sensors with different characteristics (Author)

A79-27416 **Elimination of scale and luminance distortions in thermal imaging systems with a large field of view** V G Klochkova, D N Krasnikov, and B V Ukhov *(Optiko-Mekhanicheskaia Promyshlennost',* vol 45, May 1978, p 8-10) *Soviet Journal of Optical Technology,* vol 45, May 1978, p 276 278 Translation

When a thermal image is being recorded on photographic film that is continuously moving past the screen of a CRT operating in single-line scanning mode, the elimination of scale distortions through the use of a nonlinear electron beam sweep leads to a constant ratio of the tangents of the viewing and deflection angles in

the CRT and consequently to considerable film density nonuniformity The density falloff can be eliminated by increasing the luminance toward the end of the line for a constant signal at the CRT input P T H

A79-27424 * # Wind-tunnel studies of the effects of simulated damage on the aerodynamic characteristics of airplanes and missiles M L Spearman (NASA, Langley Research Center, Hampton, Va) *American Defense Preparedness Association, Vulnerability and Survivability Symposium, 4th, Tyndall AFB, Fla , Mar 14, 15, 1979, Paper* 15 p 7 refs

In order to assess the effects on static aerodynamic characteristics of battle damage to an aircraft or missile, wind tunnel studies were performed on models from which all or parts of the wing or horizontal or vertical tail had been removed The effects of damage on the lift, longitudinal stability, lateral stability and directional stability of a swept-wing fighter are presented, along with the effects of wing removal on the control requirements of a delta-wing fighter Results indicate that the loss of a major part of the vertical tail will probably result in the loss of the aircraft at any speed, while the loss of major parts of the horizontal tail generally results in catastrophic instability at subsonic speeds but, at low supersonic speeds, may allow the aircraft to return to friendly territory before pilot ejection Major damage to the wing may be sustained without the loss of aircraft or pilot The loss of some of the aerodynamic surfaces of cruise or surface-to-air missiles may result in catastrophic instability or may permit a ballistic trajectory to be maintained, depending upon the location of the lost surface with respect to the center of gravity of the missile A L W

A79-27571 * Simultaneous measurements of ozone outside and inside cabins of two B-747 airliners and a Gates Learjet business jet P J Perkins and D Briehl (NASA, Lewis Research Center, Cleveland, Ohio) In Conference on Atmospheric Environment of Aerospace Systems and Applied Meteorology, New York, N Y , November 14-16, 1978, Preprints Boston, Mass , American Meteorological Society, 1978, p 39 44 15 refs

Recently, passengers and crew members on long distance commercial flights have filed complaints after suffering symptoms of ozone sickness Studies were conducted to determine the frequency and concentration of ozone in commercial jet transports The airliner problem with ozone prompted NASA to determine the ozone concentrations that might be encountered in the cabin of a small business jet Simultaneous measurements of atmospheric ozone levels and ozone levels in the cabins of jet aircraft were necessary because of the wide and rapid variability of atmospheric ozone in flight It was found that the atmospheric ozone concentrations in the case of B-747 airliners vary widely during a flight A constant difference, or ratio, between ozone concentrations outside and inside the cabin does not exist G R

A79-27572 Environmental models for moisture absorption by aircraft composites N D Dvoskin, W A Wolter, and V Jordan (Grumman Aerospace Corp , Bethpage, N Y) In Conference on Atmospheric Environment of Aerospace Systems and Applied Meteorology, New York, N Y , November 14-16, 1978, Preprints Boston, Mass , American Meteorological Society, 1978, p 45-50 6 refs

A description is presented of the initial portion of a study which was performed to assess the durability of advanced composite materials that have been exposed to realistic moisture environments The portion described, the environmental definition task, was performed to define the runway exposure of fighter, bomber, and transport aircraft to realistic moisture environments at Air Force bases around the world Realistic runway storage models for determining moisture absorption of advanced composite structures in Air Force aircraft were defined in terms of hour-by-hour variables for each month of the year The effects of solar radiation on structural skin surface temperature and relative humidity were computed for a high infrared emissivity typical of organic finishes and several values of surface solar absorptivity G R

A79-27574 The Dulles International Airport wind-shear detection system - Statistical results A J Bedard, Jr (NOAA, Wave Propagation Laboratory, Boulder, Colo) In Conference on Atmospheric Environment of Aerospace Systems and Applied Meteorology, New York, N Y , November 14-16, 1978, Preprints Boston, Mass , American Meteorological Society, 1978, p 57-66 10 refs FAA supported research

The Dulles system, comprised of a Doppler acoustic microwave radar and a dense network of surface sensors recorded more than 160 events The statistics of these events are reviewed and their implications are discussed for the design of systems of surface sensors, particularly for the detection of thunderstorm outflows Histograms showing frequency of various types of events as a function of month-of-year are considered, taking into account thunderstorms, squall-lines and fronts, boundary layer effects, gravity-shear waves, gravity waves, and high winds Attention is given to surface wind observations, surface pressure observations, Doppler acoustic-microwave radar observations, surface temperature observations, and weather radar observations The statistics of observations related to boundary layer effects are also examined G R

A79 27575 * Stable boundary layer wind shear model for aircraft flight hazard definition W Frost (FWG Associates, Inc , Tullahoma, Tenn), S T Wang (Tennessee, University, Tullahoma, Tenn), and D W Camp (NASA, Marshall Space Flight Center, Huntsville, Ala) In Conference on Atmospheric Environment of Aerospace Systems and Applied Meteorology, New York, N Y , November 14 16, 1978, Preprints Boston, Mass , American Meteorological Society, 1978, p 67-74 10 refs U S Department of Transportation Contract No FA76 WAI-620

It is pointed out that wind shear, particularly at the lower altitudes in the terminal area, has been identified as being hazardous to aircraft operations Accurate and reliable wind profiles are required for use in fast time and manned flight simulation studies aimed at fully defining and understanding the wind shear hazard A description is presented of wind speed profiles for neutral and stable atmospheric conditions developed for the simulation studies to improve the safety and reliability of operations in the terminal area The wind shear is mathematically modeled and the mathematical scenarios are presented in a format for direct application to wind shear hazard/flight simulation studies G R

A79-27576 * A spectral analysis of thunderstorm turbulence and jet transport landing performance J McCarthy, E F Blick, and R R Bensch (Oklahoma, University, Norman, Okla) In Conference on Atmospheric Environment of Aerospace Systems and Applied Meteorology, New York, N Y , November 14-16, 1978, Preprints Boston, Mass , American Meteorological Society, 1978, p 75-82 9 refs NSF Grant No ATM-74-03406-A02, Contract No NAS8 31377

A description is presented of a study which examines not only wind shear, but considers the velocity spectrum of the wind, as it may affect the flight of an aircraft A model reported by McCarthy and Blick (1976) and by Blick et al (1978) is considered The model simulated the approach performance of a Boeing 727-type aircraft, as affected by the time series winds measured along the aircraft's longitudinal axis Attention is given to the model and its implications, wind shear simulations, and the use of the model in the study of a crash on June 24, 1975 G R

A79-27599 # Path in rocket technology Selected works, 1924-1946 (Put' v raketnoi tekhnike - Izbrannye trudy, 1924-1946) V P Glushko Moscow, Izdatel'stvo Mashinostroenie, 1977 503 p 123 refs In Russian

Selected papers are presented from the early period of the work of V P Glushko, the rocket pioneer The papers cover a wide range

of subjects, including rocket engine design, fuel injection systems, and combustion processes A bibliography of works published by Glushko in the period 1924-1945 on jet and rocket engines and interplanetary flight is presented B J

A79-27648 # Introduction to the computer-aided design of flight vehicles (Vvedenie v mashinnoe proektirovanie letatel'nykh apparatov) V P Mishin and M I Osin Moscow, Izdatel'stvo Mashinostroenie, 1978 128 p 68 refs In Russian

The basic principles of the computer aided design of spacecraft are formulated and attention is given to various methods of design optimization, with particular emphasis placed on numerical methods of structural synthesis As examples, algorithms for the design and optimization of planetary descent vehicles and interplanetary probes are examined B J

A79-27656 Cryohydrogen-fuel for tomorrow's commercial aircraft G D Brewer (Lockheed-California Co , Burbank, Calif) In Applications of cryogenic technology Volume 7 - Proceedings of the Conference on Cryogenic Energy Systems, Oak Brook, Ill , May 16-18, 1978 Flushing, N Y , Scholium International, Inc , 1978, p 87-104 6 refs

Studies performed for NASA on the potential use of liquid hydrogen as an aircraft fuel are summarized Particular consideration is given to a recently completed study on how utilization of LH2 will affect the design of the engine and fuel system for a representative subsonic passenger transport It is concluded that adoption of cryohydrogen as the fuel for future commercial aircraft will reduce the need for oil imports, reduce pollution, and provide lower cost and more energy-efficient transportation B J

A79-27666 Air Force applications of lightweight superconducting machinery C E Oberly (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio) In Applications of cryogenic technology Volume 7 - Proceedings of the Conference on Cryogenic Energy Systems, Oak Brook, Ill , May 16-18, 1978 Flushing, N Y , Scholium International, Inc , 1978, p 293-334 45 refs

Consideration is given to the dominant factors which affect the development of such Air Force airborne superconducting machinery as alternators, MHD magnets, and energy storage devices These factors include lightweight structure design and severe losses induced by transient fields and conductor motion Adequate structure, stabilizing matrix and cooling are difficult to design because of weight and volume restrictions The promise of greater thermal margin in advanced superconducting materials such as flexible multifilament Nb3Sn and the weight saving potential of advanced structural materials provides impetus for continued Air Force development programs B J

A79-27672 New airborne display concepts (Nouveaux concepts des visualisations embarquees) M Coussedière (Thomson CSF, Paris, France) *(Colloque sur l'Integration des Systemes, Paris, France, Feb 10, 11, 1977) Sciences et Techniques de l'Armement (Mémorial de l'Artillerie Française),* vol 52, no 4, 1978, p 613-627 In French

The paper outlines some novel concepts for airborne display systems The concepts are intended to suppress the overburden imposed on aircrew members by the increasing number of display, monitoring and control instruments in the cockpit Various electronic devices using very high luminance multichrome CRTs allow integration of a large number of data into small-size instruments New technologies presently studied (plasmas, liquid crystals, LEDs, etc) are expected to supersede the CRT-based instrumentation, with other specific applications in the near future S D

A79-27674 Study of the structure of an integrated system of flight control, navigation and display (Etude d'organisation d'un système integré de pilotage, navigation et visualisation) C Roquefeuil *(Colloque sur l'Intégration des Systemes, Paris, France, Feb 10, 11, 1977) Sciences et Techniques de l'Armement (Mémorial de l'Artillerie Française),* vol 52, no 4, 1978, p 639-656 In French

The integrated system under study is intended for transport aircraft Optimization of the efficiency/cost ratio has lead to the adoption of tradeoffs between automatic and instrument control, centralized and shared processing, analog and digital processing, multiplex digital links (bus) and separate links, and electronic and electromechanical displays The proposed structure separates from the rest of the system the set of equipment needed for the critical landing in poor visibility condition S D

A79-27675 Tests of an integrated piloting, navigation, and display system (Essais d'un système intégre de pilotage, navigation et visualisation) A Klopfstein (Centre d'Essais en Vol, Bretigny-sur-Orge, Essonne, France) *(Colloque sur l'Intégration des Systemes, Paris, France, Feb 10-11, 1977) Sciences et Techniques de l'Armement (Memorial de l'Artillerie Française),* vol 52, no 4, 1978, p 657-670 In French

The paper describes an experimental integrated piloting, navigation, and display system to be flown in a Caravelle test bed A series of ground tests, flight simulator tests, and flight tests is planned The testing program will be used to evaluate the capability of the system to meet the main goals of reducing crew work load, optimizing pilot-system dialog, adaptation and evolution suppleness, maintainability, performance improvement, and safety increase P T H

A79-27727 Theoretical-experimental analysis of influence of coolant discharge from perforated turbine vanes on their aerodynamic characteristics R S Agachev and B A Kumirov *(Aviatsionnaia Tekhnika,* vol 21, no 1, 1978, p 10-15) *Soviet Aeronautics,* vol 21, no 1, 1978, p 5-9 Translation

A method for calculating the velocity loss coefficient in the steady two dimensional flow behind air cooled turbine blades is proposed, and the theoretical assumptions employed are verified experimentally Experimental results obtained with blades perforated at the leading edge showed that the cooling air blowing intensity has a very small effect on the velocity losses and the blade exit angle Likewise, the influence of coolant discharge on the pressure distribution over a perforated blade was found to be insignificant V P

A79-27728 Two-frequency-range theory of unstable turbulent combustion oscillations in a jet engine combustion chamber II - Analysis of the characteristic equation and comparison with experiment S K Aslanov *(Aviatsionnaia Tekhnika,* vol 21, no 1, 1978, p 16-21) *Soviet Aeronautics,* vol 21, no 1, 1978, p 10 14 6 refs Translation

A79-27731 Instability of fluid flow in centrifugal injector B S Drobiazko and V P Pavlovskii *(Aviatsionnaia Tekhnika,* vol 21, no 1, 1978, p 37-41) *Soviet Aeronautics,* vol 21, no 1, 1978, p 27 30 Translation

The spontaneous changes in the mode of operation of two-component swirl injectors, leading to abrupt changes in flow rate and pressure gradient, were studied experimentally This phenomenon is shown to be associated with the instability of the continuous swirling flow and rapid transition of the swirling flow to a cavitating flow V P

A79-27737 Influence of bypass ratio on jet engine weight N S Lamekin and A S Bogdanov *(Aviatsionnaia Tekhnika,* vol 21, no 1, 1978, p 68-73) *Soviet Aeronautics,* vol 21, no 1, 1978, p 52-56 Translation

In the method proposed for calculating the weight of a bypass turbojet engine, the weight is expressed as a cubic polynomial in the

characteristic dimension The calculation of the weight of a bypass engine is illustrated by an example The influence of the thrust and the bypass ratio on engine weight is evaluated It is shown that bypass ratios between 5 and 7 should be used in minimum-weight design V P

A79-27740 Comparison of BTJES and TJE characteristics in supersonic cruising flight B D Fishbein *(Aviatsionnaia Tekhnika,* vol 21, no 1, 1978, p 86-92) *Soviet Aeronautics,* vol 21, no 1, 1978, p 67-71 8 refs Translation

The paper deals with the nonlinear programming problem of fuel minimization for a boosted bypass turbojet engine at a thrust equal to that of a conventional turbojet engine The problem is solved by a method of direct search without recourse to derivatives The results are diagrammed and discussed V P

A79-27742 Convective heat exchange of gas-particle stream in flow passage of throttling device with vane-type turning element V K Shchukin, A A Iakshin, V A Filin, N S Idiatullin, and N A Nadyrov *(Aviatsionnaia Tekhnika,* vol 21, no 1, 1978, p 100-104) *Soviet Aeronautics,* vol 21, no 1, 1978, p 77-80 6 refs Translation

The experiments described were carried out to study the local convective heat transfer from a gas flow with suspended finely dispersed 0 2 to 12-micron aluminum oxide particles to the walls of a throttle whose flow area consists of two plane curvilinear supersonic nozzles The presence of the particles was found to intensify substantially the heat release to the wall V P

A79-27743 Axial compressor operation with radially nonuniform inflow A N Aniutin, A F Brekhov, V N Ershov, and V G Prokopovich *(Aviatsionnaia Tekhnika,* vol 21, no 1, 1978, p 105-107) *Soviet Aeronautics,* vol 21, no 1, 1978, p 81-83 Translation

The structure of the flow in two three stage axial-flow compressors was studied at uniform and radially nonuniform inlet flows, at a peripheral speed of 118 m/sec at the blade tips Traversing of the flow behind the rotors and at the inlet was carried out The results obtained indicate that the individual stages act to equalize the flow This compensating action of the stages is quantitatively assessed V P

A79-27744 Influence of bypass ratio change on fan aerodynamic characteristics V P Gerasimenko, V N Ershov, V A Koval', and G V Pavlenko *(Aviatsionnaia Tekhnika,* vol 21, no 1, 1978, p 108-111) *Soviet Aeronautics,* vol 21, no 1, 1978, p 84-86 Translation

In the wind tunnel experiments described, the influence of changes in bypass ratio on the characteristics of the main duct, the region of stable fan operation, and the incipient traveling stall was studied Bypass ratios of 0 5, 1 0, and 2 0 were used in the tests The results are plotted and discussed V P

A79-27745 Optimizing gasturbine engine flexible rotor balancing by the LP-search method A I Gleizer *(Aviatsionnaia Tekhnika,* vol 21, no 1, 1978, p 111-113) *Soviet Aeronautics,* vol 21, no 1, 1978, p 87-90 7 refs Translation

The paper deals with the problem of optimizing the balancing of flexible gas-turbine engine rotors by rational selection of the balancing parameters A solution is obtained by a search technique where a point in the parameter space is defined by means of numbers which form a specific sequence (the so-called LP-sequence) The effectiveness of the balancing technique proposed is demonstrated by examples V P

A79-27746 Method for digital computer calculation of unsteady temperature fields in turbomachine discs V V Zhuikov and V I Lokai *(Aviatsionnaia Tekhnika,* vol 21, no 1, 1978, p 114-120) *Soviet Aeronautics,* vol 21, no 1, 1978, p 91-96 Translation

A numerical method is proposed for calculating steady and unsteady temperature fields in the meridional cross sections of turbine disks for time variable boundary conditions over the disk profile The temperature dependence of the disk material's heat conductivity is taken into consideration For illustration, the method is applied to practical examples V P

A79-27748 Intensification of fuel vaporization in aircraft gas turbine engines by electrical forces. A S Kokin, B G Popov, and V A Bondar' *(Aviatsionnaia Tekhnika,* vol 21, no 1, 1978, p 124-127) *Soviet Aeronautics,* vol 21, no 1, 1978, p 101-104 6 refs Translation

A79-28034 An optical communication system for aircraft T N Rodgers (USAF, Armament Development and Test Center, Eglin AFB, Fla) In Laser and fiber optics communications, Proceedings of the Seminar, San Diego, Calif , August 28, 29, 1978 Bellingham, Wash , Society of Photo-Optical Instrumentation Engineers, 1978, p 108-113

The design objectives of the Optical Communicator System (OCS) are to minimize problems associated with the modification of a USAF aircraft in order to render it capable of supporting an RDT&E effort With the OCS, data is transmitted via a modulated noncoherent light beam from the data source to the instrumentation pod Wiring is confined to the amount required to obtain the data and connect it to the OCS components located in the instrumentation pod Thus the OCS decreases the cost of modifications and will allow carriage of instrumentation pods aboard aircraft that previously could not be modified by conventional methods B J

A79-28040 Military fiber optics applications D J Albares (U S Naval Ocean Systems Center, San Diego, Calif) In Laser and fiber optics communications, Proceedings of the Seminar, San Diego, Calif , August 28, 29, 1978 Bellingham, Wash , Society of Photo-Optical Instrumentation Engineers, 1978, p 160-162 18 refs

Advantages of fiber optics over electrical transmission anticipated for military systems as well as for many commercial applications include wide bandwidth, low attenuation, small size and weight, immunity from electrical interference, absence of signal leakage or crosstalk, and high temperature tolerance Optical fiber communications offers major improvements in the vital areas of weight, size, and susceptability to EMI, EMP, and crosstalk to military aircraft For fixed and mobile landbased military systems the advantages of interference immunity, lack of signal leakage, wide bandwidth, and small size and weight offered by fiber optics are very important Attention is also given to shipboard and undersea applications G R

A79-28058 Multimode radar processor J R Gaskill, Jr , L F Goldstein, E J Kapp, E Trujillo (Hughes Aircraft Co , Culver City, Calif), and J P Shanklin (USAF, Avionics Laboratory, Wright-Patterson AFB, Ohio) In Real time signal processing, Proceedings of the Seminar, San Diego, Calif , August 28, 29, 1978 Bellingham, Wash , Society of Photo-Optical Instrumentation Engineers, 1978, p 141-149

The multimode radar processor (MRP) is a general purpose programmable digital signal processor for multimode radar avionic systems in high-performance combat aircraft Based on LSI ECL, MRP implements a shared resource architecture organized to take advantage of the structured nature of signal processing functions and thus performs these functions at speeds much higher than possible with a general purpose computer Through its highly reconfigurable

modular design, the MRP can fill the requirements of many different sensor applications and thus potentially demonstrates lower cost and higher reliability B J

A79-28097 IR scanning camera measurements of an exhaust plume from an axisymmetric nozzle afterbody model at transonic Mach numbers J A Roux (ARO, Inc , Arnold Air Force Station, Tenn) and R Glidewell (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio) In Modern utilization of infrared technology IV, Proceedings of the Seminar, San Diego, Calif , August 30, 31, 1978 Bellingham, Wash , Society of Photo-Optical Instrumentation Engineers, 1978, p 215-232

An AGA Thermovision System 680 was used in studying the IR signature from an axisymmetric nozzle afterbody model at transonic Mach numbers (M = 0 0, 0 6, 0 9, 1 3) Radiance measurements from the exhaust plume in the CO2 emission band were observed through a narrow spectral filter (4 21-4 41 microns) Results are presented in the form of axial and radial plume radiance profiles Such spatially resolved plume radiance measurements serve as a flow visualization to reveal shock structure and as a baseline for plume radiation model prediction (Author)

A79-28122 Air Force applications for optical rotation rate sensors W K Stowell (USAF, Avionics Laboratory, Wright-Patterson AFB, Ohio), R W McAdory (USAF, Armament Laboratory, Eglin AFB, Fla), and R Ziernicki (USAF, Systems Command, Andrews AFB, Washington, D C) In Laser inertial rotation sensors, Proceedings of the Seminar, San Diego, Calif , August 30, 31, 1978 Bellingham, Wash , Society of Photo-Optical Instrumentation Engineers, 1978, p 166-171

Optical rotational sensors (ORSs) based on laser technology are ideal strapped down devices showing great potential for use in advanced inertial systems Possible applications include aircraft inertial reference systems, tactical weapon guidance, attitude and rate sensing in flight control, ballistic missiles, strategic cruise missiles, pointing, and tracking A critical factor common to all these applications, regarding ORSs in general and ring laser gyros in particular, is cost This, and some other major factors that could prolong the entry of ORSs into the Air Force inventory are examined V P

A79-28139 Aircraft velocity and altitude measurements using a tunable diode laser M J Rudd (Bolt Beranek and Newman, Inc , Cambridge, Mass) In Laser spectroscopy - Applications and techniques, Proceedings of the Seminar, San Diego, Calif , August 30, 31, 1978 Bellingham, Wash , Society of Photo-Optical Instrumentation Engineers, 1978, p 150-155 6 refs Contract No F49620-78-C-0023

A technique is proposed here for the on board measurement of an aircraft's speed and altitude by measuring the Doppler shift and linewidth of laser radiation which is resonantly scattered from carbon dioxide molecules in the air The system employs a small, low power, tunable laser diode which gives a small, lightweight system with low power consumption The technique promises to work very well at high altitudes (100,000 ft) and speeds (Mach 10) (Author)

A79-28160 A three-channel high resolution-TV image generation system J A Mays and R E Holmes (Systems Research Laboratories, Inc , Dayton, Ohio) In Visual simulation and image realism, Proceedings of the Seminar, San Diego, Calif , August 30, 31, 1978 Bellingham, Wash , Society of Photo-Optical Instrumentation Engineers, 1978, p 28-35

The paper deals with a three-channel high-resolution image-generation system which consists of a matrix of three TV cameras capable of operating with the output of a single wide-angle (140 deg FOV) optical probe The TV cameras are capable of correcting the geometrical errors of the optical probe, the television display, and display optics as well as the internal scanning errors of the cameras themselves from an external control panel Three video images, in conjunction with a suitable matrix of displays, are capable of presenting a continuous visual scene, 140 deg wide and 45 deg high, with a resolution of 2400 TV lines per picture width V P

A79-28161 Aviation wide angle visual system /AWAVS/ - Visual system performance E F Kashork (U S Navy, Naval Training Equipment Center, Orlando, Fla) and J A Turner (Singer Co , Link Div , Kirkwood, N Y) In Visual simulation and image realism, Proceedings of the Seminar, San Diego, Calif , August 30, 31, 1978 Bellingham, Wash , Society of Photo-Optical Instrumentation Engineers, 1978, p 36-42

This paper is intended to provide a continuance of information and data on the Navy's Wide Angle Visual Flight Simulator, designed to investigate improvements in visual systems technology and define simulator hardware performance requirements for Naval Aviation training A general overview of the visual system hardware and its developed performance levels is presented The initial configuration for carrier takeoff and landings includes a high resolution monochrome television camera which generates a narrow field of view target displayed in a low resolution seascape background The target image is inset into the background and both images are electronically corrected for lens and perspective distortions by raster computers The simulation has negligible error in perspective distortion to a target range of 2300 feet, and within 2 arc minutes beyond Current visual performance measurements are presented and discussed (Author)

A79-28184 Siting criteria for MLS stations II R M Cox and E F Kolb (Bendix Corp , Communications Div , Baltimore, Md) *Airport Forum,* vol 9, Feb 1979, p 35 38, 40, 42-44 In English and German

Siting criteria for MLS stations are discussed, considering azimuth and elevation antenna site, the missed-approach azimuth and flare antenna siting, the co-location of MLS with ALS and ILS, site preparation, installation, as well as checkout and calibration An MLS ground station is normally configured so as to match the equipment to the specific site, thereby minimizing the investment equipment, with the goal being uniform quality signal-in space at all sites The widest acceptable beamwidth must be chosen for basic antennas, currently available in 1 to 3 deg beamwidths Flare (1 5 deg) and missed approach (3 deg) antennas may be added where needed, while redundancy and no-break power may be added where required The basic antennas are sited in a manner similar to ILS, although MLS is tolerant of most adverse situations, and grading and filling is not required Installations and checkout procedures are not extensive, and certification procedures are expected to be somewhat simpler than those required for ILS A A

A79-28185 An offshore airport that works - Nagasaki M Hirai (Japan Civil Aviation Bureau, Planning Div , Tokyo, Japan) *Airport Forum,* vol 9, Feb 1979, p 69 74 In English and German

The construction of the Nagasaki airport (completed in 1975) is considered, noting that the noise problem was completely solved through the offshore location Parameters of flight operations, size and speed of aircraft, and passenger numbers are presented, indicating sharp increases in all these areas from 1975 to 1978 The regularity of operations is assessed, showing excellent results It is concluded that there is a growing possibility that scheduled international services may be inaugurated fairly soon A A

A79-28223 Design of proportional-plus-integral controllers for multivariable systems H Seraji (Arya Mehr University of Technology, Teheran, Iran) *International Journal of Control,* vol 29, Jan 1979, p 49-63 9 refs

The paper puts forward a simple method for the design of multivariable proportional-plus-integral (PI) controllers to achieve pole placement The controller acts directly on the available outputs of the system so that complications of state reconstruction and implementation of state feedback are avoided P T H

A79-28251 Structures, Structural Dynamics, and Materials Conference, 20th, St Louis, Mo , April 4-6, 1979, Technical Papers on Dynamics and Loads Conference sponsored by AIAA, ASME, ASCE, and AHS New York, American Institute of Aeronautics and Astronautics, Inc , 1979 371 p $50

Papers are presented on such topics as minimum weight structural design by the optimality criterion and projection method, divergence of forward swept wings, aeroelastic tailoring studies in fighter aircraft design, and finite element approaches for determining stresses and internal forces in geometrically nonlinear structural analysis Consideration is also given to design and fabrication of advanced titanium structures, the reentry performance of carbon-carbon nosetips, statistical estimation of economic life for aircraft structures, and static strength predictions for bolted joints in composite materials B J

A79-28252 # SDM lecture - Introduction of new SDM technology into production systems R N Hadcock (Grumman Aerospace Corp , Bethpage, N Y) In Structures, Structural Dynamics, and Materials Conference, 20th, St Louis, Mo , April 4-6, 1979, Technical Papers on Dynamics and Loads New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 1-10 21 refs (AIAA 79-0719)

The application of new Structures, Structural Dynamics and Materials (SDM) technology to aircraft design is a long and difficult process Necessary ingredients include need, availability, opportunity, confidence, and an acceptable cost The present paper examines some past examples (WWII fighter aircraft) of new SDM technologies and presents the best approach for removing many of the difficulties and accelerating the process B J

A79-28255 # Divergence of forward swept composite wings T A Weisshaar (Virginia Polytechnic Institute and State University, Blacksburg, Va) In Structures, Structural Dynamics, and Materials Conference, 20th, St Louis, Mo , April 4-6, 1979, Technical Papers on Dynamics and Loads New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 51-59 11 refs Grant No AF-AFOSR-77-3423 (AIAA 79-0722)

A laminated box beam model is used to develop algebraic expressions for predicting the static aeroelastic divergence characteristics of forward swept wings constructed of composite materials Aerodynamic strip theory is used to predict the loads due to wing bending and torsional deformation The expressions presented show that because of elastic coupling between wing bending and torsion the wing divergence may be precluded for reasonably large forward sweep angles B J

A79-28257 # Aeroelastic tailoring studies in fighter aircraft design W E Triplett (McDonnell Aircraft Co , St Louis, Mo) In Structures, Structural Dynamics, and Materials Conference, 20th, St Louis, Mo , April 4-6, 1979, Technical Papers on Dynamics and Loads New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 72-78 5 refs (AIAA 79-0725)

Studies have been conducted on the use of the directional properties of composite material to provide design improvements for fighter aircraft The TSO (Aeroelastic Tailoring and Structural Optimization) computer program, which was developed by the AFFDL, was used in these investigations The configurations evaluated covered a wide spectrum of fighter aircraft aerodynamic surfaces, including (1) the F-15 composite wing, (2) a preliminary design horizontal tail, (3) a prototype aircraft wing and (4) a future conceptual aircraft wing Both drag reduction and increased roll effectiveness, with no weight cost, are predicted for the F-15 composite wing A unique minimum weight design is shown for the preliminary design horizontal tail, in which the anisotropic characteristics of the composite material are used to perform the dual function of strength and flutter balance weight A more conventional optimum flutter solution, based on outer panel wing root pitch restraint increases, is shown for the prototype aircraft wing Finally, significant wing twist, offering potential aerodynamic benefits, can be obtained on the conceptual aircraft wing (Author)

A79-28258 # An aeroelastic optimization procedure for composite high aspect ratio wings D Gimmestad (Boeing Co , Seattle, Wash) In Structures, Structural Dynamics, and Materials Conference, 20th, St Louis, Mo , April 4-6, 1979, Technical Papers on Dynamics and Loads New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 79-86 8 refs (AIAA 79-0726)

A computer program has been developed which optimizes the structure of a composite high aspect ratio wing The program sizes composite box beam structure using aeroelastic loads in an iterative fashion Anisotropic beam bending-torsion coupling effects are included An aeroelastic design demonstration was performed which shows some of the effects of beam anisotropy on aeroelastic loads, structure weight, stability and control and flutter for both composite and conventional metal wings (Author)

A79-28260 # Structural development of the Modernized Chinook helicopter transmission gearing C O Albrecht (Boeing Vertol Co , Philadelphia, Pa) In Structures, Structural Dynamics, and Materials Conference, 20th, St Louis, Mo , April 4-6, 1979, Technical Papers on Dynamics and Loads New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 96-104 (AIAA 79 0728)

The CH-47D or Modernized Chinook helicopter utilizes the most recent state-of-the-art drive system developments for the design, fabrication, and qualification of its four different gearboxes Those developments related to gearing include use of finite element analyses, fabrication techniques that eliminate bolted joints, and the use of gear stress measurements as part of the qualification program The means by which structural optimization of the gearing is obtained using these approaches is discussed (Author)

A79-28263 * # Accuracy of an approximate static structural analysis technique based on stiffness matrix eigenmodes J Sobieszczanski-Sobieski (NASA, Langley Research Center, Hampton, Va) and P Hajela (Iowa State University of Science and Technology, Ames, Iowa) In Structures, Structural Dynamics, and Materials Conference, 20th, St Louis, Mo , April 4 6, 1979, Technical Papers on Dynamics and Loads New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 127-136 (AIAA 79-0748)

Use of the stiffness matrix eigenmodes, instead of the vibration eigenmodes, as generalized coordinates is proposed for condensation of static load deflection equations in finite element stiffness method The modes are selected by strain energy criteria and the resulting fast, approximate analysis technique is evaluated by applications to idealized built up wings and a fuselage segment The best results obtained are a two-order of magnitude reduction of the number of degrees of freedom in a high aspect ratio wing associated with less than one percent error in prediction of the largest displacement (Author)

A79-28270 # Structural aluminum materials for the 1980's R F Simenz and M K Guess (Lockheed-California Co , Burbank, Calif) In Structures, Structural Dynamics, and Materials Conference, 20th, St Louis, Mo , April 4-6, 1979, Technical Papers on

Dynamics and Loads New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 181-187 12 refs (AIAA 79-0755)

Developments in processing and alloying techniques have resulted in property improvements and increased potential application for advanced aluminum alloys in both subsonic and supersonic aircraft Lockheed-California Company engineers see the advanced aluminum alloys emerging as a promising material in addition to the advanced composites and titanium alloys for current and future aircraft Alloys receiving the bulk of attention include the high-strength corrosion-resistant 7050 alloy, the high-strength CT90, CT91 and 9051 powder alloys, and the aluminum-lithium alloys for subsonic applications Combinations of powered alloys, aluminum-lithium and mechanical alloying are being considered for high temperature supersonic applications (Author)

A79-28272 # **Design and fabrication of advanced titanium structures** C Paez and R W Messler, Jr (Grumman Aerospace Corp , Bethpage, N Y) In Structures, Structural Dynamics, and Materials Conference, 20th, St Louis, Mo , April 4 6, 1979, Technical Papers on Dynamics and Loads New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 208-220 13 refs USAF supported research (AIAA 79 0757)

The paper deals with some advanced processing technologies developed for titanium fabrication The weight advantages are documented which are achievable when innovative structural design concepts are employed Hot isostatic pressing and welding as a means of building up structures are discussed, along with specific application areas Superplastic forming/diffusion bonding is given particular attention, including such specific areas as material superplasticity, diffusion bonding, process parameters and their effects on material properties, skin stabilization techniques, and structural concepts for advanced airframes V P

A79-28275 # **Statistical estimation of economic life for aircraft structures** J N Yang (George Washington University, Wash ington, D C) In Structures, Structural Dynamics, and Materials Conference, 20th, St Louis, Mo , April 4 6, 1979, Technical Papers on Dynamics and Loads New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 240-248 33 refs Contract No F33615 77-C-3123 (AIAA 79-0761)

An analytical methodology for statistically predicting the economic life of aircraft structures is presented The approach allows for the determination of the economic life based on either one of the following two criteria (1) rapid increase of the number of crack damages exceeding the economic repair crack size, and (2) rapid increase of the maintenance cost, including the costs of inspection and repair The formulation is general enough for practical applications While the inspection and repair maintenance procedure has a significant impact on aircraft structural reliability and safety, its effect on the economic life is shown to be limited Numerical examples are worked out to demonstrate the application of the methodology (Author)

A79-28287 # **Structural stiffening of transmission housings with metal matrix materials** J W Lenski, Jr (Boeing Vertol Co , Philadelphia, Pa) In Structures, Structural Dynamics, and Materials Conference, 20th, St Louis, Mo , April 4-6, 1979, Technical Papers on Dynamics and Loads New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 333-340 5 refs Grant No DAAJ02-74-C-0040 (AIAA 79-0806)

The application of metal matrix composite materials for helicopter transmission housing has many potential benefits including decreased deflections, increased dynamic component life and reduced vibration/noise levels These improvements result from the selective stiffening of identified areas of high strain density The effects of substituting metal matrix composites for a monolithic magnesium transmission housing has been evaluated both analytically and experimentally Noise levels and accelerations were measured on a CH-47C forward transmission which was selectively stiffened In addition, basic housing elements have been fabricated using high-modulus fibers (Fiber FP) via direct casting technology and tested to determine material properties Initial test results indicate a three time increase of the modulus of elasticity of magnesium by the use of a Fiber FP/magnesium metal matrix composite material (Author)

A79-28288 # **Fuel tank sealant requirements for advance high performance aircraft** M F George, Jr and R V Burton, Jr (Lockheed California Co , Burbank, Calif) In Structures, Structural Dynamics, and Materials Conference, 20th, St Louis, Mo , April 4-6, 1979, Technical Papers on Dynamics and Loads New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 341 345 (AIAA 79-0807)

Advanced integral fuel tank sealants for high performance aircraft will be discussed identifying material property requirements to perform satisfactorily in the environment and airframe design To provide continuity, a brief historical evolution of material systems will be presented including evaluated elastomers and developmental problems Laboratory and flight test experience confirmed practicality of production application, handling and field performance (Author)

A79-28289 # **Design and development of an helicopter rotor hub and elastomeric bearing** P Donguy (Societe Europeenne de Propulsion Saint-Medard en-Jalles, Gironde, France) In Structures, Structural Dynamics, and Materials Conference, 20th, St Louis, Mo , April 4-6, 1979, Technical Papers on Dynamics and Loads New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 348 355 (AIAA 79 0815)

The paper deals with some recent advances which resulted in the development of a spherical laminated elastomeric bearing for a light helicopter rotor hub One of the main problems encountered was service life, which was found to depend strongly on good shaping The 'hydroflex' technique is shown to be very promising both with respect to service life and ease of designing V P

A79-28290 * # **Combined strength and aeroelastic wing synthesis via constraint approximation** J Mullen, Jr (Nielsen Engineering and Research, Inc , Mountain View, Calif) In Structures, Structural Dynamics, and Materials Conference, 20th, St Louis, Mo , April 4-6, 1979, Technical Papers on Dynamics and Loads New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 356 366 24 refs Contract No NAS2 8558 (AIAA 79-0724)

A numerical optimization program using constraint approximations for preliminary sizing of wing structural design parameters to satisfy simultaneous strength and aeroelastic requirements is described The effects of wing flexibility on loads and flutter are included The iterative procedure approximates wing internal load distributions and flutter response in generating design constraints Though a linear Taylor series approximation to the variation of flutter speed is made, constraints in general are formulated as nonlinear and solved in a minimum weight problem using a feasible directions search The technique is demonstrated for the determination of the optimal ply orientations and for simultaneous sizing for strength and flutter with simple constraint approximations (Author)

A79-28376 # **Wing rock due to aerodynamic hysteresis** L V Schmidt (U S Naval Postgraduate School, Monterey, Calif) *Journal of Aircraft*, vol 16, Mar 1979, p 129 133 9 refs

An analysis is presented using control theory concepts to show that aerodynamic hysteresis of the form of relay action can lead to lateral-directional limit cycle motions These limit cycle motions are usually described in a colloquial sense as airframe wing rock The aerodynamic details leading to wing-rock oscillations will vary with airframe configuration, and usually the exact description of the aerodynamic nonlinearity is difficult to obtain or predict The purpose of the studies described herein is to promulgate a flight mechan

ics analysis technique which by virtue of its simplicity offers the analyst an insight into potential candidate aerodynamic mechanisms (Author)

A79-28377 # **Formation of a trailing vortex** M S Francis (USAF, Frank J Seiler Research Laboratory, Colorado Springs, Colo) and D A Kennedy (Colorado, University, Boulder, Colo) *Journal of Aircraft,* vol 16, Mar 1979, p 148-154 16 refs USAF-sponsored research

The incompressible flowfield in the vicinity of a lifting rectangular finite wing is investigated experimentally to ascertain the nature and detailed characteristics of the formation of a trailing vortex The mean velocity field was mapped directly using a linearized constant temperature hot-wire anemometry probe in conjunction with a precision wind-tunnel traversing mechanism The associated vorticity field was inferred from these measurements through a spatial contour integration procedure The existence of several identifiable flow regions exhibiting similar characteristics was established and verified with both hot-wire and flow visualization data The nature of the near surface bound vorticity distribution is described including a map of the Prandtl-bound vortex filaments Measurements at the wing trailing edge show that the properly nondimensionalized characteristic vorticity distribution in this region is independent of angle of attack Shed vorticity emanating from the lower aerodynamic surface near the wing tip was observed to roll up adjacent to the tip and roll over onto the upper wing surface at a chordwise location which depends on the wing orientation The presence and behavior of this structure which possesses an identifiable core is suggested as the cause of the modified pressure distribution (lift increment) normally observed in this region (Author)

A79-28380 # **Factors affecting residual strength prediction of a cracked aircraft structure** M M Ratwani and D P Wilhem (Northrop Corp , Hawthorne, Calif) *Journal of Aircraft,* vol 16, Mar 1979, p 209-214 6 refs Contract No F33615-72-C-1796

Various factors influencing the analytical residual strength prediction of a cracked, stiffened structure are discussed The influence of flexibility of attachment on crack openings, stresses in the substructure and fasteners, and J-integral values are presented The flexibility of a fastener is shown to have considerable influence on the elastic stress intensity factors The J-integral values computed by assuming an elastic, Dugdale-type plastic zone, and Pradtl-Reuss material behavior are compared The analytical results of crack openings and strains in the stiffeners are compared with experimental results (Author)

A79-28381 # **A decision theory model for health monitoring of aeroengines** V V S Sarma (Indian Institute of Science, Bangalore, India), K V Kunhikrishnan, and K Ramchand *Journal of Aircraft,* vol 16, Mar 1979, p 222-224 7 refs

The Spectrometric Oil Analysis Program (SOAP) is an indirect method of health monitoring of aeroengines Under SOAP the volume of lubricating oil in the engine sump and the concentration of various metals in the oil are of prime importance The concentrations of the desired elements are directly used to represent engine wear In this paper a decision theoretical model using SOAP data for the health monitoring of aeroengines is developed A deterministic model and a stochastic model are derived and discussed A technique (sequential probability ratio test) that uses a combination of Kalman filtering and decision theory is presented for the problem of malfunction detection in aeroengines through oil sample analysis S D

STAR ENTRIES

N79-17794 British Library Lending Div Boston Spa (England)
COMPARISON OF THE AERODYNAMIC PROPERTIES OF AN AEROPLANE WITH THE TAIL-FIRST CONFIGURATION AND WITH THE CONVENTIONAL CONFIGURATION
J Staszek Nov 1978 27 p refs Transl into ENGLISH from Pr Inst Lotnictwa (Poland) v 63 1975 p 63-77
(BLL-RTS-11520) Avail British Library Lending Div Boston Spa Engl

The range of lift and drag coefficients was determined for the wing alone and for the wing together with the tailplane for the tail-first configuration in comparison with conventional layout The effect of deflection of the streams flowing from the tailplane on the main wing in the tail-first configuration was analyzed as a way of reducing the influence of deflection of the streams by the following means (1) employment of wing twist for a preferred angle of attack, (2) selection of the angle of incidence of the tailplane (3) selection of correct aspect ratio of the tailplane and (4) selection of optimum location of the wing relative to the tail Results indicate that in certain conditions the tail-first configuration has characteristics that are similar to the properties of the conventional layout and in certain configurations it is preferable in view of the possibility of obtaining maximum values of the lift coefficient S E S

N79-17796*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
AERODYNAMIC PROPERTIES OF A FLAT PLATE WITH CAVITY FOR OPTICAL-PROPAGATION STUDIES
Donald A Buell Jan 1979 100 p refs
(NASA-TM-78487 A-7450) Avail NTIS HC A05/MF A01 CSCL 01A

Transonic wind-tunnel tests were performed on a flat plate with and without a cube-shaped cavity and antiresonance devices Measurements were made of the optical propagation and aerodynamic properties of the boundary and shear layers The model and its velocity profiles and pressures are described S E S

N79-17797*# National Aeronautics and Space Administration Hugh L Dryden Flight Research Center Edwards Calif
AN IMPROVED SYSTEM FOR USE IN CONDUCTING WAKE INVESTIGATION FOR A WING IN FLIGHT Patent Application
Lawrence C Montoya and Paul F Bikle inventors (to NASA) Filed 28 Feb 1979 19 p
(NASA-Case-FRC-11024-1 US-Patent-Appl-SN-015983) Avail NTIS HC A02/MF A01 CSCL 01A

A pressure measuring system is described for use in obtaining in-flight wing profile drag measurements for low values of dynamic pressure and Reynolds number The system is supported by a wing in flight which has a total pressure head arranged in spaced relation with a wake (as the wake is generated by the wing) and a reference static pressure head adapted to be displayed along an accurate path through the wake A total pressure port and a static pressure port are included A differential transducer is connected to the heads through a pressure switching device provided to selectively connect the heads to the transducer in opposed relation Thus a single differential transducer is adapted to be utilized in obtaining differential pressure measurements for the wake NASA

N79-17798*# Bell Aerospace Textron Buffalo N Y
GENERAL PURPOSE COMPUTER PROGRAM FOR INTERACTING SUPERSONIC CONFIGURATIONS USER'S MANUAL
W Crill and B Dale [1977] 115 p refs
(Contract NAS1-13986)
(NASA-CR-145128) Avail NTIS HC A06/MF A01 CSCL 01A

The input data required to execute the computer program ISCON are described The program generates a numerical procedure for the determination of unsteady aerodynamic forces on arbitrarily interacting wings and tails in supersonic flow A velocity potential gradient method is used Constant Mach number is assumed throughout the flow field Lifting surfaces are represented by trapezoidal elements which can be generated automatically by the program The wake field is represented by rectangular strip elements The formulation is reviewed as well as input overview and input format Instruction on how to use ISCON a sample problem and the restart feature are discussed Program size limitations computer program flow and error messages are also included along with a description of the SS31 program used to compute the coefficients of surface spline A R H

N79-17799*# Boeing Commercial Airplane Co Seattle Wash
SUMMARY REPORT OF THE SECOND WIND TUNNEL TEST OF THE BOEING LFC MODEL
D George-Falvy 26 Jul 1978 27 p refs
(Contract NAS1-14630)
(NASA-CR-157792) Avail NTIS HC A03/MF A01 CSCL 01A

An 8-ft span 20-ft chord 30 deg swept wing section having provisions for laminar boundary control over the first 30% of the upper surface and the first 15% of the lower surface was tested in a 5-ft by 8-ft wind tunnel to explore the sensitivity of laminar flow to various forms of disturbances such as surface imperfections contamination off-design pressure distribution (increased crossflow) and imposed noise The test equipment used and instrumentation of the model are described Typical results obtained from configurations with spanwise ridges and spanwise rows of disks are discussed as well as suction flow characteristics at reduced incidence A R H

N79-17800*# Old Dominion Univ Research Foundation Norfolk Va
EXPERIMENTAL STUDIES ON THE EFFECTS OF A STING SUPPORT ON THE PRESSURE DISTRIBUTION AROUND A SPHERICAL OBJECT Progress Report, Aug 1977 - Aug 1978
P S Barna (Old Dominion Univ) Feb 1979 38 p refs
(Grant NsG-1143)
(NASA-CR-158127) Avail NTIS HC A03/MF A01 CSCL 01A

Experiments were conducted on a spherical object 2 5 inches in diameter to obtain the pressure distribution around its meridan plane In most of the tests the sphere was provided with a tail consisting of a circular cylinder that was attached directly to the rear with its axis in alignment with the center of the sphere In some tests the tail was removed and the sphere alone was tested for comparison purposes The main object of the tests was to obtain information on tail interference with the pressure distribution The results of the tests show that the pressure distribution was affected by the presence of the tail to a minor extent only while major differences occurred with the variation of the Reynolds number The experiments were performed both in an open as well as inside a closed wind tunnel under steady flow conditions at Reynolds numbers ranging from 0 91 to 2 6 x 100000 L S

N79-17801*# Lockheed-California Co Burbank
DELTA METHOD, AN EMPIRICAL DRAG BUILDUP TECHNIQUE Final Report, 1 Mar - 31 Dec 1978
Richard C Feagin and William D Morrison Dec 1978 177 p refs
(Contract NAS2-8612)
(NASA-CR-151971 LR-27975-Vol-1) Avail NTIS HC A09/MF A01 CSCL 01A

An empirical drag correlation technique was developed from analysis of 19 subsonic and supersonic military aircraft and 15 advanced or supercritical airfoil configurations which can be applied in conceptual and advanced aircraft design activities The Delta Method may be used for estimating the clean wing drag polar for cruise and maneuver conditions up to buffet onset and to approximately Mach 2 0 This technique incorporates a unique capability of predicting the off-design performance of advanced or supercritical airfoil sections The buffet onset limit may also be estimated The method is applicable to wind tunnel models as well as to full scale configurations This technique has been converted into a computer code for use on the IBM 360 and CDC 7600 computer facilities at NASA AMES Results obtained using this method to predict known aircraft characteristics are good and agreement can be obtained within a degree of accuracy judged to be sufficient for the initial processes of preliminary design F O S

N79-17802*# United Technologies Corp East Hartford Conn
THE INFLUENCE OF SWEEP ON AERODYNAMIC LOADING OF AN OSCILLATING NACA0012 AIRFOIL VOLUME 2 DATA REPORT
A O St Hilaire and F O Carta Feb 1979 388 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) 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 (Delta = 0 and 30 deg) for all available combinations of mean incidence angle pitching amplitude reduced frequency chordwise Mach number The second section shows the effect of chordwise Mach number on the swept wing response for all available combinations of mean incidence angle pitching amplitude and reduced frequency F O S

N79-17803*# Old Dominion Univ Research Foundation Norfolk Va
EXPERIMENTS ON TANDEM DIFFUSERS WITH BOUNDARY-LAYER SUCTION APPLIED IN BETWEEN
P Stephen Barna Feb 1979 59 p refs
(Contracts NAS1-14193)
(NASA-CR-158957) Avail NTIS HC A04/MF A01 CSCL 01A

Experiments were performed on conical diffusers of various configurations with the same but rather unusually large 16 1 area ratio Because available performance data on diffusers fall short of very large area ratio configurations an unconventional design consisting of two diffusers following each other in tandem was proposed Both diffusers had the same area ratio of 4 1 but had different taper angles While for the first diffuser (called leading) the angle remained constant for the second (called follower) the taper angle was stepped up to higher values Boundary layer control by way of suction was applied between the diffusers and a single slot suction ring was inserted between them The leading diffuser had an enclosed nominal divergence angle 2 theta = 5 degrees while the follower diffusers had either 10 20 30 or 40 degrees respectively giving 4 combinations The experiments were performed at four different Reynolds numbers with various suction rates The rates indicate a general improvement in the performance of all diffusers with boundary layer suction It appears that the improvement of the pressure recovery depends on both the Reynolds number and the suction rate and the largest increase 0 075 was found at the lowest R sub e when the follower divergence was 2 theta = 40 degrees Author

N79-17804*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
WIND-TUNNEL INVESTIGATION OF THE THRUST AUGMENTOR PERFORMANCE OF A LARGE-SCALE SWEPT WING MODEL
David G Koenig and Michael D Falarski (Army Aviation Res and Develop Command St Louis Mo) Feb 1979 58 p refs
(NASA-TM-X-73239 AVRADCOM-TR-78-55(AM)) Avail NTIS HC A04/MF A01 CSCL 01A

Tests were made in the Ames 40- by 80-foot wind tunnel to determine the forward speed effects on wing-mounted thrust augmentors The large-scale model was powered by the compressor output of J-85 driven viper compressors The flap settings used were 15 deg and 30 deg with 0 deg 15 deg and 30 deg aileron settings The maximum duct pressure and wind tunnel dynamic pressure were 66 cmHg (26 in Hg) and 1190 N/sq m (25 lb/sq ft) respectively All tests were made at zero sideslip Test results are presented without analysis J M S

N79-17805*# Texas A&M Univ College Station Dept of Aerospace Engineering
INVERSE TRANSONIC AIRFOIL DESIGN METHODS INCLUDING BOUNDARY LAYER AND VISCOUS INTERACTION EFFECTS Semiannual Progress Report, 1 Aug 1978 - 31 Jan 1979
Leland A Carlson 31 Jan 1979 16 p refs
(Grant NsG-1174)
(NASA-CR-158136 TAMRF-3224-79-01) Avail NTIS HC A02/MF A01 CSCL 01A

The development and incorporation into TRANDES of a fully conservative analysis method utilizing the artificial compressibility approach is described The method allows for lifting cases and finite thickness airfoils and utilizes a stretched coordinate system Wave drag and massive separation studies are also discussed J M S

N79-17806*# National Aeronautics and Space Administration Langley Research Center Hampton Va
A MODIFICATION TO LINEARIZED THEORY FOR PREDICTION OF PRESSURE LOADINGS ON LIFTING SURFACES AT HIGH SUPERSONIC MACH NUMBERS AND LARGE ANGLES OF ATTACK
Harry W Carlson Feb 1979 39 p refs
(NASA-TP-1406 L-12654) Avail NTIS HC A03/MF A01 CSCL 01A

A new linearized-theory pressure-coefficient formulation was studied The new formulation is intended to provide more accurate estimates of detailed pressure loadings for improved stability analysis and for analysis of critical structural design conditions The approach is based on the use of oblique-shock and Prandtl-Meyer expansion relationships for accurate representation of the variation of pressures with surface slopes in two-dimensional flow and linearized-theory perturbation velocities for evaluation of local three-dimensional aerodynamic interference effects The applicability and limitations of the modification to linearized theory are illustrated through comparisons with experimental pressure distributions for delta wings covering a Mach number range from 1 45 to 4 60 and angles of attack from 0 to 25 degrees G Y

N79-17807*# Grumman Aerospace Corp Bethpage N Y
AN IMPROVED SUPERSONIC, THREE-DIMENSIONAL, EXTERNAL, INVISCID FLOW FIELD CODE Final Report
Frank Marconi and Frank Koch Mar 1979 30 p refs
(Contract NAS1-14162)
(NASA-CR-3108) Avail NTIS HC A03/MF A01 CSCL 01A

A numerical procedure was developed to compute the inviscid super/hypersonic flow fields about complex vehicle geometries accurately and efficiently A second-order accurate finite difference scheme is used to integrate the three-dimensional Euler equations in regions of continuous flow while all shock waves are computed as discontinuities via the Rankine-Hugoniot jump conditions Conformal mappings are used to develop a computational grid The effects for equilibrium air are included using curve fits of Mollier charts This report deals only with modifications to these procedures in four specific areas inlet mass ingestion subsonic axial Mach number improved conformal mappings and vehicles

flying at yaw In each area both the modifications to the computational procedures and computer code are discussed G Y

N79-17808*# National Aeronautics and Space Administration Langley Research Center Hampton Va
STABILITY AND CONTROL CHARACTERISTICS OF A MONOPLANAR ELLIPTIC MISSILE MODEL AT MACH NUMBERS FROM 1 60 TO 2 86
Wallace C Sawyer and Giuliana Sangiorgio Feb 1979 49 p refs
(NASA-TP-1352 L-12268) Avail NTIS HC A03/MF A01 CSCL 01A

An investigation was conducted of a monoplanar maneuverable missile concept having a nose forebody with a circular cross section and a centerbody and afterbody with elliptical cross sections The tests involved several component changes and were conducted in the low Mach number test section of the Langley Unitary Plan wind tunnel at Mach numbers of 1 60 2 16 and 2 86 at angles of attack ranging from -4 degs to 28 degs and at sideslip angles ranging from -4 degs to 8 degs The most significant result was that at the highest Mach number (2 86) *the configuration with the infrared nose produced nearly twice* the axial force as the same configuration with the radar nose The cranked wing had a destabilizing effect on the longitudinal stability and had no effect on the lateral-directional stability The nose strakes had no effect longitudinally and were detrimental to the lateral-directional stability Author

N79-17809*# National Aeronautics and Space Administration Langley Research Center Hampton Va
AN EXPERIMENTAL WIND-TUNNEL INVESTIGATION OF A RAM-AIR-SPOILER ROLL-CONTROL DEVICE ON A FORWARD-CONTROL MISSILE AT SUPERSONIC SPEEDS
A B Blair Jr Dec 1978 191 p refs
(NASA-TP-1353 L-12518) Avail NTIS HC A09/MF A01 CSCL 01A

A parametric experimental wind-tunnel investigation was made at supersonic Mach numbers to provide design data on a ram-air-spoiler roll-control device that is to be used on forward-control cruciform missile configurations The results indicate that the ram-air-spoiler tail fin is an effective roll-control device and that roll control is generally constant with vehicle attitude and Mach number unless direct canard and/or forebody shock impingement occurs The addition of the ram-air-spoiler tail fins resulted in only small changes in aerodynamic-center location For the ram-air-spoiler configuration tested there are large axial *force coefficient effects associated with the increased fin thickness* and ram-air momentum loss Author

N79-17810*# National Aeronautics and Space Administration *Marshall Space Flight Center Huntsville Ala*
SPACE SHUTTLE AFTERBODY AERODYNAMICS/PLUME SIMULATION DATA SUMMARY
Kenneth L Blackwell and Leroy M Hair (REMTECH Inc Huntsville Ala) Dec 1978 195 p refs
(NASA-TP-1384 M-276) Avail NTIS HC A09/MF A01 CSCL 01A

A series of parametric wind tunnel tests was conducted to provide a base for developing a simulation of afterbody/base aerodynamics for multibody/multibase rocket-powered vehicles (such as Space Shuttle) which use unheated air as the simulant gas in development wind tunnel tests The tests described were parameterized on external configuration nozzle internal configuration base geometry propulsion gas type and freestream Mach number (0 5 to 3 5) The tests were conducted over a 4-year period Presented in this report are the data and pertinent reference information necessary to perform an analysis which would lead to a simulation procedure The type of data obtained during the tests described herein include model base afterbody and nozzle internal surface static pressure distributions model chamber pressure and temperature and freestream conditions Also included is a brief description of simulation procedures that were used by the Space Shuttle program L S

N79-17811*# Boeing Vertol Co Philadelphia Pa
ROTARY-WING AERODYNAMICS VOLUME 2 PERFORMANCE PREDICTION OF HELICOPTERS Final Report
C N Keys and W Z Stephniewski ed Jan 1979 242 p refs
(Contract NAS2-7007)
(NASA-CR-3083) Avail NTIS HC A11/MF A01 CSCL 01A

Application of theories as well as special methods of procedures applicable to performance prediction are illustrated first on an example of the conventional helicopter and then *winged and tandem configurations Performance prediction of* conventional helicopters in hover and vertical ascent are investigated Various approaches to performance prediction in forward translation are presented Performance problems are discussed only this time a wing is added to the baseline configuration and both aircraft are compared with respect to their performance This comparison is extended to a tandem Appendices on methods for estimating performance guarantees and growth of aircraft concludes this volume L S

N79-17812*# MacNeal-Schwendler Corp Los Angeles Calif
AEROELASTIC ADDITION TO NASTRAN Final Report
William P Rodden Robert L Harder and E Dean Bellinger Mar 1979 116 p refs
(Contract NAS1-13034)
(NASA-CR-3094) Avail NTIS HC A06/MF A01 CSCL 01A

A description is given of the additions made to the NASTRAN program to allow analysis of aeroelastic phenomena Several methods for flutter analysis (termed K PK KE methods) are included as well as the means for calculating random and gust response of aerodynamic surfaces and bodies under fluid flow Doublet lattice mach box and piston theory aerodynamics are all incorporated Interference between bodies and surfaces is accounted for and several basic illustrative examples are presented L S

N79-17813*# National Aeronautics and Space Administration Langley Research Center Hampton Va
AERODYNAMIC SIDE-FORCE ALLEVIATOR MEANS Patent Application
Dhanvada M Rao inventor (to NASA) (Old Dominion Univ Norfolk Va) Filed 12 Mar 1979 14 p Sponsored by NASA
(NASA-Case-LAR-12326-1 US-Patent-Appl-SN-019541) Avail NTIS HC A02/MF A01 CSCL 01A

An apparatus is presented for alleviating high angle-of-attack *side force on slender pointed cylindrical forebodies such as fighter* aircraft missiles and the like employing a symmetrical pair of helical separation trips to disrupt the leeside vortices normally attained The novelty of the invention appears to reside in the use of a pair of symmetrical separation trips to force boundary layer separation and thereby disrupt the leeside vortices normally attained on slender pointed cylindrical forebodies such as fighter aircraft and missiles to thereby alleviate high angle of attack side forces and yawing moments NASA

N79-17814# Messerschmitt-Boelkow-Blohm G m b H Ottobrunn (West Germany)
VORTEX MODELS ON MISSILE CONFIGURATIONS [WIREBELMODELLE AN FLUGKOERPERN]
G Gregoriou and D Nikolitsch Bonn DOKZENTBW 1977 58 p refs In GERMAN ENGLISH summary Sponsored by Bundesmin fuer Verteidigung
(BMVG-FBWT-77-27) Avail NTIS HC A04/MF A01 DOKZENTBW DM 30

A *computer program developed for the determination of* aerodynamic coefficients at high angle-of-attack was improved Due to the modification of the originally used vortex model the physical properties of the flow pattern are described more adequately the range of applicability of the method is enlarged appreciably and the aerodynamic coefficients can now be determined almost up to 90 degree incidence A 4-vortex model for the determination of the downwash on missile configurations was developed to replace the 2-vortex model of the slender-body-theory Aerodynamic coefficients can be computed at arbitrary roll and Mach number with or without control deflection for *both tail-control and wing-control configurations* A R H

N79-17815# Technische Universitaet Munich (West Germany) Lehrstuhl A fuer Thermodynamik

HEAT GENERATION IN CAVITIES AT HIGH VELOCITY FLIGHTS [WAERMEENTWICKLUNG IN HOHLRAEUMEN BEIM SCHNELLFLUG]

R Schaellig Bonn DOKZENTBW 1977 96 p refs In GERMAN ENGLISH summary Sponsored by Bundesmin fuer Verteidigung

(BMVG-FBWT-77-28) Avail NTIS HC A05/MF A01

The resonance-pipe effect and mean values for the pressure higher than the equivalent total pressures are discussed Even for nonisentropic flows approximations for the extreme pressures and temperatures at the closed end are derived which fit with the calculations of the method of characteristics up to Ma infinity = 1 for the outflow Mach number There are local- and time dependent supersonic flows in pipes with variable cross section The heating of the pipe end is attributed to a coupling effect of solid temperature boundary layer and gas-space through heat conduction together with the pressure oscillation of the gas The produced temperature rise is calculated as a function of a turbulence parameter which is still to be determined A R H

N79-17816# Bundesministerium der Verteidigung Bonn (West Germany)

CONTRIBUTION TO THE DEVELOPMENT OF THEORETICAL CALCULATIONS FOR THE DESIGN AND OPTIMIZATION OF LIFTING BODIES (SOLUTION OF THREE-DIMENSIONAL BASIC THERMO FLUID DYNAMICS EQUATIONS WITH STRONG INTERACTING ATTACHED AND SEPARATED FLOW FIELDS) [BEITRAG ZUR ENTWICKLUNG PRAXISGERECHTER THEORETISCHER BERECHNUNGSMETHODEN FUER ENTWURF UND OPTIMIERUNG VON FLUGKOERPERN (LOESUNG DER DREIDIMENSIONALEN GRUNDGLEICHUNGEN DER THERMOFLUIDDYNAMIK BEI STARKER WECHSELWIRKUNG ZWISCHEN ANLIEGENDEN UND ABGELOESTEN STROEMUNGSBEREICHEN)]

Alfred Walz Bonn DOKZENTBW 1978 43 p refs In GERMAN ENGLISH summary

(BMVG-FBWT-78-4) Avail NTIS HC A03/MF A01, DOKZENTBW DM 30

Prediction methods for the aero-thermodynamical behavior of lifting bodies or jet engines must include the prediction of strong interacting flow field effects such as generated by flow separation and vortex formations which are decisively influencing the pressure distribution boundary layer development and vice versa The transition to turbulence as well as the influence of chemical reactions on boundary layer and/or turbulent jet flow must also be considered A numerical method for solving the generally valid 3D-NAVIER-STOKES equations was developed and tested giving correct results for the fully complex flow field up to Re is greater than 10 to the 6th power with reasonable time expense A critical survey on the present state of art of 3D-turbulent (and compressible) boundary layer prediction methods and its empirical inputs is presented Methods are proposed for including results about turbulent boundary behavior into the quasi-laminar NAVIER-STOKES scheme A R H

N79-17817# Royal Aircraft Establishment Bedford (England) Aerodynamics Dept

BOUNDARY LAYER TRANSITION MEASUREMENTS ON THE AEDC 10 DEG CONE IN THREE RAE WIND TUNNELS AND THEIR IMPLICATIONS

D G Mabey London Aeron Res Council 1978 56 p refs Supersedes RAE-TR-76077 ARC-37395

(ARC-R/M-3821 BR64190 RAE-TR-76077 ARC-3795) Avail NTIS HC A04/MF A01 HMSO £ 5 PHI

The 10 degs cone was tested in a large number of transonic wind tunnels to investigate the influence of free stream pressure fluctuations on transition Reynolds numbers Measurements made on the cone in three wind tunnels are described In the 8ft x 8ft subsonic/supersonic tunnel the cone transition Reynolds numbers were relatively high and the pressure fluctuations low In the 3ft x 4ft high supersonic speed tunnel the transition Reynolds numbers were high and there were strong unit Reynolds number effects In the 8ft x 6ft tunnel transition was controlled by an effective roughness either at the cone tip or the microphones the tunnel pressure fluctuations varied appreciably with Mach number and were high at subsonic speeds The results show that surface pressure fluctuation measurements at supersonic speeds are sensitive to the degree of smoothness of the surface particularly in the transition region of the boundary layer A tentative classification of the aerodynamics facilities used for transition tests is suggested L S

N79-17818# Technische Hogeschool Delft (Netherlands) Dept of Aerospace Engineering

A SLENDER DELTA WING OSCILLATING IN SURFACE WAVES

R Coene Dec 1977 88 p refs

(VTH-LR-257 VTH-456) Avail NTIS HC A05/MF A01

An experimental investigation of some cases of unsteady propulsion in non-uniform flow conditions is discussed A not-so-deeply submerged rigid slender delta wing-like body is towed horizontally through a regular train of surface waves At the same time the body is forced to carry out heaving and pitching oscillations at the frequency of encounter The results are compared with theoretical predictions based on slender body potential flow assumptions The experiments tend to confirm the theoretical prediction that energy can be extracted from the waves in such a way that it can be used efficiently for propulsion The results are relevant to the theory of swimming of cetacea and fishes in waves and to the theory of the resistance of ships in a wavy sea Additional theoretical considerations are included S E S

N79-17819# Technische Hogeschool Delft (Netherlands) Dept of Aerospace Engineering

INTERACTION OF THE SUPERSONIC FLOW BELOW A WING AND A SUPERSONIC FREE JET (TWO-DIMENSIONAL SITUATION)

F J F deJong Apr 1978 53 p refs

(VTH-LR-268) Avail NTIS HC A04/MF A01

The interaction of the compression field below a wing in supersonic flow and supersonic jet parallel to the wing chord was investigated to verify the suggestion that the sonic boom generated by a supersonic transport aircraft might be substantially reduced by a suitable arrangement of the propulsive jets A theoretical investigation showed that the effect of the inviscid jet did have the desired direction but was very small Experiments were made to investigate the effect of turbulence however no extra effect was found No significant advantages are to be expected of practical application of the special configuration studied A R H

N79-17820# Dornier-System G m b H Friedrichshafen (West Germany) Theoretical Aerodynamics Group

THEORETICAL INVESTIGATIONS OF REAL GAS EFFECTS IN CRYOGENIC WIND TUNNELS Final Report

Bernhard Wagner and Wolfgang Schmidt Dec 1976 82 p refs

(DS-FB-76/508) Avail NTIS HC A05/MF A01

Real gas effects in cryogenic nitrogen flows were calculated using the Beattie-Bridgeman equation of state The investigations include Prandtl-Meyer expansions oblique shocks transonic small perturbation theory transonic flow past a NACA 0012 aerofoil and shock boundary layer interaction The two last cases mentioned were treated with the aid of finite volume techniques F O S

N79-17821# National Transportation Safety Board Washington D C

AIRCRAFT ACCIDENT REPORT MIDAIR COLLISION INVOLVING A FALCON JET, N121GW, AND A CESSNA 150M, N6423K, MEMPHIS, TENNESSEE

30 Nov 1978 42 p

(NTSB-AAR-78-14) Avail NTIS HC A03/MF A01

The Falcon Jet which was on an instrument flight rules flight plan had an instructor pilot and three students on board An instructor pilot and one passenger were aboard the Cessna 150M The Cessna was VFR and was receiving Stage III radar service The aircrafts were under control of Memphis tower

controllers and were in radar and radio contact with the tower The weather in the Memphis area was Scattered clouds at 4 500 feet and visibility--6 miles with haze The National Transportation Safety Board determined that the probable cause of this accident was the failure of controller personnel to separate the aircraft as required by procedures established for a terminal radar service area to insure that proper coordination was effected to issue appropriate traffic advisories and the failure of each flightcrew to see and avoid the other aircraft S E S

N79-17822*# Lockheed-Georgia Co Marietta
CARGO/LOGISTICS AIRLIFT SYSTEM STUDY (CLASS), VOLUME 1
J M Norman R D Henderson F C Macey and R P Tuttle Hampton Va NASA Nov 1978 338 p
(Contract NAS1-14967)
(NASA-CR-158915 LG78ER0266-Vol-1) Avail NTIS HC A15/MF A01 CSCL 01C

Current and advanced air cargo systems are evaluated using industrial and consumer statistics Market and commodity characteristics that influence the use of the air mode are discussed along with a comparison of air and surface mode on typical routes Results of on-site surveys of cargo processing facilities at airports are presented and institutional controls and influences on air cargo operations are considered F O S

N79-17823*# Lockheed-Georgia Co Marietta
CARGO/LOGISTICS AIRLIFT SYSTEM STUDY (CLASS), VOLUME 2
J M Norman R D Henderson F C Macey and R P Tuttle Hampton Va NASA Nov 1978 334 p refs
(Contract NAS1-14967)
(NASA-CR-158916 LG78ER0267-Vol-2) Avail NTIS HC A15/MF A01 CSCL 01C

Air containerization is discussed in terms of lower freight rates size and pallet limitations refrigeration backhaul of empties and ownership It is concluded that there is a need for an advance air cargo system as indicated by the industry/transportation case studies and a stimulation of the air cargo would result in freight rate reductions F O S

N79-17824*# Lockheed-Georgia Co Marietta
CARGO/LOGISTICS AIRLIFT SYSTEM STUDY (CLASS), EXECUTIVE SUMMARY
J M Norman R D Henderson F C Macey and R P Tuttle Hampton Va NASA Nov 1978 37 p
(Contract NAS1-14967)
(NASA-CR-158959 LG78ER0265) Avail NTIS HC A03/MF A01 CSCL 01C

The current air cargo system is analyzed along with advanced air cargo systems studies A forecast of advanced air cargo system demand is presented with cost estimates It is concluded that there is a need for a dedicated advance air cargo system and with application of advanced technology reductions of 45% in air freight rates may be achieved F O S

N79-17825# National Aviation Facilities Experimental Center Atlantic City N J
FULL-SCALE FIRE MODELING TESTS OF A COMPACT *RAPID RESPONSE FOAM AND DRY CHEMICAL POWDER* DISPENSING SYSTEM Final Report, Jul 1975 - Aug 1976
George B Geyer Lawrence M Neri and Charles H Urban Oct 1978 81 p refs
(FAA Proj 081-431-100)
(FAA-NA-78-24 FAA-RD-78-105) Avail NTIS HC A05/MF A01

The firefighting capability of a rapid firefighting system of the dual-agent type capable of dispensing Aqueous-Film-Forming-Foam (AFFF) or dry chemical powder either singly or in combination was established Fire control times were determined for three 6 percent and two 3 percent-type AFFF agents and five dry chemical powders on 35 and 82 4 foot diameter Jet A fuel fires at nominal discharge rates of 3 5 and 7 0 pounds per second Foam ground patterns were developed for the five AFFF agents and the effective throw range of each of the five dry chemical powders was determined A means was developed for estimating the response time of a rapid fire-intervention vehicle to attend to any part of the operational area of an airport in a hypothetical aircraft accident situation The methodology was based upon the results obtained by conducting a series of segmented time trials of basic maneuvers the sum of which closely approximated the actual vehicle response time Experiments tend to indicate that the Twinned Agent Unit (TAU) would be capable of extinguishing the practical critical fire area associated with U S Index A aircraft within 120 seconds S E S

N79-17826# National Transportation Safety Board Washington D C
AIRCRAFT ACCIDENT REPORT CONTINENTAL AIR LINES, INCORPORATED, MCDONNELL-DOUGLAS DC-10-10 N68045, LOS ANGELES, CALIFORNIA, MARCH 1, 1978
25 Jan 1979 52 p refs
(NTSB-AAR-79-1) Avail NTIS HC A04/MF A01

As the aircraft departed the wet load-bearing surface of the runway the left main landing gear collapsed and fire erupted from the left wing area The aircraft slid to a stop about 664 feet from the departure end of the runway The left side of the aircraft was destroyed Of the 184 passengers 2 infants and 14 crewmembers aboard 2 passengers were killed and 28 passengers and 3 crewmembers were seriously injured during the evacuation of the aircraft The probable cause of the accident was the sequential failure of two tires on the left main landing gear and the resultant failure of another tire on the same landing gear at a critical time during the takeoff roll These failures resulted in the captain s decision to reject the takeoff The cumulative effect of the partial loss of aircraft braking because of the failed tires and the reduced braking friction achievable on the wet runway surface which increased the accelerate-stop distance to a value greater than the available runway length contributed to the accident These factors prevented the captain from stopping the aircraft within the runway confines S E S

N79-17828# National Transportation Safety Board Washington D C Bureau of Technology
LISTING OF ACCIDENTS/INCIDENTS BY MAKE AND MODEL, US CIVIL AVIATION, 1977
19 Dec 1978 198 p
(NTSB-AMM-78-12) Avail NTIS HC A09/MF A01

This publication contains a listing of all U S civil aviation accidents/incidents occurring in calendar year 1977 sorted by aircraft make and model Included are the file number aircraft registration number date and location of the accident aircraft make and model and injury index for all 4 427 accidents/incidents occurring in this period This publication will be published annually Author

N79-17829# National Transportation Safety Board Washington D C Bureau of Technology
BRIEFS OF ACCIDENTS INVOLVING MIDAIR COLLISIONS, US GENERAL AVIATION, 1977
19 Dec 1978 62 p
(NTSB-AMM-78-13) Avail NTIS HC A04/MF A01

There are 34 accidents included 17 of which involve fatal accidents The facts conditions circumstances and probable cause(s) for each accident are presented Additional statistical information is tabulated by kind of flying phase of operation injury index altitude of occurrence airport proximity aircraft damage pilot certificate injuries and casual factor(s) S E S

N79-17830# National Transportation Safety Board Washington, D C Bureau of Technology
BRIEFS OF ACCIDENTS INVOLVING TURBINE POWERED AIRCRAFT, US GENERAL AVIATION, 1977
19 Dec 1978 99 p
(NTSB-AMM-78-14) Avail NTIS HC A05/MF A01

This publication contains reports of U S general aviation turbine powered aircraft accidents occurring in 1977 Included are 129 accident Briefs 37 of which involve fatal accidents 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

injury index aircraft damage pilot certificate injuries and cause/factor(s) This publication will be published annually
Author

N79-17831# National Transportation Safety Board Washington D C Bureau of Technology
BRIEFS OF ACCIDENTS INVOLVING ROTORCRAFT, US GENERAL AVIATION, 1977
19 Dec 1978 179 p
(NTSB-AMM-78-15) Avail NTIS HC A09/MF A01
There are 276 accidents included 29 of which involve fatal accidents The facts conditions circumstances and probable cause(s) for each accident are presented Additional statistical information is tabulated by type of accident phase of operation injury index aircraft damage kind of flying pilot certificates injuries and causes and related factors S E S

N79-17832# National Transportation Safety Board Washington D C Bureau of Technology
BRIEFS OF FATAL ACCIDENTS INVOLVING WEATHER AS A CAUSE/FACTOR, US GENERAL AVIATION, 1977
19 Dec 1978 259 p
(NTSB-AMM-78-16) Avail NTIS HC A12/MF A01
Reports are presented of all fatal U S general aviation accidents involving weather as a cause/factor for the year 1977 Included are 258 fatal accidents in the brief format This format presents the facts conditions circumstances and probable cause(s) for each accident Additional statistical information is tabulated on all accidents involving weather as a cause/factor by type of accident phase of operation injury index aircraft damage pilots certificate injuries and cause/factor(s) S E S

N79-17833# National Transportation Safety Board Washington D C Bureau of Technology
BRIEFS OF ACCIDENTS INVOLVING ALCOHOL AS A CAUSE/FACTOR, US GENERAL AVIATION, 1977
19 Dec 1978 43 p
(NTSB-AMM-78-17) Avail NTIS HC A03/MF A01
There are 47 accidents included 41 of which involve fatal accidents The facts conditions circumstances and probable cause(s)/factor(s) for each accident are presented Additional statistical information is tabulated by type of accident phase of operation injury index aircraft damage pilot certificate injuries and causal factor(s) S E S

N79-17834# National Transportation Safety Board Washington D C Bureau of Technology
BRIEFS OF ACCIDENTS INVOLVING MISSING AND MISSING LATER RECOVERED AIRCRAFT, US GENERAL AVIATION, 1977
19 Dec 1978 65 p
(NTSB-AMM-78-18) Avail NTIS HC A04/MF A01
There are 63 accidents included 11 of which cover missing aircraft not recovered and 52 missing later recovered The facts conditions circumstances and probable cause(s) for each accident are presented Additional statistical information is tabulated by type of accident phase operation injury index aircraft damage pilot certificate injuries and causal factor(s) S E S

N79-17835# National Transportation Safety Board Washington D C Bureau of Technology
BRIEFS OF ACCIDENTS, INVOLVING CORPORATE/EXECUTIVE AIRCRAFT, US GENERAL AVIATION, 1977
19 Dec 1978 59 p
(NTSB-AMM-78-19) Avail NTIS HC A04/MF A01
There are 60 accidents included 18 of which involve fatal accidents The facts conditions circumstances and probable cause(s) for each accident are presented Additional statistical information is tabulated by type of accident phase of operation injuries and causal/factor(s) S E S

N79-17836# National Transportation Safety Board Washington D C Bureau of Technology
BRIEFS OF ACCIDENTS INVOLVING AMATEUR/HOME BUILT AIRCRAFT, US GENERAL AVIATION, 1977
19 Dec 1978 71 p
(NTSB-AMM-78-20) HC A04/MF A01
There are 106 accidents 21 of which involve fatalities The facts conditions circumstances and probable causes(s)/factor(s) for each accident are presented Additional statistical information is tabulated by type of accident phase of operation injury index aircraft damage pilot certificate injuries and casual/factor(s)
S E S

N79-17837# National Transportation Safety Board Washington D C Bureau of Technology
BRIEFS OF ACCIDENTS INVOLVING AERIAL APPLICATION OPERATIONS, US GENERAL AVIATION, 1977
19 Dec 1978 319 p
(NTSB-AMM-78-21) Avail NTIS HC A14/MF A01
This publication contains reports of U S general aviation aerial application accidents occurring in 1977 Included are 454 accident Briefs 30 of which involve fatal accidents 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 injury index aircraft damage pilot certificate injuries kind of operation and causes/factors This publication will be published annually
Autnor

N79-17838# National Transportation Safety Board Washington D C Bureau of Technology
BRIEFS OF ACCIDENTS INVOLVING COMMUTER AIR CARRIERS AND ON-DEMAND AIR TAXI OPERATIONS, US GENERAL AVIATION, 1977
19 Dec 1978 153 p
(NTSB-AMM-78-22) Avail NTIS HC A08/MF A01
There are 37 commuter air carrier and 180 on-demand air taxi and accident briefs The facts conditions circumstances and probable cause(s) for each accident are presented Additional statistical information is tabulated by type of operation injuries aircraft weight and cause(s) and related factor(s) S E S

N79-17839# Technische Hogeschool Delft (Netherlands) Dept of Aerospace Engineering
WORST CASE TIME-HISTORIES CAUSING LARGEST DEVIATIONS FROM A DESIRED FLIGHT PATH AN ANALYTICAL APPROACH
J C VanderVaart Apr 1978 43 p refs
(VTH-LR-267) Avail NTIS HC A03/MF A01
An analytical method to find wind or turbulence time-histories causing largest deviations of aircraft motion variables is described Basic concepts of linear system theory is used to show that the largest deviation of a particular aircraft variable is caused by a turbulence time-history that is proportional to the time-reversed impulse response of that particular variable A maximum deviation caused by the (deterministic) worst case time-history is shown to be proportional to the variance of the motion variable in the (imagery) stochastic case if the aircraft is considered to be perturbed by white noise random turbulence The problem of finding worst case responses is reduced to that of the statistics of a white noise driven linear system Some possibilities are suggested for the use of this concept as a tool in designing control systems aimed at making an aeroplane less sensitive to the class of low frequency turbulence usually denoted by the term windshears S E S

N79-17840# Federal Aviation Administration Washington D C Systems Research and Development Service
COLLISION AVOIDANCE AN ANNOTATED BIBLIOGRAPHY Final Report, May 1972 - Nov 1977
Dorothy E Bulford Dec 1977 308 p
(FAA-NA-78-8) Avail NTIS HC A14/MF A01
A bibliography of 859 annotated references to collision avoidance are presented These references are to literature issued since April 1972 Corporate author personal name and subject indexes are included F O S

N79-17841# Systems Control Inc Palo Alto Calif
RNAV ROUTE DESIGN-TERMINAL AREA DESIGN PROCEDURES AND TRANSITION AREA DESIGN GUIDELINES
Final Report
E D McConkey and A G Halverson Jan 1978 221 p
(DOT-FA72WA-3098)
(FAA-RD-78-61) Avail NTIS HC A10/MF A01

Techniques are presented which can be used to produce terminal and transition area route structures that are designed for use by aircraft equipped with area navigation (RNAV) computers The route design processes were developed during investigation into RNAV route structures for terminal and enroute airspace The design techniques provide for the consideration of user and air traffic control (ATC) requirements Among the user considerations are minimization of the number of waypoints and the reduction of aircraft time and fuel penalties by utilizing the RNAV routes The ATC considerations include procedural separation of arriving and departing aircraft organization of the terminal area according to traffic flow and provision for sufficient maneuvering airspace to permit efficient traffic separation procedures The terminal area design process is characterized by a set of procedures by which the route structure is developed The data requirements and the data processing programs which can aid in the design process are described The terminal design procedure describes the means by which the terminal waypoints can be located by considering traffic demand Techniques for locating feeder fixes and providing traffic patterns for several active runway combinations are included Procedures for developing efficient vertical aircraft profiles are described F O S

N79-17843*# National Aeronautics and Space Administration Langley Research Center Hampton Va
ALGORITHMS AND LOGIC FOR INCORPORATING MLS BACK AZIMUTH INFORMATION INTO THE NASA TCV B-737 AIRPLANE AREA NAVIGATION SYSTEM
Charles E Knox Jan 1979 21 p refs
(NASA-TM-80039) Avail NTIS HC A02/MF A01 CSCL 17G

Navigation position estimates are based on range information form a randomly located DME and MLS back azimuth angular information The MLS volmetric coverage checks are performed to ensure that proper navigation inputs are being utilized These algorithms and volumetric checks were designed so that they could be added to most existing area navigation systems with minimum software modification S E S

N79-17847* National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
CONSTANT LIFE ROTOR FOR A HEAVIER THAN AIR CRAFT
Patent
Robert H Stroub inventor (to NASA) Issued 30 Jan 1979 8 p Filed 25 Jul 1977 Supersedes N77-28111 (15 - 19 p 2486)
(NASA-Case-ARC-11045-1 US-Patent 4 137 010
US-Patent-Appl-SN-818916 US-Patent-Class-416-51
US-Patent-Class-416-88 US-Patent-Class-416-89
US-Patent-Class-416-132R US-Patent-Class-416-138) Avail US Patent and Trademark Office CSCL 01C

A rotor blade extended radially from a hub characterized by an elongated spar and a plurality of axially aligned shells pivotally mounted on the spar is presented Each has an aerodynamic center located in trailing relation with the spar and supported thereby for simultaneous axial and angular displacement as centrifugal forces are applied a pitch controller plus a plurality of pivotal pitch limiting arms transversely related to the spar A push-pull link interconnecting the arms is used for imparting simultaneous pivotal motion whereby the angular relationship of the arms to the spar is varied for varying the motion of the trucks along the arms for thus limiting the pitch of the segments about the spar

Official Gazette of the U S Patent and Trademark Office

N79-17848*# Lockheed-Georgia Co Marietta
ADVANCED SYSTEM DESIGN REQUIREMENTS FOR LARGE AND SMALL FIXED-WING AERIAL APPLICATION SYSTEMS FOR AGRICULTURE
J T Hinely Jr and R Q Boyles Jr Hampton Va NASA Jan 1979 302 p refs
(Contracts NAS1-15185 NAS1 15186)
(NASA-CR-158939 LG79ER0005) Avail NTIS HC A14/MF A01 CSCL 01C

Several candidate aircraft configurations were defined over the range of 1000 to 10 000 pounds payload and evaluated over a broad spectrum of agricultural missions From these studies baseline design points were selected at 3200 pounds payload for the small aircraft and 7500 pounds for the large aircraft The small baseline aircraft utilizes a single turboprop powerplant while the large aircraft utilizes two turboprop powerplants These configurations were optimized for wing loading aspect ratio and power loading to provide the best mission economics in representative missions Wing loading of 20 lb/sq ft was selected for the small aircraft and 25 lb/sq ft for the large aircraft Aspect ratio of 8 was selected for both aircraft It was found that a 10% reduction in engine power from the original configurations provided improved mission economics for both aircraft by reducing the cost of the turboprop Refined configurations incorporate a 675 HP engine in the small aircraft and two 688 HP engines in the large aircraft J M S

N79-17849*# Kansas Univ Lawrence
THE DEVELOPMENT OF THE DAST I REMOTELY PILOTED RESEARCH VEHICLE FOR FLIGHT TESTING AN ACTIVE FLUTTER SUPPRESSION CONTROL SYSTEM Ph D Thesis
Final Report
David L Grose Feb 1979 365 p refs
(Contract NAS1-4007)
(NASA-CR-144881) Avail NTIS HC A16/MF A01 CSCL 01C

The development of the DAST I (drones for aerodynamic and structural testing) remotely piloted research vehicle is described The DAST I is a highly modified BQM-34E/F Firebee II Supersonic Aerial Target incorporating a swept supercritical wing designed to flutter within the vehicle s flight envelope The predicted flutter and rigid body characteristics are presented A description of the analysis and design of an active flutter suppression control system (FSS) designed to increase the flutter boundary of the DAST wing (ARW-1) by a factor of 20% is given The design and development of the digital remotely augmented primary flight control system and on-board analog backup control system is presented An evaluation of the near real-time flight flutter testing methods is made by comparing results of five flutter testing techniques on simulated DAST I flutter data The development of the DAST ARW-1 state variable model used to generate time histories of simulated accelerometer responses is presented This model uses control surface commands and a Dryden model gust as inputs The feasibility of the concept of extracting open loop flutter characteristics from closed loop FSS responses was examined It was shown that open loop characteristics can be determined very well from closed loop subcritical responses Author

N79-17850*# Rockwell International Corp Los Angeles Calif
FORMULATION OF AERODYNAMIC PREDICTION TECHNIQUES FOR HYPERSONIC CONFIGURATION DESIGN
Feb 1979 114 p refs
(Contract NAS1-15075)
(NASA-CR-158994) Avail NTIS HC A06/MF A01 CSCL 01C

An investigation of approximate theoretical techniques for predicting aerodynamic characteristics and surface pressures for relatively slender vehicles at moderate hypersonic speeds was performed Emphasis was placed on approaches that would be responsive to preliminary configuration design level of effort Supersonic second order potential theory was examined in detail to meet this objective Shock layer integral techniques were considered as an alternative means of predicting gross aerodynamic characteristics Several numerical pilot codes were developed for simple three dimensional geometries to evaluate the capability of the approximate equations of motion considered Results from the second order computations indicated good agreement with higher order solutions and experimental results for a variety of wing like shapes and values of the hypersonic similarity parameter M delta approaching one Author

N79-17851*# National Aeronautics and Space Administration Langley Research Center Hampton Va
EFFECTS OF LAMINAR FLOW CONTROL ON THE PERFORMANCE OF A LARGE SPAN-DISTRIBUTED-LOAD FLYING-WING CARGO AIRPLANE CONCEPT
Lloyd S Jernell Jun 1978 23 p refs
(NASA-TM-78715) Avail NTIS HC A02/MF A01 CSCL 01C

The effects of laminar flow control (LFC) on the performance of a large span-distributed-load flying-wing cargo airplane concept having a design payload of 2 669 MN and range of 5 93 Mm were determined Two configurations were considered One employed laminarized flow over the entire surfaces of the wing and vertical tails with the exception of the estimated areas of interference due to the fuselage and engines The other case differed only in that laminar flow was not applied to the flaps elevons spoilers or rudders The two cases are referred to as the 100 percent and 80 percent laminar configurations, respectively The utilization of laminar flow control results in reductions in the standard day sea level installed maximum static thrust per engine from 240 kN for the non-LFC configuration to 205 kN for the 100 percent laminar configuration and 209 kN for the 80 percent case Weight increases due to the LFC systems cause increases in the operating empty weights of approximately 3 to 4 percent The design takeoff gross weights decrease approximately 3 to 5 percent The FAR-25 takeoff field distances for the LFC configurations are greater by about 6 to 7 percent Fuel efficiencies for the respective configurations are increased 33 percent and 23 percent J M S

N79-17852*# Vought Corp Hampton Va
EVALUATION OF A LONG-ENDURANCE-SURVEILLANCE REMOTELY-PILOTED VEHICLE WITH AND WITHOUT LAMINAR FLOW CONTROL
R V Turriziani W A Lovell J E Prince C B Quartero and S F Washburn Feb 1979 56 p refs
(Contract NAS1-13500)
(NASA-CR-159006) Avail NTIS HC A04/MF A01 CSCL 01C

Two aircraft were evaluated using a derated TF34-GE-100 turbofan engine one with laminar flow control (LFC) and one without The mission of the remotely piloted vehicles (RPV) is one of high-altitude loiter at maximum endurance With the LFC system maximum mission time increased by 6 7 percent L/D in the loiter phase improved 14 2 percent and the minimum parasite drag of the wing was reduced by 65 percent resulting in a 37 percent reduction for the total airplane Except for the minimum parasite drag of the wing the preceding benefits include the offsetting effects of weight increase suction power requirements, and drag of the wing-mounted suction pods In a supplementary study using a scaled-down rather than derated version of the engine on the LFC configuration a 17 6 percent increase in mission time over the airplane without LFC and an incremental time increase of 10 2 percent over the LFC airplane with derated engine were attained This improvement was due principally to reductions in both weight and drag of the scaled engine L S

N79-17854*# National Aeronautics and Space Administration Langley Research Center Hampton Va
LED INSTRUMENT APPROACH INSTRUCTION DISPLAY
Barry D Meredith W Lane Kelly IV and Roger K Crouch Jan 1979 18 p
(NASA-TM-78823) Avail NTIS HC A02/MF A01 CSCL 01D

A display employing light emitting diodes (LED s) was developed to demonstrate the feasibility of such displays for presenting landing and navigation information to reduce the workload of general aviation pilots during IFR flight The display consists of a paper tape reader digital memory control electronics digital latches and LED alphanumeric displays A presentable digital countdown clock-timer is included as part of the system to provide a convenient means of monitoring time intervals for precise flight navigation The system is a limited capability prototype assembled to test pilot reaction to such a device under simulated IFR operation Pilot opinion indicates that the display is helpful in reducing the IFR pilots workload when used with a runway approach plate However the development of a compact low power second generation display was recommended which could present several instructions simultaneously and provide information update capability A microprocessor-based display could fulfill these requirements J M S

N79-17855# Westinghouse Defense and Electronic Systems Center Baltimore Md Systems Development Div
INTEGRATED THERMAL AVIONICS DESIGN (ITAD) Final Report
R F Porter E R Levitt Y Lord R T Dolbeare and R H Worsham Jun 1978 156 p refs
(Contract F33615-77-C-2074)
(AD-A061227 Rept-78-0610 AFFDL-TR-78-76) Avail NTIS HC A08/MF A01 CSCL 01/3

This volume contains a description of the ITAD study program results It includes definition of the computer facility requirements and software and shows by example the improvement to be made in Life Cycle cost when ITAD is applied to the design of electronic equipment Author (GRA)

N79-17856 British Library Lending Div Boston Spa (England)
SEPARATION AND INVESTIGATION OF WEAR PARTICLES FROM AERO-ENGINES
E Jantzen 4 May 1978 12 p refs Transl into ENGLISH from Z Flugwiss und Weltraumforsch (West Germany) v 1 pt 3 1971 p 193-199
(BLL-Risley-TR-3308-(9091 9F)) Copyright Avail British Library Lending Div Boston Spa Engl

After a survey of the methods of separating wear particles from engine oils a detailed description of filters and filtration techniques is given Investigations with the scanning electron microscope on the size and form of wear particles from aero-engines are then presented The methods advantages and results of analysis of individual wear particles by the energy-dispersive technique in the scanning microscope are discussed J M S

N79-17858*# Hamilton Standard Windsor Locks Conn
INTERACTIVE MULTI-MODE BLADE IMPACT ANALYSIS Final Report, Jan 1976 - Aug 1977 and Feb 1978 - Aug 1978
A Alexander and R W Cornell Aug 1978 301 p refs
(Contract NAS3-20091)
(NASA-CR-159462) Avail NTIS HC A16/MF A01 CSCL 21E

The theoretical methodology used in developing an analysis for the response of turbine engine fan blades subjected to soft-body (bird) impacts is reported and the computer program developed using this methodology as its basis is described This computer program is an outgrowth of two programs that were previously developed for the purpose of studying problems of a similar nature (a 3-mode beam impact analysis and a multi-mode beam impact analysis) The present program utilizes an improved missile model that is interactively coupled with blade motion which is more consistent with actual observations It takes into account local deformation at the impact area blade camber effects and the spreading of the impacted missile mass on the blade surface In addition it accommodates plate-type mode shapes The analysis capability in this computer program represents a significant improvement in the development of the methodology for evaluating potential fan blade materials and designs with regard to foreign object impact resistance S E S

N79-17859*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
COLD-AIR PERFORMANCE OF FREE POWER TURBINE DESIGNED FOR 112-KILOWATT AUTOMOTIVE GAS-TURBINE ENGINE 2 EFFECTS OF VARIABLE STATOR-VANE-CHORD SETTING ANGLE ON TURBINE PERFORMANCE Final Report
Kerry L McLallin and Milton G Kofskey Feb 1979 53 p refs
(Contract EC-77-A-31-1011)
(NASA-TM-78993 DOE/NASA/1011-78/28 E-9775) Avail NTIS HC A04/MF A01 CSCL 21A

The cold-air performance of an axial-flow power turbine with a variable stator designed for a 112-kW automotive gas-turbine

engine was determined at speeds from 30 to 110 percent of design and at pressure ratios from 1 11 to 2 67 Performance is presented in terms of equivalent mass flow torque power and efficiency for stator-vane-chord setting angles of 26 degs 30 degs 35 degs (design) 40 degs 45 degs and 50 degs Turbine braking performance at a nominal stator setting angle of 107 degs is also presented Turbine efficiency increased with increasing stator setting angle A 10-point efficiency increase was obtained by opening the stator from the design setting angle of 35 degs to a setting angle of 45 degs Author

N79-17860# Northern Research and Engineering Corp Cambridge Mass

TIME DEGRADATION FACTORS FOR THE TURBINE ENGINE EXHAUST EMISSIONS VOLUME 1 PROGRAM DESCRIPTION AND RESULTS Interim Report, Aug 1974 - Jun 1977

Melvin Platt and E R Norster May 1978 153 p refs 8 Vol
(Contract DOT-FA74NA-1100)
(NREC-1238-6-Vol-1 FAA-NA-77-179-Vol-1
FAA-RD-78-56-Vol-1) Avail NTIS HC A08/MF A01

Turbine emission degradation was studied An introduction to the program a description of the test schedule equipment procedures and data processing techniques as well as a discussion of the test data itself were included A total of 519 repetitious emission tests were conducted over a period of 22 months on units of the following engine types JT8D-9 JT8D-7 JT3D-3B JT9D-3B JT9D-3A RB211-22B and CF700-2D Emissions of CO2 CO HC NO NOx and smoke were monitored in addition to various engine operating parameters over an eight-mode test cycle ranging from cold idle to take-off and back to hot idle
J M S

N79-17862# Dornier-System G m b H Friedrichshafen (West Germany)

ENGINE DYNAMICS [TRIEBWERKSDYNAMIK]

M Buchstaller Bonn DOKZENTBW 1978 162 p refs In GERMAN ENGLISH summary Sponsored by Bundesmin fuer Verteidigung
(BMVG-FBWT-78-6) Avail NTIS HC A08/MF A01

Simulation groups of Dornier fighters maneuvers are studied with the aid of digital and/or hybrid computation The influence of energy management on fighters maneuvers is considered Simulation runs were done with three aircraft comparing maneuvers with frequent RPM changes and with different initial conditions for the whole flight envelope The results in low speed area for light fighters using engine dynamics indicate a rise in speed time reduction for maneuvers better set in position to opponent and reducing time in opponent s threat area The results for heavier fighters indicate important tactical advantages at high speed level S E S

N79-17863# Northern Research and Engineering Corp Cambridge Mass

TIME DEGRADATION FACTORS FOR THE TURBINE ENGINE EXHAUST EMISSION VOLUME 2 JT8D-9 TEST DATA Interim Report, Aug 1974 - Jun 1977

May 1978 382 p refs 8 Vol
(Contract DOT-FA74NA-1100)
(NREC-1238-7-Vol-2 FAA-NA-77-179-Vol-2
FAA-RD-78-56-Vol-2) Avail NTIS HC A17/MF A01

Degradation of turbine engine emissions was examined A compilation of all emission test data and analysis data used in the development of degradation factors for the JT8D-9 engine type is presented Maintenance data for the test units during the period of testing as well as analyses of the samples of fuel used in each test are included J M S

N79-17864# Northern Research and Engineering Corp Cambridge Mass

TIME DEGRADATION FACTORS FOR TURBINE ENGINE EXHAUST EMISSIONS VOLUME 3 JT3D-7 TEST DATA Interim Report, Aug 1974 - Jun 1977

May 1978 376 p refs 8 Vol
(Contract DOT-FA74NA-1100)
(NREC-1238-8-Vol-3 FAA-NA-77-179-Vol-3
FAA-RD-78-56-Vol-3) Avail NTIS HC A17/MF A01

Emission test data and analysis data used in the development of degradation factors for the JT8D-7 engine are presented along with maintenance data for the test units during the period of testing Analyses of the samples of fuel used in each test are included J M S

N79-17865# Northern Research and Engineering Corp Cambridge Mass

TIME DEGRADATION FACTORS FOR TURBINE ENGINE EXHAUST EMISSIONS VOLUME 4 JT3D-7 TEST DATA Interim Report, Aug 1974 - Jun 1977

May 1978 373 p refs 8 Vol
(Contract DOT-FA74NA-1100)
(NREC-1238-9-Vol-4 FAA-NA-77-179-Vol-4
FAA-RD-78-56-Vol-4) Avail NTIS HC A16/MF A01

Degradation factors for the JT3D-7 engine were developed Emission test data analysis data maintenance data for the test units for the period of testing and analyses of the samples of fuel used in each test are presented in tabular form J M S

N79-17866# Northern Research and Engineering Corp Cambridge Mass

TIME DEGRADATION FACTORS FOR TURBINE ENGINE EXHAUST EMISSIONS VOLUME 5 JT3D-3B TEST DATA Interim Report, Aug 1974 - Jun 1977

May 1978 374 p refs 8 Vol
(Contract DOT-FA74NA-1100)
(NREC-1238-10-Vol-5 FAA-NA-77-179-Vol-5
FAA-RD-78-56-Vol-5) Avail NTIS HC A16/MF A01

Tests were conducted to determine degradation factors for pollutant emissions from various aircraft engines Emission test data for the JT3D-3B engine are presented Analysis data used in the development of degradation factors maintenance data for the test units during the period of testing and analyses of the samples of fuel used in each test are included J M S

N79-17867# Northern Research and Engineering Corp Cambridge Mass

TIME DEGRADATION FACTORS FOR TURBINE ENGINE EXHAUST EMISSIONS VOLUME 6 JT9D-3A TEST DATA Interim Report, Aug 1974 - Jun 1977

May 1978 376 p refs 8 Vol
(Contract DOT-FA74NA-1100)
(NREC-1238-11-Vol-6 FAA-NA-77-179-Vol-6
FAA-RD-78-56-Vol-6) Avail NTIS HC A17/MF A01

Emission test data and analysis data used in the development of degradation factors for the JT9D-3A engine type are presented Maintenance data for the test units during the period of testing as well as analyses of the samples of fuel used in each test are included J M S

N79-17868# Northern Research and Engineering Corp Cambridge Mass

TIME DEGRADATION FACTORS FOR TURBINE ENGINE EXHAUST EMISSIONS VOLUME 7 RB211-22B TEST DATA Interim Report, Aug 1974 - Jun 1977

May 1978 318 p refs 8 Vol
(Contract DOT-FA74NA-1100)
(NREC-1238-12-Vol-7 FAA-NA-77-179-7
FAA-RD-78-56-Vol-7) Avail NTIS HC A14/MF A01

A compilation of all emission test data and analysis data used in the development of degradation factors for the RB211-22B engine type is presented Maintenance data for the test units during the period of testing and analyses of the samples of fuel used in each test are included J M S

N79-17869# Northern Research and Engineering Corp Cambridge Mass

TIME DEGRADATION FACTORS FOR TURBINE ENGINE EXHAUST EMISSIONS VOLUME 8 C700-2D TEST DATA Interim Report, Aug 1974 - Jun 1977

May 1978 319 p refs 8 Vol
(Contract DOT-FA74NA-1100)
(NREC-1238-13-Vol-8 FAA-NA 77-179-Vol-8
FAA-RD-78-56-Vol-8) Avail NTIS HC A14/MF A01

Degradation of turbine engine emissions is reported Emission test data and analysis data used in the development of degradation factors for the CF700-2D engine type are presented Maintenance data for the test units during the period of testing as well as analyses of the samples of fuel used in each test are given
J M S

N79-17870# Aeronautical Research Associates of Princeton Inc N J
GUST LOAD ESTIMATION USING A SIMPLIFIED POWER SPECTRAL TECHNIQUE Final Report, Apr 1977 - Apr 1978
Guy Williamson Oct 1978 26 p refs
(ARAP-362 FAA-RD-78-118) Avail NTIS HC A03/MF A01
A one-degree-of-freedom power spectral technique for estimating gust loads on aerodynamic surfaces produced by atmospheric turbulence is presented A procedural flow chart to guide the designer in the use of this technique and sample calculations are included
S E S

N79-17871*# National Aeronautics and Space Administration Langley Research Center Hampton Va
THEORETICAL AND EXPERIMENTAL INVESTIGATION OF GROUND INDUCED EFFECTS FOR A LOW-ASPECT-RATIO HIGHLY SWEPT ARROW-WING CONFIGURATION
Paul L Coe Jr and James L Thomas Jan 1979 100 p refs
(NASA-TM-80041) Avail NTIS HC A05/MF A01 CSCL 01C
An investigation was conducted in the Langley V/STOL tunnel to determine the influence of ground proximity on the aerodynamic characteristics of a low aspect ratio highly swept arrow wing configuration The tests were conducted using a moving belt ground plane to simulate ground heights varying from 0 1 to 1 0 wing spans The experimental results show that as the height above the ground decreases the configuration experiences substantial increases in lift and reductions in induced drag Although a significant percentage of these ground-induced performance improvements are lost due to trim requirements the net performance improvement remains quite favorable The tests also show that decreasing ground height results in a marked increase in the tail downwash factor and therefore results in a substantial increase in the horizontal tail contribution to longitudinal stability Comparison of the experimental results with results predicted by a planar vortex lattice theoretical model shows that the theoretical model provides a good estimate of the ground induced effect on lift drag and longitudinal stability for the wing-body combination
J M S

N79-17872*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
CONFIGURATION MANAGEMENT AND AUTOMATIC CONTROL OF AN AUGMENTOR WING AIRCRAFT WITH VECTORED THRUST
Luigi S Cicolani B Sridhar and George Meyer Mar 1979 138 p refs
(NASA-TP-1222 A-7099) Avail NTIS HC A07/MF A01 CSCL 01C
An advanced structure for automatic flight control logic for powered-lift aircraft operating in terminal areas is under investigation at Ames Research Center This structure is based on acceleration control acceleration commands are constructed as the sum of acceleration on the reference trajectory and a corrective feedback acceleration to regulate path tracking errors The central element of the structure termed a Trimmap uses a model of the aircraft aerodynamic and engine forces to calculate the control settings required to generate the acceleration commands This report describes the design criteria for the Trimmap and derives a Trimmap for Ames experimental augmentor wing jet STOL research aircraft
Author

N79-17875# National Aerospace Lab Amsterdam (Netherlands) Flight Div
THE NEED OF STICK FORCE STABILITY FOR ATTITUDE-STABILIZED AIRCRAFT, PART 2
H A Mooij and M F C vanGool 31 Jan 1977 75 p refs
(Contracts NIVR-1745 RB-RLD-1976-1 3 1)
(NLR-TR-77027-H) Avail NTIS HC A04/MF A01

Flight tests related to the effect of various levels of (artificial) positive stick force stability on the longitudinal controllability in the landing approach of an attitude-stabilized aircraft are described Approach performance and pilot commentary of 60 ILS/VASIS approaches flown with a twin-engined jet transport were analyzed The aircraft was operated at a speed corresponding to the bottom of the thrust required versus speed curve Feedback of a signal proportional to the difference between the actual and the reference airspeed was used to generate (artificial) stick force stability For the intermediate gradient of positive stick force stability investigated a modest reduction of airspeed deviation on the approach was measured pilot effort and glide path tracking perforamnce did not differ from those in the case of neutral stick force stability For a high gradient of positive stick force stability (approximately 2 8 lbs per 6 knots) a marked increase in pilot effort and serious degradation of glide path control performance were measured
S E S

N79-17876# Naval Civil Engineering Lab Port Hueneme Calif
AIRFIELD MARKING PAINTS STATE-OF-THE-ART Final Report
Richard W Drisko Sep 1978 45 p refs
(Contract DOT-FA78WAI-847)
(FAA-RD-78-104) Avail NTIS HC A03/MF A01
Information on the composition of such paints federal specifications available test methods reflectorization methods deterioration mechanism skid-resistance relationships surface preparation application requirements and alternative marking systems is presented Information on traffic paints was used where it was relevant Recommended airfield marking practices to provide practical information to people responsible for airfield marking are summarized While currently used airfield marking practices are considered adequate improved materials and/or methods may significantly reduce maintenance costs and may be necessary for more restrictive regulations that are anticipated
S E S

N79-17877# National Aviation Facilities Experimental Center Atlantic City N J
SURVEY OF RADAR SIMULATION TRAINING AT ATC FIELD FACILITIES Final Report, Jun 1977 - Mar 1978
Stephen Karovic and Theodore Rundall Sep 1978 51 p refs
(FAA Proj 216-103-100)
(FAA-NA-78-27 FAA-RD-78-77) Avail NTIS HC A04/MF A01
The results of a system-wide review of the current air traffic control enroute and terminal radar simulation training capability are discussed Teams of air traffic controllers from NAFEC and from the field with engineering support visited 10 en route air traffic control centers and 17 terminals equipped with Automated Radar Terminal Systems (ARTS) Training personnel from three other ARTS facilities were interviewed It was found that the field simulation systems although originally designed only as software checkout tools now provide the field facilities with a radar training capability far surpassing that previously possible Despite the generally wide acceptance and acclaim given this new capability shortcomings were uncovered which limit the training effectiveness and full utilization of the system These shortcomings including problems with equipment software staffing etc are identified and discussed Specific recommendations are made for the purpose of enhancing air traffic control radar simulation training in field facilities including software modifications increased staffing improved communications and in terminals an increased number of displays
Author

N79-17878# Federal Aviation Agency Palmdale Calif
RUNWAY SURFACE CONDITION SENSOR
6 Nov 1978 6 p
(AC-150/5220-13) Avail NTIS HC A02/MF A01
Methods for predicting and detecting pavement surface ice formation are considered Equipment design and performance specifications selection of sensors and installation of sensors are discussed
J M S

N79-17879# Air Force Inst of Tech Wright-Patterson AFB Ohio
DEVELOPMENT OF SMART TARGET FOR SIMULATION OF ONE-ON-ONE AIR-TO-AIR COMBAT M S Thesis
Dennis A Leuthauser Mar 1978 166 p refs
(AD-A056739 AFIT/GAE/AA/78M-7) Avail NTIS HC A08/MF A01 CSCL 15/7

The feasibility of using an adaptive maneuvering target for air-to-air combat simulation in the large amplitude multimode aerospace research simulator was investigated A computer program was developed which enabled the target to make tactical decisions based on aircraft states make variations in decision parameters corresponding to differences in pilots and provide control inputs to fly actual air combat maneuvers Validation of the simulated target was accomplished by numerous test runs to ensure that simulated maneuvers were realistic and that continuity between mameuvers at different pilot skill levels was valid Author

N79-17880# Technische Hogeschool Delft (Netherlands) Dept of Aerospace Engineering
TWO-SEGMENT APPROACH INVESTIGATION ON A MOVING-BASE PILOTED FLIGHT SIMULATOR
G Bekebrede and M Baarspul Apr 1978 111 p refs
(VTH-LR-250) Avail NTIS HC A06/MF A01

The objectives of the study were to investigate the influences of the following qualitative variables on the accuracy of the landing approach and on the pilot workload (1) the influence of the approach profile (2) the influence of atmospheric and (3) the influence of lateral autopilot control Regression analysis was applied to the recorded data as well as to the pilot-ratings obtained after each run The results of the analysis indicate that the glide slope configuration the presence of atmospheric turbulence and applied automatic lateral control do have significant influences on the pilot s actions and on the pilot ratings Noise contours demonstrating possible noise reductions as a consequence of the two-segment noise abatement approaches are presented For the two-segment approaches the sound pressure level can be significantly reduced depending on the observers location At respectively 6 n mi and 3 5 n mi from touchdown at the vertical projection of the flightpath the sound pressure level reductions amount to 11 PNdb and 7 PNdb respectively L S

N79-17966# National Aviation Facilities Experimental Center Atlantic City N J
POOL FIRE RADIATION THROUGH A DOOR IN A SIMULATED AIRCRAFT FUSELAGE Final Report, Aug - Dec 1977
Thor I Eklund Dec 1978 44 p refs Original contains color illustrations
(FAA Proj 181-521-000)
(FAA-NA-78-38 FAA-RD-78-135) Avail NTIS HC A03/MF A01

Small-scale methods of simulating postcrash fuel spill fires adjacent to fuselage open doors are evaluated Pool fires in a quiescent environment were scaled down and their radiant heat transfer through fuselage doorways evaluated Steel ducts of 1, 2 3 and 4 foot diameter were employed as models Analytic solutions to radiative transfer equations were developed and matched with the experimental heat fluxes at two locations within each model The analysis demonstrates that the doorway can be treated as a radiating black body surface of 1 874 F, and that heat fluxes to other areas around the doorway can be calculated A comparison of heat flux to the model exterior was compared with existing full-scale fire test data G Y

N79-18012# National Aerospace Lab Amsterdam (Netherlands) Structures and Materials Div
ENVIRONMENTAL EFFECTS ON CRACK GROWTH IN FLIGHT-SIMULATION TESTS ON 2024-T3 AND 7075-T6 MATERIAL
J Schijve F A Jacobs and P J Tromp 13 Jul 1978 57 p refs
(Contract NIVR-1725)
(NLR-TR-76104-U) Avail NTIS HC A04/MF A01

Flight-simulation tests based on a standardized gust load spectrum were carried out in normal air very dry air and salt water Specimen thicknessess were t = 2 mm and t = 10 mm mean stress in flight was 70 or 55 MN/sq m In all cases a significant effect of the environment was found Fatigue lives for t = 10 mm were much shorter than for t = 2 mm The more severe flights caused noticeable crack growth delays thus having a predominant effect on crack growth Technical implications of the test results are discussed Author

N79-18057*# Union Carbide Corp Tonawanda N Y
STUDY OF HYDROGEN RECOVERY SYSTEMS FOR GAS VENTED WHILE REFUELING LIQUID-HYDROGEN FUELED AIRCRAFT
C R Baker Feb 1979 70 p refs
(Contract NAS1-14698)
(NASA-CR-158991) Avail NTIS HC A04/MF A01 CSCL 21P

Methods of capturing and reliquefying the cold hydrogen vapor produced during the fueling of aircraft designed to utilize liquid hydrogen fuel were investigated An assessment of the most practical economic and energy efficient of the hydrogen recovery methods is provided S E S

N79-18074*# Little (Arthur D) Inc Cambridge Mass
AN ASSESSMENT OF THE RISKS PRESENTED BY THE USE OF CARBON FIBER COMPOSITES IN COMMERCIAL AVIATION VOLUME 1 FINAL REPORT VOLUME 2 SUPPORTING APPENDICES Final Report
Ashok S Kalelkar Joseph Fiksel Phani P K Raj and Donald B Rosenfield Jan 1979 426 p refs
(Contract NAS1-15380)
(NASA CR-158989) Avail NTIS HC A19/MF A01 CSCL 12B

Carbon fiber (CF) composites are being used to an increasing extent in commercial aircraft due to their excellent structural properties Since carbon fibers are highly conductive a potential risk was identified in the event that an aircraft with CF composite structures is involved in an accidental fire If carbon fibers are released from the fire they could disperse in the atmosphere and eventually cause damaging short circuits in electronic equipment at remote locations This phenomenon could conceivably result in economic losses The purpose of this study was to assess the risks presented to the nation as a whole by the use of CF composites in commercial aircraft in terms of the potential economic losses from air carrier accidents

N79-18075*# Little (Arthur D) Inc Cambridge Mass
AN ASSESSMENT OF THE RISKS PRESENTED BY THE USE OF CARBON FIBER COMPOSITES IN COMMERCIAL AVIATION EXECUTIVE SUMMARY
In its An Assessment of the Risks Presented by the Use of Carbon Fiber Composites in Com Aviation Jan 1979 p 1-24

Avail NTIS HC A19/MF A01 CSCL 12B

To support the investigation experimental data from a number of different sources were used including tests of carbon fibers (CF) release from burning composites and vulnerability tests for selected equipment Field survey were conducted in the vincinity of several major airports in order to characterize the types of facilities that might be exposed to CF releases Census data were employed to enumerate the number of residential and commercial establishments in the vicinity of the 26 large hub airports These data formed part of the input to a risk simulation model which produced a conditional risk profile showing the probability of different amounts of loss given that an accidental release of CF has occurred A national risk profile was developed which estimates the annual losses due to CF usage in commercial aircraft based upon the anticipated usage in 1993 G Y

N79-18076*# Little (Arthur D) Inc Cambridge Mass
OVERVIEW OF THE CARBON FIBER PROBLEM
In its An Assessment of the Risks Presented by the Use of

Carbon Fiber Composites in Com Aviation Jan 1979 p 25-41 refs
Avail NTIS HC A19/MF A01 CSCL 13L

Carbon fibers (CF) composite structures are being utilized more as alternatives to metals in both civilian and military applications They are valued for their light weight and high strength as well as for their ease of designing structures with specific shapes and sizes However a problem may exist due to the high conductivity of CF CF are manufactured from a precursor material which is subjected to great stress and heat treatment causing a change in the physical and electrical properties The fibers are bound together by a matrix of epoxy In the event of fire (aircraft accident) the epoxy would burn away releasing these fibers into the atmosphere When these fibers come in contact with electronic equipment they might cause damage to by settling on electrical junctions An overview is given of the objectives for a study and the approach and methodology developed for determination of risk profiles G Y

N79-18078*# Little (Arthur D) Inc Cambridge Mass
PROBABILISTIC ANALYSIS OF AIR CARRIER ACCIDENTS
In its An Assessment of the Risks Presented by the Use of Carbon Fiber Composites in Com Aviation Jan 1979 p 61-90 refs
Avail NTIS HC A19/MF A01 CSCL 13L

In order to estimate the potential risks due to carbon fibers (CF) released from aircraft accidents it was necessary to quantify the probability of an accident or incident at a major hub airport This probability was contingent upon various conditions surrounding the incident including the phase of operation aircraft type and the weather conditions The type of accident predicted was categorized according to its location relative to the runway and the severity of damage sustained The methodology utilized to estimate the probability of a specific type of accident is outlined and the various models that were developed in the course of this work are described G Y

N79-18079*# Little (Arthur D) Inc Cambridge Mass
CARBON FIBER RELEASE CONDITIONS
In its An Assessment of the Risks Presented by the Use of Carbon Fiber Composites in Com Aviation Jan 1979 p 91-100 refs
Avail NTIS HC A19/MF A01 CSCL 13L

The methodology and data sources analyzed to determine the carbon fiber release scenarios for aircraft accidents are presented The scenarios consisted of a set of probability distributions for each of the variables judged to have impact on carbon dispersion and economic loss Most of the distributions were independent of each other but some were correlated The set of probability distributions for all of the variables considered was used as input to a risk simulation Because of this simulation approach unique scenarios that encompassed a whole set of variables were not identified rather the emphasis was on a distribution for each individual variable G Y

N79-18080*# Little (Arthur D) Inc Cambridge Mass
CARBON FIBER DISPERSION MODELS USED FOR RISK ANALYSIS CALCULATIONS
In its An Assessment of the Risks Presented by the Use of Carbon Fiber Composites in Com Aviation Jan 1979 p 101-124

Avail NTIS HC A19/MF A01 CSCL 13L

For evaluating the downwind ground level exposure contours from carbon fiber dispersion two fiber release scenarios were chosen The first is the fire and explosion release in which all of the fibers are released instantaneously This model applies to accident scenarios where an explosion follows a short-duration fire in the aftermath of the accident The second is the plume release scenario in which the total mass of fibers is released into the fire plume This model applies to aircraft accidents where only a fire results These models are described in detail G Y

N79-18083*# Little (Arthur D) Inc Cambridge Mass
ESTIMATION OF ECONOMIC LOSSES
In its An Assessment of the Risks Presented by the Use of Carbon Fiber Composites in Com Aviation Jan 1979 p 160-177 refs
Avail NTIS HC A19/MF A01 CSCL 05C

If the concentration of carbon fibers (CF) is high after their dispersion due to an aircraft fire there is a significant possibility that a number of residential commercial and industrial establishments might be affected by electronic equipment failure Estimating economic losses from CF release involves characterizing an entire spectrum of buildings and electronic equipment within a given community A number of simplified assumptions were made to reduce the data collection requirements to manageable proportions A limited number of facility categories were identified and assumed to be relatively homogeneous The detailed examination of potential losses on an industry-by-industry basis is an important area for future investigation G Y

N79-18084*# Little (Arthur D) Inc Cambridge Mass
MONTE CARLO SIMULATION OF SINGLE ACCIDENT AIRPORT RISK PROFILE
In its An Assessment of the Risks Presented by the Use of Carbon Fiber Composites in Com Aviation Jan 1979 p 178-192 refs
Avail NTIS HC A19/MF A01 CSCL 12A

A computer simulation model was developed for estimating the potential economic impacts of a carbon fiber release upon facilities within an 80 kilometer radius of a major airport The model simulated the possible range of release conditions and the resulting dispersion of the carbon fibers Each iteration of the model generated a specific release scenario which would cause a specific amount of dollar loss to the surrounding community By repeated iterations a risk profile was generated showing the probability distribution of losses from one accident Using accident probability estimates the risks profile for annual losses was derived The mechanics are described of the simulation model the required input data and the risk profiles generated for the 26 large hub airports G Y

N79-18085*# Little (Arthur D) Inc Cambridge Mass
SYNTHESIS OF NATIONAL RISK PROFILE
In its An Assessment of the Risks Presented by the Use of Carbon Fiber Composites in Com Aviation Jan 1979 p 193-216 refs
Avail NTIS HC A19/MF A01 CSCL 12B

The methodology used and results obtained in computing the national risk profile for carbon fibers (CF) released after an aircraft accident (fire or explosion) are presented The computation was performed by use of twenty-six individual conditional risk profiles together with the extrapolation of these profiles to other U S airports The risk profile was obtained using 1993 CF utilization forecasts but numbers of facilities were taken from 1972 and 1975 census data while losses were expressed in 1977 dollars G Y

N79-18086*# Little (Arthur D) Inc Cambridge Mass
INTERPRETATION OF RESULTS
In its An Assessment of the Risks Presented by the Use of Carbon Fiber Composites in Com Aviation Jan 1979 p 217-232 refs
Avail NTIS HC A19/MF A01 CSCL 12B

An analysis of the risks to the nation which may arise due to carbon fiber release from air carrier accidents was presented The purpose of this report is to place these risks in perspective by examining their implications for society as a whole Some additional aspects of risk estimation which were not dealt with by simulation modeling approach are addressed and open issues which may require further study are indicated G Y

N79-18115# Communications Research Centre Ottawa (Ontario) Dept of Communications
THE SEARCH AND RESCUE SATELLITE (SARSAT) SYSTEM PROJECT
H L Werstiuk and A E Winter *In* AGARD Operational Modelling of the Aerospace Propagation Environ Vol 1 and 2 Nov 1978 12 p refs
Avail NTIS HC A99/MF A01

The application of satellite technology as an aid to search and rescue (SAR) was studied The work included examination

of SAR requirements and the investigation of various system concepts culminating in proof-of-concept experiments using the AMSAT OSCAR satellites during 1975 and 1976 In the experiments signals from simulated Emergency Locator Transmitters (ELTs) were received by the polar-orbiting OSCAR 6 satellite and relayed to a ground station at the Communications Research Centre (CRC) By the processing of Doppler information contained in this relayed signal the position of the ELT could be determined with an accuracy of 5-15 km The experimental techniques and earlier results obtained in the program are described J M S

N79-18156# Federal Aviation Administration Washington D C
SHORT RANGE TERMINAL RADAR (SRTR) DEFINITION STUDY Final Report, Oct 1974 - Oct 1975
Sep 1978 138 p refs Prepared in cooperation with APL Laurel Md Lincoln Lab MIT and MITRE Corp McLean Va (FAA Proj 023-241)
(FAA-RD-78-64) Avail NTIS HC A07/MF A01

The operational requirements developed for the SRTR include coverage on a small aircraft (one square meter radar cross section) out to 16 nautical miles up to 10 000 feet altitude and in an environment of precipitation clutter ground clutter angle clutter, and anomalous propagation The MTBF goal is 500 hours and the MTTR goal is one hour Using these operational requirements candidate radar systems were defined at three frequencies L-band (1250 - 1350 MHz), S-band (2700 -2900 MHz) and S prime-band (3500 - 3700 MHz) The recommended SRTR system is the S prime-band system (3500 - 3700 MHz) and has the following characteristics azimuth beamwidth of 3 4 deg pulse width of 2 usecs PRF of 2000 pps (average) instrumented range of 32 nautical miles and a data rate of 4 sec M M

N79-18229# Air Force Flight Dynamics Lab Wright-Patterson AFB Ohio Atmospheric Electricity Hazards Group
EVALUATION OF THE RYAN STORMSCOPE AS A SEVERE WEATHER AVOIDANCE SYSTEM FOR AIRCRAFT Preliminary Report
Timothy J Seymour and Robert K Baum *In* Florida Inst of Technol FAA-Florida Inst of Technol Workshop on Grounding and Lightning Technol Mar 1978 p 29-35 refs

Avail NTIS HC A08/MF A01

The Ryan Stormscope was evaluated for use as a severe weather avoidance system for aircraft An instrumented T-39B aircraft was flown in the vicinity of thunderstorm activity while displays of the Stormscope and onboard weather radar were documented photographically The coordinates of the Stormscope display points and their acquisition times were interfaced to an onboard computer system for post-flight data reduction and comparison with the ground-based LDAR system Preliminary analysis of the data shows that Stormscope exhibits reasonably good correlation with weather radar precipitation contours Stormscope does not exhibit the tight clustering of data points characteristic of the groundbased LDAR system a result which is attributed to inaccuracies in the Stormscope ranging system Author

N79-18237# Lightning and Transients Research Inst St Paul Minn
AN RF COMPATIBLE LIGHTNING DIVERTER STRIP
John Robb Jay Cline (Dayton-Granger Aviation Inc) John Raney (Dayton-Granger Aviation Inc) and J Dunn (US Air Force Eglin AFB) *In* Florida Inst of Technol FAA-Florida Inst of Technol Workshop on Grounding and Lightning Technol Mar 1979 p 91-95
Avail NTIS HC A08/MF A01

Airborne and Ground Radome Lightning protection with superior RF characteristics is discussed Dayton-Granger STRIKEGUARD is examined along with a presentation of laboratory test data Additional material is presented describing major thunderstorm penetrations by USAF L S

N79-18238# Air Force Flight Dynamics Lab Wright-Patterson AFB Ohio Atmospheric Electricity Hazards Group
PROTECTION/HARDENING OF AIRCRAFT ELECTRONIC SYSTEMS AGAINST THE INDIRECT EFFECTS OF LIGHTNING
John C Corbin Jr *In* Florida Inst of Technol FAA-Florida Inst of Technol Workshop on Grounding and Lightning Technol Mar 1979 p 97-103 refs

Avail NTIS HC A08/MF A01

A number of different approaches which can be applied to protect or harden aircraft and their electronic systems against the indirect effects of lightning are discussed in this paper The basic approaches include (1) hardening the external structure to prevent or greatly reduce the penetration of rf energy into the aircraft (2) shielding equipment and cables (3) hardening electronic circuits and (4) combinations of all three The use of filters limiters circuit design and functional hardening are described as techniques which can be applied for protecting electronic circuits A systems approach is recommended for achieving an optimum hardened configuration Author

N79-18242# Grumman Aerospace Corp Bethpage N Y
INDUCED EFFECTS OF LIGHTNING ON AN ALL COMPOSITE AIRCRAFT
R A Perala (Mission Research Corp) K Lee (Mission Research Corp) and R Cook (Mission Research Corp) *In* Florida Inst of Technol FAA-Florida Inst of Technol Workshop on Grounding and Lightning Technol Mar 1979 p 127-131 refs

(Contract F33615-77-C 5169)
Avail NTIS HC A08/MF A01

Results are presented for lightning induced cable currents and voltages on typical cable runs inside an all composite aircraft Both a direct stroke and a nearby stroke are considered Results are also given for the case in which the aircraft is coated with 6-mil aluminum flame spray It is shown that as expected the direct stroke induces the largest voltages but the effects of the nearby strike are not negligible Author

N79-18246# Lightning Technologies Inc Pittsfield Mass
A NEW STANDARD FOR LIGHTNING QUALIFICATION TESTING OF AIRCRAFT TECHNICAL OVERVIEW, DEFINITIONS AND BASIC WAVEFORMS
J Anderson Plumer *In* Florida Inst of Technol FAA-Florida Inst of Technol Workshop on Grounding and Lightning Technol Mar 1979 p 155-163 refs

Avail NTIS HC A08/MF A01

In an effort to provide widely accepted criteria representative of a severe environment Society of Automotive Engineers Committee AE4-L (on lightning) and a similar group in UK prepared documents defining lightning waveforms and testing techniques for aerospace vehicles and hardware Agreement exists on the criteria to be employed for qualification testing and the U S Committee has drafted a U S military standard for lightning qualification testing based on this criteria This paper summarizes the scope lightning strike zone definitions and test waveforms presented in the draft standard L S

N79-18274# Tuebingen Univ (West Germany)
ELECTRIC CHARGING OF HELICOPTERS [ELEKTRISCHE AUFLADUNG VON HUBSCHRAUBERN]
R Muehleisen and H J Fischer Bonn DOKZENTBW 1978 76 p refs In GERMAN ENGLISH summary Sponsored by Bundesmin fuer Verteidigung
(BMVG-FBWT-78-7) Avail NTIS HC A05/MF A01 DOKZENTBW DM 30

In order to improve aircraft safety and reduce accidents electrical measurements were made on UH 1D and CH 53 helicopters to determine charging in the atmospheric electric field charging by exhaust gases and charging from external forces such as precipitation and dust The electric discharger mounted on the CH 53 helicopter is helpful only during fine weather but not in the cases of high field strength An improved method for discharging is recommended A R H

N79-18284*# National Aeronautics and Space Administration Langley Research Center Hampton Va
PRESSURE AND HEAT-TRANSFER DISTRIBUTIONS IN A SIMULATED WING-ELEVON COVE WITH VARIABLE LEAKAGE AT A FREE-STREAM MACH NUMBER OF 6 9

William D Deveikis and Whitney Bartlett Dec 1978 53 p refs
(NASA-TM-74095 L-12591) Avail NTIS HC A04/MF A01 CSCL 20D

An experimental aerodynamic heating investigation was conducted to determine effects of hot boundary-layer ingestion into the cove on the windward surface between a wing and elevon for cove seal leak areas nominally between 0 and 100 percent of cove entrance area Pressure and heating-rate distributions were obtained on the wing and elevon surfaces and on the cove walls of a full-scale model that represented a section of the cove region on the space shuttle orbiter Data were obtained for both attached and separated turbulent boundary layers upstream of the unswept cove entrance Average free-stream Mach number was 6 9 average free-stream unit Reynolds numbers were 1 31 x 10 to the 6th power and 4 40 x 10 to the 6th power per meter (0 40 x 10 to the 6th power and 1 34 x 10 to the 6th power per foot) and average total temperature was 1888 K (3400 R) Cove pressures and heating rates varied as a function of seal leak area independent of leak aspect ratio Although cove heating rates for attached flow did not appear intolerable it was postulated that convective heating in the cove may increase with time For separated flow the cove environment was considered too severe for unprotected interior structures of control surfaces Author

N79-18286*# Northrop Corporate Labs Hawthorne Calif
A WATER TUNNEL FLOW VISUALIZATION STUDY OF THE F-15 Final Report
Dale J Lorincz Dec 1978 96 p refs
(Contract NAS4-2526)
(NASA-CR-144878 NOR-78-176) Avail NTIS HC A05/MF A01 CSCL 20D

Water tunnel studies were performed to qualitatively define the flow field of the F-15 aircraft Two lengthened forebodies one with a modified cross-sectional shape were tested in addition to the basic forebody Particular emphasis was placed on defining vortex flows generated at high angles of attack The flow visualization tests were conducted in the Northrop diagnostic water tunnel using a 1/48-scale model of the F-15 Flow visualization pictures were obtained over an angle-of-attack range to 55 deg and sideslip angles up to 10 deg The basic aircraft configuration was investigated in detail to determine the vortex flow field development vortex path and vortex breakdown characteristics as a function of angle of attack and sideslip Additional tests showed that the wing upper surface vortex flow fields were sensitive to variations in inlet mass flow ratio and inlet cowl deflection angle Asymmetries in the vortex systems generated by each of the three forebodies were observed in the water tunnel at zero sideslip and high angles of attack F O S

N79-18296* National Aeronautics and Space Administration Langley Research Center Hampton Va
APPARATUS FOR MEASURING AN AIRCRAFT'S SPEED AND HEIGHT Patent
William R Young and Charles W Stump inventors (to NASA) Issued 23 Jan 1979 7 p Filed 9 Mar 1978 Supersedes N78-22115 (16 - 13 p 1667)
(NASA-Case-LAR-12275-1 US-Patent-4 135 817
US-Patent-Appl-SN-885065 US-Patent-Class-356-28
US-Patent-Class-358-107) Avail US Patent and Trademark Office CSCL 14B

An apparatus for measuring aircraft horizontal speed and height above ground without the need for airborne cooperative devices is presented Two ground level TV cameras separated by a measured distance and pointed at zenith are placed in line with the projection of the expected path of the aircraft Speed is determined by measuring the time that it takes the aircraft to travel between the fields of view of the two TV cameras using zenith crossings as the reference points Height is determined by correlating the speed with the time required to cross the field of view of either of the two cameras

Official Gazette of the U S Patent and Trademark Office

N79-18318* National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
COMPOSITE SEAL FOR TURBOMACHINERY Patent
Robert C Bill and Lawrence P Ludwig inventors (to NASA) Issued 23 Jan 1979 5 p Filed 27 May 1977 Supersedes N77-24498 (15 - 15 p 1999)
(NASA-Case-LEW-12131-1 US-Patent-4 135 851
US-Patent-Appl-SN-801290 US-Patent-Class-415-174
US-Patent-Class-415-200) Avail US Patent and Trademark Office CSCL 11A

A gas path seal suitable for use with a turbine engine or compressor is provided A shroud wearable or abradable by the abrasion of the rotor blades of the turbine or compressor protects the rotor blades A compliant backing surrounds the shroud The backing may be made of corrugated sheets or the like with adjacent layers having off-set corrugations with axes of the folds parallel to the rotor axis The sheets may be bonded together at points of contact by brazing welding or the like In another embodiment a compliant material is covered with a thin ductile layer A mounting fixture surrounds the backing

Official Gazette of the U S Patent and Trademark Office

N79-18320*# Lockheed-California Co Burbank Advanced Development Projects Div
FABRICATION AND EVALUATION OF ADVANCED TITANIUM STRUCTURAL PANELS FOR SUPERSONIC CRUISE AIRCRAFT
L Payne Washington NASA Mar 1977 80 p refs Film supplements L1204 and L1205 to this report are available on loan from National Aeronautics and Space Administration Langley Research Center Hampton Va 23665
(NASA-CR-2744 SP-4508) Avail NTIS HC A05/MF A01 CSCL 01C

Flightworthy primary structural panels were designed fabricated and tested to investigate two advanced fabrication methods for titanium alloys Skin-stringer panels fabricated using the weldbraze process and honeycomb-core sandwich panels fabricated using a diffusion bonding process were designed to replace an existing integrally stiffened shear panel on the upper wing surface of the NASA YF-12 research aircraft The investigation included ground testing and Mach 3 flight testing of full-scale panels and laboratory testing of representative structural element specimens Test results obtained on full-scale panels and structural element specimens indicate that both of the fabrication methods investigated are suitable for primary structural applications on future civil and military supersonic cruise aircraft A R H

N79-18470 British Library Lending Div Boston Spa (England)
AERODYNAMIC BEHAVIOR OF FIBRES AND SAMPLING OF RESPIRABLE DUST
W Walkenhorst Jul 1978 20 p refs Transl into ENGLISH from Staub Reinhaltung der Luft (West Germany) v 37 no 9 1977 p 323-328
(BLL-RTS-11267) Avail British Library Lending Div Boston Spa Engl

Straight fibers of the same size have different aerodynamic diameters according to the sedimentation direction In inclined positions the sedimentation and effective force no longer coincide in direction In shear flow the fibers may perform a gyratory motion or their longitudinal axis can set itself practically in the flow direction Bent fibers mostly present in actual cases perform rotational motion in shear flow A mean value of the aerodynamic diameter therefore sets in In respiratory passages the fibers are deposited according to their aerodynamic diameters In addition to this a blocking effect plays a role primarily for bent fibers A pre-elutriator with sheet stack is proposed and gives to the blocking effect G Y

N79-18475# Argonne National Lab Ill
AIRPORT VICINITY AIR POLLUTION MODEL ABBREVIATED VERSION USER'S GUIDE Final Report
L A Conley and D M Rote Sep 1978 126 p refs
(Contract DOT-FA71WAI-223)
(FAA-RD-78-111) Avail NTIS HC A07/MF A01

A discussion of the theoretical considerations fundamental to the Airport Vicinity Air Pollution Model Abbreviated Version as well as program flow diagrams essential to understanding the theory is presented Required sequential card data input to the program is illustrated along with substitution options for program constants Additionally an example problem and a program listing are provided G Y

N79-18686*# National Aeronautics and Space Administration Langley Research Center Hampton Va
APPLICATIONS OF DIFFRACTION THEORY TO AERO-ACOUSTICS
Donald L Lansing Liu Chen-Huei and Thomas D Norum Jan 1979 14 p refs To be presented at the VKI/AGARD Special Course Brussels 28 May 1979 1 Jun 1979
(NASA-TM-80053) Avail NTIS HC A02/MF A01 CSCL 20A

A review is given of the fundamentals of diffraction theory and the application of the theory to several problems of aircraft noise generation propagation and measurement The general acoustic diffraction problem is defined and the governing equations set down Diffraction phenomena are illustrated using the classical problem of the diffraction of a plane wave by a half-plane Infinite series and geometric acoustic methods for solving diffraction problems are described Four applications of diffraction theory are discussed the selection of an appropriate shape for a microphone the use of aircraft wings to shield the community from engine noise the reflection of engine noise from an aircraft fuselage and the radiation of trailing edge noise L S

N79-18687*# National Aeronautics and Space Administration Langley Research Center Hampton Va
VARIABILITY OF ANNOYANCE RESPONSE DUE TO AIRCRAFT NOISE
Thomas K Dempsey and Jimmy M Cawthorn Mar 1979 77 p refs
(NASA-TP-1335 L-12483) Avail NTIS HC A05/MF A01 CSCL 20A

An investigation was conducted to study the variability in the response of subjects participating in noise experiments This paper presents a description of a model developed to include this variability which incorporates an aircraft-noise adaptation level or an annoyance calibration for each individual The results indicate that the use of an aircraft-noise adaption level improved prediction accuracy of annoyance responses (and simultaneously reduced response variation) Author

N79-18799# Federal Aviation Administration Washington D C
HELICOPTER OPERATIONS DEVELOPMENT PLAN
Sep 1978 116 p
(FAA-RD-78-101 PAR-517-78) Avail NTIS HC A06/MF A01

The Helicopter Operations Development Plan is designed to provide for upgrading and development of all those criteria standards procedures systems and regulatory activities which will allow safe timely and economical integration of the helicopter into all-weather operations in the National Airspace System It describes a five-year development program whose objective is to improve the National Airspace System so as to enable helicopters to employ their unique capabilities These areas are covered in the plan (1) IFR Helicopter Operations (2) Navigation Systems Development (3) Communication Systems Development, (4) Helicopter Air-Traffic Control (5) Weather Environment (6) All-Weather Heliport Development (7) IFR Helicopter Certification Standards (8) Helicopter Icing Standards (9) Helicopter Crashworthiness and (10) Helicopter Noise Characterization The FAA groups other Federal Government agencies and other organizations participating in this effort are identified Program management responsibilities are addressed A program schedule with milestones is presented and program funding requirements are identified L S

N79-18886# General Dynamics Corp San Diego Calif
F-16 HIGH ANGLE OF ATTACK TESTING
Philip F Oestricher and Robert C Ettinger (AFFTC Edwards AFB Calif) *In* SETP SETP Tech Rev Vol 14 No 2 1979 p 1-10
Avail NTIS HC A10/MF A01

A fly-by-wire flight control system is developed to allow a fighter pilot the maneuverability of reckless abandon Vigorous air combat maneuvering without the concern of maintaining the aircraft was proved Ballistic flight and full lateral stick rolls were examined The angle of attack and structural limiting features were found to provide protection in air combat maneuvering S E S

N79-18888# McDonnell-Douglas Corp, St Louis Mo
F-18 STATUS REPORT
John E Krings *In* SETP SETP Tech Rev Vol 14 No 2 1979 p 21-25
Avail NTIS HC A10/MF A01

The entire F-18 program including the design of the cockpit displays weapon system integration and approach configuration is outlined Fly-by-wire digital system of the F-18 is described Aerodynamic refinements were finalized in flight simulations S E S

N79-18889# Israeli Air Force Zahal
FLIGHT TESTING THE KFIR
Yitzhak Peer *In* SETP SETP Tech Rev Vol 14 No 2 1979 p 26-37
Avail NTIS HC A10/MF A01

The canard concept to improve the supersonic maneuvering of the Mirage 3 aircraft is developed This test program included redesign of the cockpit integration of modern weapons delivery system with headup display the improvement of the flight control system and aerodynamic configurations modification design An engine for greater combat maneuvers was examined S E S

N79-18890# Rockwell International Corp Canoga Park Calif Collins Avionics and Missiles Group
COCKPIT MANAGEMENT
C I Rice *In* SETP SETP Tech Rev Vol 14 No 2 1979 p 39-42
Avail NTIS HC A10/MF A01

A challenge to avionic manufacturers airframe manufacturers, and test pilots is presented Cockpit management in general aviation air transport, and military aircraft are discussed S E S

N79-18891# Garrett Corp Torrance Calif
SMALL FAN-JET ENGINES
Ivan E Speer *In* SETP SETP Tech Rev Vol 14 No 2 1979 p 43-51
Avail NTIS HC A10/MF A01

The changes from straight jets to medium bypass fans in business aircraft power plants are presented The cycle for business aircraft at higher altitudes is discussed The changes to the fan engine to improve fuel consumption reduce weight increase reliability and durability and reduce noise are described S E S

N79-18892# NCR Corp, Los Angeles, Calif
CORPORATE AVIATION IN THE 1980'S
Donald T Keeley *In* SETP SETP Tech Rev Vol 14 No 2 1979 p 52-56
Avail NTIS HC A10/MF A01

The problems of corporate aviation and corporate aircraft are discussed The planned environment of the airline pilots commuter pilots, military pilots, and test pilots was studied S E S

N79-18893# Cincinnati Univ Ohio
THE LEARJET LONGHORN SERIES THE FIRST JETS WITH WINGLETS
Neil A Armstrong and Peter T Reynolds (Gates Learjet Corp) *In* SETP SETP Tech Rev Vol 14 No 2 1979 p 57-66 refs
Avail NTIS HC A10/MF A01

The Gates Learjet Model 28 is described following the first test flight The cruise fuel flow is increased and the takeoff and landing performance is improved The cruise fuel flow reductions are the result of several factors (1) the aircraft can operate at higher altitudes due to the added wing area (2) for the same payload and range the takeoff weight will be lower because less mission fuel is required, and (3) drag is reduced by removing the tip tanks increasing the aspect ratio and adding the winglets S E S

N79-18894*# National Aeronautics and Space Administration Langley Research Center Hampton, Va
FLYING NASA'S TERMINAL CONFIGURED VEHICLE AGAINST THE MICROWAVE LANDING SYSTEM
Lee H Person, Jr and Kenneth R Yenni *In* SETP SETP Tech Rev , Vol 14, No 2 1979 p 110-123

Avail NTIS HC A10/MF A01 CSCL 01C
Technology for advanced airborne systems and flight procedures to improve terminal-area operations in ATC environment is developed The terminal configured vehicle (TCV) aircraft, its integrated digital electronic displays and flight controls, and how the pilot interfaces with the aircraft to fly precise curved descending approaches using Microwave Landing System (MLS) guidance are discussed S E S

N79-18895# Lockheed Aircraft Corp Burbank, Calif
DEVELOPMENT OF THE L-1011 FLIGHT MANAGEMENT SYSTEM
Donald A Moor *In* SETP SETP Tech Rev , Vol 14 No 2 1979 p 124-134
Avail NTIS HC A10/MF A01
The Lockheed/Army Flight Management System is described in preparation to make present and future generations more efficient A means for automatic precise control of aircraft speeds and engine thrust during climb cruise and descent, full time performance management in areas of near neutral speed-thrust stability, reducing crew workload and offering a large potential for fuel savings are discussed S E S

N79-18896# Boeing Co Seattle Wash
THE CONTINUITY FACTOR IN AIRCRAFT DEVELOPMENT

A M Johnston *In* SETP SETP Tech Rev Vol 14, No 2 1979 p 135-145
Avail NTIS HC A10/MF A01
The continuity factor is the respective sequential application of tested and desirable and undesirable technologies Vehicle models are studied to indicate when the continuity factor is appropriately applied and the respective product excels S E S

N79-18897# Rockwell International Corp Canoga Park Calif
XF4D SKYRAY DEVELOPMENT NOW IT CAN BE TOLD
Robert O Rahn *In* SETP SETP Tech Rev Vol 14, No 2 1979 p 147-161
Avail NTIS HC A10/MF A01
The XF4D is a single-place low aspect ratio, delta-wing interceptor-type airplane which is described Primary longitudinal and lateral control is accomplished by use of differentially acting elevons located along the trailing edge of either wing Longitudinal and lateral trim is obtained from trimmers located inboard of the elevons Directional stability and control are obtained from a single swept vertical surface lying in the plane of symmetry The elevons are actuated by a single irreversible power control system with feel for the pilot provided by a system utilizing electrical magnetic clutches Rudder operation by the pilot is by a direct-connected cable system The airplane is equipped with a yaw damper which also actuates the rudder through a servo-system A manual flight control system for the elevons was provided should failure of the power system occur An emergency auxiliary electrically-driven hydraulic pump was added for flight tests A unique four-wheel landing gear was designed which utilized a small retractable tail wheel to absorb the tail loads during high angle of attack landings S E S

N79-18903 Johns Hopkins Univ , Baltimore Md
SOME ASPECTS OF UNSTEADY INSECT AERODYNAMICS ACCELERATION POTENTIAL METHODS IN PLANE UNSTEADY AIRFOIL THEORY, AND MEASUREMENTS OF UNSTEADY-PERIODIC FORCES GENERATED BY THE BLOWFLY Ph.D. Thesis
Richard Hugh Buckholz 1978 363 p
Avail Univ Microfilms Order No 7906436
A simple dynamic force balance was developed and applied to the measurement of the instantaneous lift and drag forces generated by a blowly flying fixed in a wind tunnel The novel force balance was a simple, taut, wire string with fixed ends, the live insect is mounted near the strong midpoint The instantaneous force exerted by the blowfly s thorax on the wire was measured by detection of miniscule wire motion This force was attributed to both wing inertial forces and wing aerodynamic forces Subsequently the former were computed from the kinematics of fly wings as photographed and measured by Nachtigall (1966) The phase relation between the wing kinematics and the streamwise insect forces was measured It was found that the periodic lift and drag forces experienced by the insect s thorax during flapping flight contained a surprisingly small amount of higher harmonics of the wing beating frequency
Dissert Abstr

N79-18909 Iowa State Univ of Science and Technology, Ames
CALCULATION OF SUPERSONIC VISCOUS FLOW OVER DELTA WINGS WITH SHARP SUBSONIC LEADING EDGES Ph D Thesis
Yvon Clovis Vigneron 1978 79 p
Avail Univ Microfilms Order No 7904026
Two complementary procedures were developed to calculate the viscous supersonic flow over conical shapes at large angles of attack with application to cones and delta wings In the first approach, the flow was assumed to be conical and the governing equations were solved at a given Reynolds number with a time-marching explicit finite difference algorithm In the second method the parabolized Navier-Stokes equations were solved with a space-marching implicit noniterative finite difference algorithm This latter approach was not restricted to conical shapes and provided a large improvement in computational efficiency over published methods Results from the two procedures agree very well with each other and with available experimental data
Dissert Abstr

N79-18914*# National Aeronautics and Space Administration, Washington, D C
VORTEX PATTERN DEVELOPMENT ON THE UPPER SURFACE OF A SWEPT WING AT HIGH ANGLE OF ATTACK
J Mirande V Schmitt and H Werle Mar 1979 35 p refs Transl into ENGLISH of Conf paper from ONERA, Paris Presented at AGARD Reunion sur l Aerodynamique des Grandes Incidences Sandefjord, Norway 4-6 Oct 1978 Original language document was announced as A79-18554 Transl by Kanner (Leo) Associates Redwood City Calif
(Contract NASw-3199)
(NASA-TM-75377 ONERA-TP-1978-124, Memoire-12) Avail NTIS HC A03/MF A01 CSCL 01A
An experimental study based on a swept wing, was undertaken in the water tunnel and the wind tunnel at low speeds with a view to improving the understanding of the intervening phenomena and to make easier their modelling The vortex flow effects on the wing are first illustrated from global effort measurements and static pressure distributions The domain of existence of this type of flow is deduced as a function of both sweep angle and angle of attack By a phenomenological study in the water tunnel an attempt is made to describe the physical pattern of the vortex flow from its formation near the apex to its breakdown at the trailing edge Lastly by means of a clinometric probe the flow field over the wing is determined
L S

N79-18915*# National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif
APPROXIMATION CONCEPTS FOR NUMERICAL AIRFOIL OPTIMIZATION

Garret N Vanderplaats Mar 1979 38 p refs
(NASA-TP-1370 A-7682) Avail NTIS HC A03/MF A01 CSCL 01A

An efficient algorithm for airfoil optimization is presented The algorithm utilizes approximation concepts to reduce the number of aerodynamic analyses required to reach the optimum design Examples are presented and compared with previous results Optimization efficiency improvements of more than a factor of 2 are demonstrated Improvements in efficiency are demonstrated when analysis data obtained in previous designs are utilized The method is a general optimization procedure and is not limited to this application The method is intended for application to a wide range of engineering design problems
S E S

N79-18916*# National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif
INERTIAL DYNAMICS OF A GENERAL PURPOSE ROTOR
Ronald W DuVal Mar 1979 34 p refs
(NASA-TM-78557 A-7731) Avail NTIS HC A03/MF A01 CSCL 01A

The inertial dynamics of a fully articulated stiff rotor blade are derived with emphasis on equations that facilitate an organized programming approach for simulation applications The model for the derivation includes hinge offset and six degrees of freedom for the rotor shaft Results are compared with the flapping and lead-lag equations currently used in the Rotor Systems Research Aircraft simulation model and differences are analyzed
Author

N79-18917*# Kansas Univ Center for Research Inc Lawrence Flight Research Lab
ANALYSIS OF SOME AERODYNAMIC CHARACTERISTICS DUE TO WING-JET INTERACTION
Greg L Fillman and C Edward Lan Mar 1979 126 p refs (Grant NsG-1139)
(NASA-CR-158349 CRINC-FRL-281-4) Avail NTIS HC A07/MF A01 CSCL 01A

The results of two separate theoretical investigations are presented A program was used which is capable of predicting the aerodynamic characteristics of both upper-surface blowing (USB) and over-wing blowing (OWB) configurations A theoretical analysis of the effects of over-wing blowing jets on the induced drag of a 50 deg sweep back wing was developed Experiments showed net drag reductions associated with the well known lift enhancement due to over-wing blowing The mechanisms through which this drag reduction is brought about are presented Both jet entrainment and the so called wing-jet interaction play important roles in this process The effects of a rectangular upper-surface blowing jet were examined for a wide variety of planforms The isolated effects of wing taper sweep and aspect ratio variations on the incremental lift due to blowing are presented The effects of wing taper ratio and sweep angle were found to be especially important parameters when considering the relative levels of incremental lift produced by an upper-surface blowing configuration
M M M

N79-18921# Von Karman Inst for Fluid Dynamics, Rhode-Saint-Genese (Belgium)
WINGS
W Stahl *In its* Missile Aerodyn Vol 1 1976 62 p refs

Avail NTIS HC A23/MF A01

Material is presented on low aspect ratio wings to provide an insight into the flow field and to discuss some of the effects of the flow on the wing Experimental evidence as obtained in wind tunnels by various flow visualization techniques and from pressure meaurements made on the model surfaces or in the outer flow are used to help in designing a wing with some desired properties Some results of force measurements are presented to give an idea of the aerodynamic characteristics of such wings A short survey is also given on some of the better known theoretical methods for the prediction of the aerodynamic characteristics of wings Results obtained from some of the theories are compared to the results from experiments
G Y

N79-18925# Messerschmitt-Boelkow-Blohm G m b H Munich (West Germany)
AIRBREATHING ENGINES - AERODYNAMIC ASPECTS
Guenther Jungclaus *In* Von Karman Inst for Fluid Dyn Missile Aerodyn, Vol 1 1976 40 p refs

Avail NTIS HC A23/MF A01

The interrelation between air inlet and the engine and the types of inlet are discussed Air inlet design is discussed with respect to flow modes flow around the cowl mass flow vs pressure relationship starting conditions efficiency definitions and multiple-shock diffusers Some special problems dealing with interference angle of attack and nonstationary flow are presented
G Y

N79-18926# Illinois Univ at Urbana-Champaign Urbana Dept of Mechanical and Industrial Engineering
ANALYSIS OF BASE-FLOW PROBLEMS DURING POWERED SUPERSONIC FLIGHT
A L Addy *In* Von Karman Inst for Fluid Dyn Missile Aerodyn Vol 1 1976 100 p refs

Avail NTIS HC A23/MF A01

At supersonic flight speeds aircraft and missile performance during powered flight can be significantly affected by the separated flow region formed at the base of the vehicle by the interaction between the freestream and propulsive-nozzle flows The proper evaluation of the effects of this separated-flow region the base-flow region is a difficult and recurring problem in aerodynamic design Due to the generality, flexibility and potential for extension the Chapman-Korst component model provides a means for the qualitative and quantitative evaluation of the effect on the afterbody-base problem of all pertinent design and performance parameters The object of these notes is to present the theoretical bases for the generalized Chapman-Korst model, to demonstrate the capabilities and limitations of the model, to compare experimental and theoretical results and, to discuss areas requiring further development
G Y

N79-18933# Hawker Siddeley Dynamics Ltd Hatfield (England) Naval Weapons Div
THE PLACE OF AERODYNAMICS IN THE DESIGN PROCESS
J I Haworth *In* Von Karman Inst for Fluid Dyn Missile Aerodyn Vol 2 1976 143 p

Avail NTIS HC A23/MF A01

The subject of how aerodynamics is dealt with in its practical application to missile design and development is the aim of this lecture An explanation of the main stages involved in the inception and growth of a major project is given and the underlining principles which govern the whole of the design and development work is explained It is shown how the aerodynamic requirements are derived from the overall missile design and performance requirements The steps taken to meet these requirements leading to the specification of the aerodynamic characteristics, and the verification of these, are outlined In general this lecture aims at stating what the aerodynamicist has to do, and why these tasks arise
G Y

N79-18946*# National Aeronautics and Space Administration Ames Research Center, Moffett Field Calif
SOME RECENT PROGRESS IN TRANSONIC FLOW COMPUTATION
William F Ballhaus *In* Von Karman Inst for Fluid Dyn Computational Fluid Dyn Vol 1 1976 122 p refs

Avail NTIS HC A19/MF A01 CSCL 01A

Although the development of a finite difference relaxation procedure to solve the steady form of equations of motion gave birth to the study of computational transonic aerodynamics and considerable progress has been made using the small disturbance theory, no general analytical solution method yet exists for transonic flows that include three dimensional unsteady and

viscous effects Two techniques are described which are useful in computational transonic aerodynamics applications The finite volume method simplifies the application of boundary conditions without introducing the constriction associated with small disturbance theory Governing equations are solved in a Cartesian coordinate system using a body-oriented and shock-oriented mesh network Only the volume and surface normal directions of the volume elements must be known The other method configuration design by numerical optimization, can be used by aircraft designers to develop configurations that satisfy specific geometric performance constraints Two examples of airfoil design by numerical optimization are presented A R H

N79-18951# Dornier-Werke G m b H Friedrichshafen (West Germany) Theoretical Aerodynamics Group
PROGRESS IN TRANSONIC FLOW COMPUTATIONS ANALYSIS AND DESIGN METHODS FOR THREE-DIMENSIONAL FLOWS
Wolfgang Schmidt *In* Von Karman Inst for Fluid Dyn Computational Fluid Dyn Vol 2 1976 56 p refs

Avail NTIS HC A19/MF A01

The difference schemes used for the evaluation of supercritical transonic wings and wing-body combinations at Dornier are described and compared with those used in relaxation methods elsewhere Special attention is given to different assumptions made because of the small perturbation form of the equations A flow chart of the analysis and design system is presented which shows how the use of different blocks minimizes the input information needed The possible procedure to be used in designing a new configuration is illustrated including the proof of the off-design behavior and the check on possible constraints A R H

N79-18956# Boeing Vertol Co Philadelphia, Pa
INTERACTIONAL AERODYNAMICS OF THE SINGLE ROTOR HELICOPTER CONFIGURATION VOLUME 8 FREQUENCY ANALYSES OF WAKE SINGLE FILM DATA, BASIC CONFIGURATION WAKE EXPLORATION Final Report, 15 Mar 1977 - 13 Feb 1978
Philip F Sheridan Sep 1978 482 p refs
(Contract DAAJ02-77-C-0020)
(AD-A062013, USARTL-TR-78-23H-Vol-8) Avail NTIS HC A21/MF A01 CSCL 01/3

This is the second of the three volumes of Volume VIII containing frequency spectrographs of the model helicopter hub/rotor wake velocities derived from the single-film velocity transducer data This sub-volume deals with the wake characteristics of the baseline configurations Author (GRA)

N79-18957# Purdue Univ , Lafayette Ind School of Aeronautics and Astronautics
INVESTIGATION OF TORSION FREE WING TREND FLUTTER MODELS Final Report, 1 Feb 1977 - 31 Aug 1978
Henry T Y Yang and C H Wan 15 Sep 1978 60 p refs (Grant AF-AFOSR-3265-77 AF Proj 2307)
(AD-A061942, AFOSR-78-1514TR) Avail NTIS HC A04/MF A01 CSCL 20/4

Four types of aluminum plate flutter models of a torsion free wing (TFW) were studied (1) cantilever wing (2) pitch restrained wing, (3) TFW with forward trim surface, and (4) TFW with aft trim surface Models (3) and (4) included the effect of fuselage Free vibration analyses were performed by using the finite element program NASTRAN Generalized aerodynamic forces were computed by using the program LAT2D based on the subsonic lifting surface theory of Kussner Flutter speeds and frequencies were predicted by using the program FLTTR based on the V-g method The predicted flutter speeds were compared with available computed and tested results The predicted flutter speeds for the four models were compared with each other and conclusions were made To determine the designs that yielded higher flutter speeds, parametric studies were conducted by varying each of the six parameters thickness parameter of the wing, thickness parameter of either trim surface, location of the wing pivot length of the boom, swept angle of the wing, and swept angle of either trim surface The effect of these parameters on the flutter speeds of models (3) and (4) were plotted as trend curves and discussions and conclusions were made Author (GRA)

N79-18958# Boeing Vertol Co Philadelphia, Pa
INTERACTIONAL AERODYNAMICS OF THE SINGLE ROTOR HELICOPTER CONFIGURATION. VOLUME 6-A ONE-THIRD OCTAVE BAND SPECTROGRAMS OF WAKE SINGLE FILM DATA, BUILDUP TO BASELINE Final Report, 15 Mar 1977 - 13 Feb 1978
Philip F Sheridan Sep 1978 303 p
(Contract DAAJ02-77-C-0020 DA Proj 1L2-62209-AH-76)
(AD-A061994, USARTL-TR-78-23F-Vol-6-A) Avail NTIS HC A14/MF A01 CSCL 01/3

This is the first of the three volumes of Volume VI containing one-third octave band spectrographs of the model helicopter hub/rotor wake velocities derived from the single-film velocity transducer data This sub-volume deals with the wake changes as the model is built up to the baseline configuration Author (GRA)

N79-18959# Boeing Vertol Co , Philadelphia, Pa
INTERACTIONAL AERODYNAMICS OF THE SINGLE ROTOR HELICOPTER CONFIGURATION VOLUME 8-C FREQUENCY ANALYSES OF WAKE SINGLE FILM DATA, HUBCAPS AND AIR EJECTORS Final Report, 15 Mar 1977 - 13 Feb 1978
Philip F Sheridan Sep 1978 286 p
(Contract DAAJ02-77-C-0020, DA Proj 1L2-62209-AH-76)
(AD-A061995, USARTL-TR-78-23H-Vol-8-C) Avail NTIS HC A13/MF A01 CSCL 01/3

This is the third of the three volumes of Volume VIII containing frequency spectrographs of the model helicopter hub/rotor wake velocities derived from the single-film velocity transducer data This sub-volume deals with the effects of hub caps and air ejector systems on wake velocities Author (GRA)

N79-18960*# National Aeronautics and Space Administration Ames Research Center, Moffett Field Calif
EVALUATION OF A WAKE VORTEX UPSET MODEL BASED ON SIMULTANEOUS MEASUREMENTS OF WAKE VELOCITIES AND PROBE-AIRCRAFT ACCELERATIONS
Barbara J Short and Robert A Jacobsen Mar 1979 42 p refs
(NASA-TM-78561 A-7735) Avail NTIS HC A03/MF A01 CSCL 01C

Simultaneous measurements were made of the upset responses experienced and the wake velocities encountered by an instrumented Learjet probe aircraft behind a Boeing 747 vortex-generating aircraft The vortex-induced angular accelerations experienced could be predicted within 30% by a mathematical upset response model when the characteristics of the wake were well represented by the vortex model The vortex model used in the present study adequately represented the wake flow field when the vortices dissipated symmetrically and only one vortex pair existed in the wake L S

N79-18961# National Transportation Safety Board Washington D C Bureau of Accident Investigation
AIRCRAFT ACCIDENT REPORT ALLEGHENY AIRLINES, INC BAC 1-11, N1550, ROCHESTER, NEW YORK, JULY 9, 1978
8 Feb 1979 52 p refs
(NTSB-AAR-79-2) Avail NTIS HC A04/MF A01

After completing a precision approach and landing in visual flight conditions, the aircraft overran the end of the runway crossed a drainage ditch and came to rest 728 ft past the end of the runway threshold Although the aircraft was damaged substantially when it hit the drainage ditch there was no fire There were 73 passengers and a crew of 4 on board, one passenger was injured seriously The probable cause of the accident was the captain s complete lack of awareness of airspeed vertical speed and aircraft performance throughout an ILS approach and landing in visual meteorological conditions which resulted in his landing the aircraft at an excessively high speed and with insufficient runway remaining for stopping the aircraft

but with sufficient aircraft performance capability to reject the landing well after touchdown Contributing to the accident was the first officer s failure to provide required callouts which might have altered the captain to the airspeed and sink rate deviations The Safety Board was unable to determine the reason for the captain s lack of awarness or the first officer s failure to provide required callouts A R H

N79-18962# Air Force Inst of Tech Wright-Patterson AFB Ohio
ANALYSIS OF THE FUNCTIONAL REQUIREMENTS FOR AN INTELLIGENT AIRBORNE COMPUTER SYSTEM M S Thesis
Ronald Itsuo Morishige 1978 49 p refs
(AD-A061649 AFIT-CI-79-8) Avail NTIS HC A03/MF A01 CSCL 01/2

The use of artificial intelligence methods in an airborne computer system can enhance flight safety by reducing the possibility of pilot error caused by inadequate or misleading information The intelligent computer system would have the ability to screen information for relevancy to the current situation The selection of information requires knowledge of the context which may depend upon the phase of flight, the condition of the aircraft or external factors The phase-based context might be represented by scripts The condition-based and the external context can be represented by a cause-effect net Knowledge of context will not only enable priority resolution of information but also definitions of goals for generating plans to cope with abnormal situations Author (GRA)

N79-18968 Old Dominion Univ , Norfolk, Va
DESIGN, CALIBRATION, AND APPLICATION OF A SENSOR FOR MEASURING TIME DEPENDENT ANGLE OF ATTACK OF HELICOPTER BLADES Ph D Thesis
Weiyuan Henry Liu 1978 206 p
Avail Univ Microfilms Order No 7904820

Various pressure probes were designed and tested which could be attached to helicopter blades when a helicopter is in flight The pressure probes consisted of spherical heads which were held in place by cylindrical shanks Built inside the heads were transducers to measure the pressure differential between pressure ports which were located on the front portion of the spherical head facing the airstream Data was obtained over a range of airstream velocity of 11 6 to 88 4 m/s(38 to 290 ft/sec), corresponding to Reynolds numbers of 24 000 184 000 based on the sphere diameter Both static and dynamic tests were performed For the dynamic testing cases the probe oscillating frequency was varied from 1 59 to 5 20 Hz , covering the range of frequencies typical of helicopter blade motion Dissert Abstr

N79-18969# Dynamics Research Corp , Wilmington Mass Systems Div
AN ANALYSIS OF FUEL CONSERVING OPERATIONAL PROCEDURES AND DESIGN MODIFICATIONS FOR BOMBER/TRANSPORT AIRCRAFT VOLUME 1. EXECUTIVE SUMMARY Final Report, 7 Jun 1976 - 7 Jul 1978
R Aggarwal Jul 1978 24 p refs
(Contract F33615-76-C-3104)
(AD-A061746 R-247U-Vol-1 AFFDL-TR-78-96-Vol-1) Avail NTIS HC A02/MF A01 CSCL 01/3

Various proposed improvements in the design and operational procedures for bomber/transport aircraft are evaluated The evaluation is performed in terms of the estimated savings in fuel consumption and in Direct Operating Cost (DOC) As an aid in the evaluation of design modifications graphs of fuel and DOC savings as a function of the design parameters are developed These graphs are based on actual mission trajectory data rather than some type trajectory profile The actual mission data is presented in terms of histograms which provide statistical information concerning altitude air speed take-off weight landing weights, and mission time Separate analyses are performed on the following aircraft the B-52G the B-52H the KC-135, the C-141, the C-130 and the C-5A Author (GRA)

N79-18970# Naval Test Pilot School Patuxent River, Md
PRINCIPLES OF HELICOPTER PERFORMANCE
Robert B Richards 8 Mar 1968 142 p refs
(AD-A061671, USNTPS-T-1) Avail NTIS HC A07/MF A01 CSCL 01/13

This textbook is used as the primary reference for the Helicopter Performance Course at the U S Naval Test Pilot School The Helicopter Performance Course is an integral part of the School curriculum the particular requirements of which influence the manner and degree of development of these notes The course is intended to provide a background for the helicopter performance flight projects conducted by the students The helicopter with emphasis on the main rotor is analyzed in various flight conditions to determine the major factors which influence the performance Simplified analysis is first applied to hover and then extended to include translational conditions after which consideration is given to the effect of some of the more significant simplifications Author (GRA)

N79-18971# Calspan Corp Buffalo N Y
TOTAL ENVIRONMENT SURVIVABILITY METHODOLOGY Final Report, Oct 1977 - Mar 1978
Charles J Krebs Hans G Reif, and William E Ring Wright-Patterson AFB, Ohio AFFDL Jul 1978 105 p refs
(Contract F33615-77-C-2102 AF Proj 2402)
(AD-A061888 CALSPAN-6200-X-2 AFFDL-TR-78-90) Avail NTIS HC A06/MF A01 CSCL 12/2

This report documents the results of an analytical study to develop an architecture for a Total Environment Survivability (TES) methodology to provide a capability to evaluate the relative importance of (1) threats on technologies and (2) technologies on air flight vehicle non-nuclear survivability in the total environment This methodology couples mission effectiveness and life cycle cost analysis techniques to yield a final measure of merit (MOM) or payoff for each technology evaluated Three candidate methodologies are described which were studied and compared to arrive at the final selected approach The selected methodology is described in detail along with a qualitative assessment of the methodology using a candidate technology and threat problem The report also documents the development plan for the implementation of the methodology Author (GRA)

N79-18972# Naval Air Development Center, Warminster, Pa Aircraft and Crew Systems Technology Directorate
STATISTICAL REVIEW OF COUNTING ACCELEROMETER DATA FOR NAVY AND MARINE FLEET AIRCRAFT Semiannual Summary Report, 1 Jan 1962 - 30 Jun 1978
Alan M Kaniss 1 Nov 1978 159 p
(AD-A061894 NADC-13920-2) Avail NTIS HC A08/MF A01 CSCL 01/3

This report is a specialized summary of normal acceleration data recorded by counting accelerometers Data are separated by calendar time and mission category Only data reported in the counting accelerometer program are included Author (GRA)

N79-18973*# University of Southern Illinois, Carbondale Dept of Electrical Sciences and Systems Engineering
GASP-PL/I SIMULATION OF INTEGRATED AVIONIC SYSTEM PROCESSOR ARCHITECTURES M S Thesis
Glen A Brent Sep 1978 274 p refs
(Grant NsG-2238)
(NASA-CR-158244) Avail NTIS HC A12/MF A01 CSCL 01D

A development study sponsored by NASA was completed in July 1977 which proposed a complete integration of all aircraft instrumentation into a single modular system Instead of using the current single-function aircraft instruments computers compiled and displayed inflight information for the pilot A processor architecture called the Team Architecture was proposed This is a hardware/software approach to high-reliability computer systems A follow-up study of the proposed Team Architecture is reported GASP-PL/1 simulation models are used to evaluate the operating characteristics of the Team Architecture The problem model development simulation programs and results at length are presented Also included are program input formats outputs and listings G Y

N79-18974# Naval Research Lab , Washington D C
SOFTWARE REQUIREMENTS FOR THE A-7E AIRCRAFT
Kathryn L Heninger John W Kallander David L Parnas and John E Shore 27 Nov 1978 523 p refs
(AD-A061751 NRL-MR-3876) Avail NTIS HC A22/MF A01 CSCL 01/3

The Naval Research Laboratory and the Naval Weapons Center are engaged in a joint project to redesign and rebuild the A-7E Operational Flight Program (OFP) using several advanced software engineering principles This report is the first product of the project It describes the required behavior of the OFP without describing an implementation It also describes relevant characteristics of the A-7 computer, sensors, and display devices Primarily intended as a reference document for the rest of the project this report also serves as a complete example of good requirements definition Its organization allows rapid answering of specific questions A large amount of information is presented concisely and precisely in formats that facilitate checking for completeness and consistency The documentation techniques illustrated by this report should be useful for other software development projects Author (GRA)

N79-18975 Tennessee Univ Knoxville
INVESTIGATION OF THE AERODYNAMIC AND ACOUSTIC PERFORMANCE OF A LOW-PRESSURE RATIO TANDEM-BLADE COMPRESSOR Ph D Thesis
Jenn-Gang John Cherng 1978 224 p
Avail Univ Microfilms Order No 7903408

The experimental results show that the tandem blade configuration is capable of reducing the rotor-stator interaction noise by reducing the radial wake distortion behind the rotor blades, especially at highly loaded conditions i e higher rotor speeds Span wise circulation distribution can have a significant influence on noise generation for the single rotor and for the rotor-stator combinations The design parameters of an axial flow compressor such as the blade twist angle rotor solidity rotor degree of reaction and hydraulic efficiency etc , were investigated A series of computations on the effects of geometric changes on the flow characteristics of tandem-blade compressor rotors are presented Dissert Abstr

N79-18976*# Shaker Research Corp Ballston Lake N Y
TURBOJET BLADE VIBRATION DATA ACQUISITION DESIGN AND FEASIBILITY TESTING Final Report
J L Frarey, N J Petersen (Amherst Systems) and D A Hess Nov 1978 72 p
(Contract NAS3-21015)
(NASA-CR-159505 SRC-78-TR-36) Avail NTIS HC A04/MF A01 CSCL 21E

A turbojet blade vibration data acquisition system was designed to allow the measurement of blade vibration The data acquisition system utilizing 96 microprocessors to gather data from optical probes, store sort and transmit to the central computer is described Areas of high technical risk were identified and a two-microprocessor system was breadboarded and tested to investigate these areas Results show that the system was feasible and that low technical risk would be involved in proceeding with the complete system fabrication S E S

N79-18977*# Naval Air Propulsion Test Center Trenton N J
ROTOR FRAGMENT PROTECTION PROGRAM STATISTICS ON AIRCRAFT GAS TURBINE ENGINE ROTOR FAILURES THAT OCCURRED IN US COMMERCIAL AVIATION DURING 1976 Final Report, 1975 - 1976
R A DeLucia and J T Salvino Jul 1978 30 p
(NASA Order C-41581-B)
(NASA-CR-159474 NAPC-PE-9) Avail NTIS HC A03/MF A01 CSCL 21E

Statistical information relating to the number of gas turbine engine rotor failures which occurred during 1976 in commercial aviation service use is presented The predominant failure involved blade fragments 88 percent of which were contained Although fewer rotor rim disk, and seal failures occurred all were uncontained Sixty-seven percent of the 186 rotor failures occurred during the takeoff and climb stages of flight S E S

N79-18979# Von Karman Inst for Fluid Dynamics Rhode-Saint-Genese (Belgium)
TURBINE BLADE COOLING
1976 539 p refs Partly in ENGLISH and FRENCH Lecture held at Rhode Saint Genese Belgium, 12-16 Jan 1976
(VKI-Lecture-Series-83) Avail NTIS HC A23/MF A01

An introductory lecture presented the contemporary trends in gas turbine development and their impact on turbine design A survey of the techniques and information available on heat transfer coefficients and cooling efficiency was made, with emphasis on impingement and film types of cooling The test corrosion phenomena was reviewed The possibility of cooling by fluids other than air was discussed The methods for calculation of stresses deformation, fatigue and life expectancy of cooled blades was described The interaction between cooling requirements and aerodynamic design was considered

N79-18980# Societe Nationale d Etude et de Construction de Moteurs d Aviation, Melun (France)
TURBINE BLADE COOLING
Jerome Francois *In* Von Karman Inst for Fluid Dyn Turbine Blade Cooling 1976 22 p refs

Avail NTIS HC A23/MF A01

Increasing the compression ratio and maximum temperature of thermodynamic cycles influences the design of gas turbines The various cooling techniques used not only multiply the number of parameters to be considered in blade design but also complicate the technology and interfere with aerodynamics Problems involved in the design of a blade capable of withstanding high temperatures relate not only to thermodynamics, but also to aerodynamics heat, resistance, technology and fabrication methods The finally constructed blade will represent a compromise of the respective requirements of each of these disciplines Transl by A R H

N79-18984# Creare Inc Hanover, N H Fluids/Thermal Engineering Div
ALTERNATIVE TURBINE COOLING TECHNOLOGY
David Japikse *In* Von Karman Inst for Fluid Dyn Turbine Blade Cooling 1976 39 p refs

Avail NTIS HC A23/MF A01

Alternatives to conventional gas turbine airfoil cooling (compressor discharge air) have existed for more than three decades Air cooling gained early popularity due to convenience now restructured energy values offer incentive to consider alternatives A variety of demonstrated airfoil cooling alternatives are reviewed and a careful assessment of the current technology base for designing alternative cooling methods is presented here A speculative view of future alternative applications is offered G Y

N79-18986# Rolls-Royce Ltd , Derby (England) Derby Engine Div
THE AERODYNAMIC PENALTIES ASSOCIATED WITH TURBINE BLADE COOLING
B Barry *In* Von Karman Inst for Fluid Dyn Turbine Blade Cooling 1976 36 p refs

Avail NTIS HC A23/MF A01

A state of the art review of the cooled aero engine turbine design field is provided in particular the interactions between the aerodynamic and cooling requirements/constraints of the turbine The processes which a designer goes through to establish the preliminary characteristics of the turbine are considered The aerodynamic and cooling interactions and losses are also considered G Y

N79-18990# Von Karman Inst for Fluid Dynamics, Rhode-Saint-Genese (Belgium) Dept of Turbomachinery
TIME MARCHING FINITE AREA METHOD
Michel Couston *In its* Transonic Flows in Axial Turbomachinery, Vol 1 1976 42 p refs

Avail NTIS HC A13/MF A01

Aerodynamically efficient blades linked to the knowledge of shock strength and position because a slight blade profile variation ca induce strong shock waves and boundary layer separation are discussed A numerical method to solve the steady transonic blade to blade flow in axial turbomachinery is developed A two dimensional problem using the isentropic assumption was examined The damping surface, rotor tip and stator hub sections, blade velocity distribution Mach number and wall profiles were investigated SES

N79-18997# Von Karman Inst for Fluid Dynamics Rhode-Saint-Genese (Belgium)
OUTLET AIR ANGLE PREDICTION FOR SUBSONIC FLOW CASCADES
R VanDenBraembussche *In its* Transonic Flows in Axial Turbomachinery, Vol 2 1976 34 p refs

Avail NTIS HC A18/MF A01
In order to define the unique outlet air angle corresponding to real flow, three groups of criteria were developed (1) relates the outlet air angle to overall geometrical data (2) relates the outlet air angle to local flow condition at the trailing edge and contains the Kutta condition, and (3) directly relates the outlet air angle to the viscous inviscid interation of the flow SES

N79-19000# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany)
COMPARISON BETWEEN FLOWS IN CASCADES AND ROTORS IN THE TRANSONIC RANGE 1 BASIC CONSIDERATIONS
H Starken *In* Von Karman Inst for Fluid Dyn Transonic Flows in Axial Turbomachinery Vol 2 1976 18 p refs

Avail NTIS HC A18/MF A01
Five different parameters which influence a comparison between stationary cascade tests results and axial flow turbomachine measurements are discussed The parameters are (1) cascade projection (2) axial velocity, (3) position of reference planes, (4) data reduction method and (5) viscosity effects SES

N79-19001# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany)
COMPARISON BETWEEN FLOWS IN CASCADES AND ROTORS IN THE TRANSONIC RANGE 2 INVESTIGATION OF TWO TRANSONIC COMPRESSOR CASCADES AND COMPARISON WITH ROTOR DATA
H A Schreiber *In* Von Karman Inst for Fluid Dyn Transonic Flows in Axial Turbomachinery Vol 2 1976 32 p refs

Avail NTIS HC A18/MF A01
The influence of the axial velocity density ratio on the transonic cascade flow by varying the sidewall contraction was studied The flow behavior the static pressure transonic and supersonic range on the shock wave configuration, the shock losses and the throat area inside of the blade are described SES

N79-19002# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany)
COMPARISON BETWEEN FLOWS IN CASCADES AND ROTORS IN THE TRANSONIC RANGE 3: COMPARISON OF EXPERIMENTAL AND THEORETICAL RESULTS OF FLOW STUDIES ON BLADE-TO-BLADE SURFACES IN AN AXIAL COMPRESSOR ROTOR
R Dunker, P Strinning and H G Hungenberg *In* Von Karman Inst for Fluid Dyn Transonic Flows in Axial Turbomachinery Vol 2 1976 19 p refs

Avail NTIS HC A18/MF A01
A nonintrusive flow-velocity measuring method on an optical basis is described This technique is developed for applications in turbomachines, where extremely difficult test conditions are normally present Results of experimental investigations and of quasi-three-dimensional calculations in axial compressor rotors are compared The results demonstrate the capability of this technique for future research work on turbomachines and especially for the development of the aerodynamic calculation methods SES

N79-19004# Naval Research Lab Washington D C Ocean Technology Div
FAILURE STUDIES OF A THIRD STAGE FAN DISK FROM A TF-30 TURBINE ENGINE Final Report
W H Vaughan, R J Sanford J M Krafft, W H Cullen and J W Dally (Maryland Univ, College Park) 13 Nov 1978 29 p refs
(AD-A061801, NRL-MR-3874) Avail NTIS HC A03/MF A01 CSCL 21/5

A detailed failure analysis was made of a fan disk from the third stage of the Navy s turbo-jet engine in order to gain a better understanding of the origin and growth kinetics of the cracks that had developed in service The in service stress that had caused the cracks to originate was determined by a two dimensional photoelastic and holographic stress analysis A further experimental stress analysis was made to determine the stress intensity factor, after the crack had formed as a function of crack length These results were compared with a fractographic study of the bearing surface and the fracture surface It was found that the striation spacings were in good agreement with the calculated values of the stress intensity factor Some conclusions were drawn concerning the origin and growth mechanism of these cracks Author (GRA)

N79-19005# ARO, Inc, Arnold Air Force Station, Tenn
COMPARISONS OF TURBINE ENGINE COMBUSTOR EXHAUST EMISSIONS MEASUREMENTS USING THREE GAS-SAMPLING PROBE DESIGNS Final Report, 1 Dec 1976 - 30 Aug 1977
R J Bryson and J D Few Nov 1978 67 p refs
(AD-A061733, AEDC-TR-78-7) Avail NTIS HC A04/MF A01 CSCL 21/5

The effects of sampling probe design and probe operating procedures on measurements of concentrations of nitric oxide (NO), oxides of nitrogen (NOx), carbon monoxide (CO), carbon dioxide (CO2), total hydrocarbons (CxHy), and gaseous hydrogen (H2) in the exhaust of a turbine engine combustor were studied Measurements of the concentrations were made using commercial gas analysis instruments and three types of gas-sampling probes The probe types were a tubular inlet probe a quick-quench probe, and a dilution probe Diluent gas (N2, A, He) and diluent flowrate effects on measurements were studied for the dilution probe Effects of sampling surface material and sample residence time in the probe were investigated for the tubular inlet probe, and the effects of pressure ratio across the quick-quench probe were determined At fuel-to-air ratios greater than 0 01, the levels of NO, NOx and CO2 were somewhat smaller for the quick-quench and dilution probes than for the tubular inlet probe The measured concentrations of carbon monoxide and unburned hydrocarbons, however, were greater for the quick-quench and dilution probes than for the tubular inlet probe Author (GRA)

N79-19006 Ohio State Univ, Columbus
AEROSERVOELASTIC STABILITY ANALYSIS OF AN AIRPLANE WITH A CONTROL AUGMENTATION SYSTEM Ph.D. Thesis
Robert Lee Moore 1978 200 p
Avail Univ Microfilms Order No 7902191

The aeroservoelastic stability equations of motion, including the airframe dynamics the unsteady aerodynamics, and the control augmentation system were developed by using a modal representation in the Laplace domain For this formulation, the unsteady aerodynamics were transformed from the commonly used frequency domain into the Laplace domain Fitted Laplace polynomial fractions for the Laplace transformed generalized aerodynamic forces were derived These fitted Laplace polynomial fractions were formulated for a given flight condition (i e, a particular Mach number and altitude) were applicable for all frequencies within the desired frequency fit range and were

most valid for Laplace arguments near the imaginary axis (small positive or negative damping) along which the fit was made and which was the region of the greatest physical interest for stability Dissert Abstr

N79-19007# General Electric Co , Binghamton, N Y Aerospace Controls and Electrical Systems Dept
DIRECT DRIVE CONTROL VALVE FOR FLY-BY-WIRE FLIGHT CONTROL SYSTEM ACTUATORS Final Report, Apr 1976 - Dec 1977
D Hogan and J E Rinde Mar 1978 144 p refs
(Contract F33615-76-C-3037)
(AD-A062030 ACS-11595 AFFDL-TR-78-32) Avail NTIS HC A07/MF A01 CSCL 01/3

The development of a high force linear motor suitable for directly actuating an aircraft hydraulic power control valve used on a flight control system actuator is described A breadboard unit was fabricated and tested and met the 80 lb midpoint force requirement with an input of 4 4 amperes (1 1 amps/coil) A modified F-4 aileron actuator incorporating the force motor and position LVDTs met the frequency response requirements Three sets of brassboard equipment each consisting of a modified F-4 aileron actuator incorporating a new force motor and position LVDTs and an electronic control box were designed fabricated and tested One set was subjected to and satisfactorily completed flightworthiness tests The remaining are available for flight testing Author (GRA)

N79-19008# Northrop Corp Hawthorne Calif Aircraft Div
VALIDATION OF MIL-F-9490D GENERAL SPECIFICATION FOR FLIGHT CONTROL SYSTEM FOR PILOTED MILITARY AIRCRAFT VOLUME 1 SUMMARY OF YF-17 AND C-5A VALIDATIONS Final Report, Apr 1976 - Jan 1977
S Dobos-Bubno Larry B Hartsook, Ralph J Hylton and Harold A Valery Apr 1977 56 p refs
(Contract F33615-76-C-3034)
(AD-A061807 NOR-77-06-Vol-1 AFFDL-TR-77-7-Vol-1) Avail NTIS HC A04/MF A01 CSCL 01/3

This volume presents a summary of two studies performed to validate the new MIL-F-9490D Specification This work was accomplished by the Northrop Corporation Aircraft Division using the YF-17 Lightweight Fighter, and the Lockheed-Georgia Company using the C-5A Heavy Logistics Transport This validation was based on existing ground test flight test and analytical data as was available for this validation process Each applicable paragraph was examined with regard to practicability accuracy, and completeness as a requirement for procurement, design test and installation of flight control systems for future piloted military aircraft Recommendations have been made with regard to changes considered necessary to improve the practicability accuracy and completeness of the specification and to improve or update the Users Guide Author (GRA)

N79-19009# Northrop Corp Hawthorne Calif Aircraft Div
VALIDATION OF MIL-F-9490D GENERAL SPECIFICATION FOR FLIGHT CONTROL SYSTEM FOR PILOTED MILITARY AIRCRAFT VOLUME 2 YF-17 LIGHTWEIGHT FIGHTER VALIDATION Final Report, Apr 1976 - Jan 1977
S Dobos-Bubno and Larry B Hartsook Apr 1977 364 p refs
(Contract F33615-76-C-3034)
(AD-A062008, NOR-77-06-Vol-2 AFFDL-TR-77-7-Vol-2) Avail NTIS HC A16/MF A01 CSCL 01/3

This study was conducted to validate military specification MIL-F-9490D Flight Control Systems-Design Installation and Test of Piloted Aircraft, General Specification For, dated 6 June 1975 by checking the specification requirements utilizing the experience and knowledge derived during the recent procurement of the YF-17 Lightweight Fighter This validation was based on existing ground test flight test and analytical data as was available for this validation process Each applicable paragraph was examined with regard to practicability, accuracy, and completeness as a requirement for procurement, design test and installation of flight control systems for future piloted military aircraft Recommendations were made with regard to changes considered necessary to improve the practicability accuracy, and completeness of the specification and to improve or update the Users Guide Author (GRA)

N79-19010*# Bolt, Beranek and Newman, Inc , Canoga Park, Calif
COMPUTER-AIDED COLLECTION OF DEMOGRAPHIC DATA WITHIN DAY-NIGHT LEVEL CONTOURS TWO TEST CASES Final Report
Harry Seidman and Connice Bravelly Aug 1978 30 p refs
(Contract F33615-76-C-0528)
(AD-A061657 BBN-3702 AMRL-TR-78-39) Avail NTIS HC A03/MF A01 CSCL 20/1

This study demonstrates the feasibility of automating a procedure for counting the number of people exposed to various levels of aircraft noise near airbases The procedure involves developing contours of equal noise exposure about military installations based on aircraft noise and performance data and airport operational/flight track information using the NOISEMAP computer program developing polygon descriptions of the noise contours that are compatible with commercially available demographic programs using census tract data and outputting for land use planning purposes, demographic and socio-economic data for present or future years as a function of predicted noise exposure level GRA

N79-19112*# Boeing Commercial Airplane Co Seattle, Wash
DEVELOPMENT OF FIRE TEST METHODS FOR AIRPLANE INTERIOR MATERIALS Final Report
Everett A Tustin Oct 1978 301 p refs
(Contract NAS9-15168)
(NASA-CR-160119, D6-48071) Avail NTIS HC A14/MF A01 CSCL 21B

Fire tests were conducted in a 737 airplane fuselage at NASA-JSC to characterize jet fuel fires in open steel pans (simulating post-crash fire sources and a ruptured airplane fuselage) and to characterize fires in some common combustibles (simulating in-flight fire sources) Design post-crash and in-flight fire source selections were based on these data Large panels of airplane interior materials were exposed to closely-controlled large scale heating simulations of the two design fire sources in a Boeing fire test facility utilizing a surplused 707 fuselage section Small samples of the same airplane materials were tested by several laboratory fire test methods Large scale and laboratory scale data were examined for correlative factors Published data for dangerous hazard levels in a fire environment were used as the basis for developing a method to select the most desirable material where trade-offs in heat, smoke and gaseous toxicant evolution must be considered Author

N79-19122# Naval Research Lab Washington D C
NEW AGENTS FOR THE EXTINGUISHMENT OF MAGNESIUM FIRES Final Report, Aug 1976 - Sep 1977
Kenneth D Lawrence Frederick W Williams and Richard G Gann Apr 1978 31 p refs
(MIPR-FY8952-76-65017)
(AD-A061664 NRL-6180-376-KDL-FWW-NJS CEEDO-TR-78-19) Avail NTIS HC A03/MF A01 CSCL 13/12

Ground glass powders (frits) have been evaluated as possible suppressants for magnesium fires Conceptually, these would melt and form a glass coating on the surface of the burning metal isolating it from the oxygen supply Some frits containing oxides of magnesium and lithium reacted violently with the burning magnesium However several low melting frits proved to be good suppressants and were better than commercial suppressants Author (GRA)

N79-19149# Teledyne CAE Toledo Ohio
ADVANCED TURBINE ENGINE GAS GENERATOR (ATEGG) FRACTOGRAPHY OF CAST NICKEL BASE SUPERALLOYS Final Report, 1 Oct 1975 - 30 Jun 1978
Nov 1978 28 p
(Contract F33657-76-C-0215)
(AD-A061701 TCAE-1567-Vol-4 AFAPL-TR-77-30-Vol-4) Avail NTIS HC A03/MF A01 CSCL 11/6

This report documents Teledyne CAE s efforts to correlate the fracture surfaces of cast nickel-base superalloys to known conditions of low cycle fatigue testing (strain range partitioning) Rene 80 and In-100 low cycle fatigue test specimens (supplied by NASA-Lewis and TRW materials laboratories) were examined by means of scanning electron microscope (SEM) The fractography obtained with the SEM can be compared to actual engine component failures and will provide strong indications of the metal temperature, creep conditions strain levels, and cycles imposed, during the events leading to component failure
Author (GRA)

N79-19314*# Pratt and Whitney Aircraft, East Hartford Conn Commercial Products Div
STRAIN GAGE SYSTEM EVALUATION PROGRAM Final Report
G W Dolleris, H J Mazur and E Kokoszka, Jr Dec 1978 126 p
(Contract NAS3-20298)
(NASA-CR-159486, PWA-5615-3) Avail NTIS HC A07/MF A01 CSCL 14B

A program was conducted to determine the reliability of various strain gage systems when applied to rotating compressor blades in an aircraft gas turbine engine A survey of current technology strain gage systems was conducted to provide a basis for selecting candidate systems for evaluation Testing and evaluation was conducted in an F 100 engine Sixty strain gage systems of seven different designs were installed on the first and third stages of an F 100 engine fan Nineteen strain gage failures occurred during 62 hours of engine operation, for a survival rate of 68 percent Of the failures, 16 occurred at blade-to-disk leadwire jumps (84 percent), two at a leadwire splice (11 percent) and one at a gage splice (5 percent) Effects of erosion, temperature, G-loading, and stress levels are discussed Results of a post-test analysis of the individual components of each strain gage system are presented M M

N79-19351# Nuovo Pignone S p A , Florence (Italy)
TRANSONIC COMPRESSORS FOR HEAVY GASES PART 1 SELECTIONS OF THE AERO-DESIGN PARAMETERS
E Benvenuti *In* Von Karman Inst for Fluid Dyn Ind Compressor, Vol 1 1976 31 p refs

Avail NTIS HC A14/MF A01

The problems of correctly applying test data obtained for cascades and stages operating with air to designing heavy gas compressor stages are outlined Some differences to be expected in the compressor performance are examined It is concluded that the aerodynamic design of a multistage transonic axial compressor for very heavy gases has in general more severe constaints than the design of an air compressor of the same pressure ratio and specific flow Some criteria for the selection of the design aerodynamic parameters are indicated, when high efficiency and good operating range are requested G Y

N79-19352# Nuovo Pignone S p A Florence (Italy)
TRANSONIC COMPRESSORS FOR HEAVY GASES PART 2 AERO-MECHANICAL CONSIDERATIONS, TESTING AND OPERATION
E Benvenuti *In* Von Karman Inst for Fluid Dyn Ind Compressors Vol 1 1976 34 p refs

Avail NTIS HC A14/MF A01

Some comparisons are made between the design of transonic stages operating with air and that of stages operating with heavy gases taking blades stresses natural frequencies and flutter into consideration It is shown that, in general, the mechanical constaints on the aerodynamic design are less severe for the heavy gas compressor than for the equivalent air compressor When testing a compressor design for a certain gas using different gas, care must be taken in selecting the test gas properties and an appropriate data correlation must be used by defining performance parameters, suitable to represent the compressor performance when operating with different gases Performance maps are shown which were calculated on the basis of typical stage characteristics, using, the stage-stacking technique G Y

N79-19353# United Technologies Research Center East Hartford, Conn
TURBOMACHINERY FLUTTER INTRODUCTORY CONCEPTS
Franklin O Carta *In* Von Karman Inst for Fluid Dyn Ind Compressors, Vol 1 1976 26 p refs

Avail NTIS HC A14/MF A01

An attempt is made to acquaint the reader with several turbomachinery flutter problems confronting the design engineer Some of the ways in which the designer can cope with these problems are suggested The reader is exposed to the basic differences between wing flutter and turbomachinery blade flutter This is helpful in establishing the areas in which elementary theories can be used to explain basic principles G Y

N79-19354# United Technologies Research Center East Hartford, Conn
IDENTIFICATION OF VARIOUS FLUTTER REGIMES AND DISCUSSION OF DYNAMIC STALL
Franklin O Carta *In* Von Karman Inst for Fluid Dyn Ind Compressors Vol 1 1976 45 p refs

Avail NTIS HC A14/MF A01

An attempt is made to identify several of the specific flutter problems that are of concern to the turbomachinery designer Following a general historical account of the early attempts to cope with various flutter problems relevant to turbomachines a detailed survey of single degree of freedom torsional stall flutter is given Although the phenomenon is experienced by all rotating blade systems only isolated airfoil studies relevant to helicopters and propellers are extensive enough to produce a truly predictive design system However, this prediction relies heavily on empiricism G Y

N79-19363# Von Karman Inst for Fluid Dynamics, Rhode-Saint-Genese (Belgium)
AERODYNAMIC AND MECHANICAL FACTORS AFFECTING THE SURGE LINE INLET FLOW DISTORTION INFLUENCES ON AXIAL FLOW COMPRESSORS
J Colpin *In its* Ind Compressors Vol 2 1976 15 p refs

Avail NTIS HC A11/MF A01

An inlet flow distortion is one of the compressor perturbations to be considered in designing a turbomachine Two of the most important practical methods the parallel compressor model and the Melick model available for the prediction of the effects of inlet flow distortion on the surge line shift are presented It appears that both models give satisfactory results at the moment but without adding new fundamental elements to the knowledge of the flow phenomena This would necessarily reduce their range of application There is a need for a deeper insight in the flow physics in order to link the global approach to a detailed study of the unsteady response of the rotating rows which would improve the prediction methods G Y

N79-19365# Von Karman Inst for Fluid Dynamics Rhode-Saint-Genese (Belgium)
COMBUSTION PROBLEMS IN GAS TURBINE APPLICATIONS
1977 505 p refs Proc of lectures held on 10-14 Jan 1977 (VKI-Lecture-Series-93) Avail NTIS HC A22/MF A01

A discussion is given of the combustion problems in gas turbines with emphasis on the combustion process the combustion chamber, and application in the aeronautical and industrial fields

N79-19366# Purdue Univ Lafayette Ind
COMBUSTION IN THE GAS TURBINE, PARTS 1, 2, 3

A H Lefebvre *In* Von Karman Inst for Fluid Dyn Combust Probl in Gas Turbine Appl 1977 28 p

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Reference to the conventional P-V diagram for a turbo-jet cycle shows that between the compression and expansion stages there is a stage in which the working fluid (air) expands at constant pressure This expansion is achieved in a practical system through heating of the air by injection and combustion of a liquid fuel The useful work output of the engine is related to the area within the P-V loop Thus a large degree of expansion will give a large work output Since, however, the gas is being expanded by raising its temperature, a practical limit to the degree of expansion attainable is set by the maximum temperature limits of the engine components, especially the turbine L S

N79-19368# Purdue Univ , Lafayette, Ind
FUEL INJECTION
A H Lefebvre *In* Von Karman Inst for Fluid Dyn Combust Probl in Gas Turbine Appl 1977 43 p

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A survey is presented of various methods of achieving an atomized spray and to the influence of atomizer geometry and chamber operating conditions on spray characteristics The influence of spray characteristics on various important aspects of combustion performance is discussed Attention is centered mainly on pressure atomizers, but consideration is also given to other methods of atomization, such as air-blast atomization and centrifugal atomization A brief discussion is given on the relative merits of the various types of fuel injector, with particular emphasis on aircraft systems in which the fuel injection process plays a much more dominant role than in the case of industrial engines L S

N79-19369# Purdue Univ Lafayette, Ind
DIFFUSERS FOR GAS TURBINE COMBUSTION SYSTEMS
A H Lefebvre *In* Von Karman Inst for Fluid Dyn Combust Probl in Gas Turbine Appl 1977 12 p refs

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It is a characteristic of axial flow compressors that a high axial velocity is needed to achieve a high outlet pressure in a small number of stages Thus it is necessary to reduce the velocity of the compressor efflux A five-fold reduction is typical and is achieved by fitting a diffuser between the compressor outlet and the upstream end of the flame tube The simplest and aerodynamically most efficient diffuser is a diverging circular duct Such a diffuser will have an optimum divergence angle for minimum pressure loss, and consideration of the flow regimes in a diffuser of increasing angle will show the physical basis for such an optimum L S

N79-19372# Purdue Univ Lafayette, Ind
IGNITION IN THE GAS TURBINE
A H Lefebvre *In* Von Karman Inst for Fluid Dyn Combust Probl in Gas Turbine Appl 1977 45 p refs

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The trend towards higher flight speeds and engines of higher compression ratio produced a gradual deterioration in the environmental conditions of the ignition unit and igniter plug At the same time there has been an increasing demand for improvements in performance life and reliability of ignition equipment Thus the problem of ignition, particularly in aircraft engines, is one of continuing importance and is discussed in some detail L S

N79-19376# Purdue Univ Lafayette Ind
CONTROL OF AIR POLLUTION FROM AIRCRAFT AND AIRCRAFT ENGINES
A H Lefebvre *In* Von Karman Inst for Fluid Dyn Combust Probl in Gas Turbine Appl 1977 5 p

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Tables and graphs are presented of the data relating to air pollution from aircraft and aircraft engines L S

N79-19380# Rolls-Royce Ltd , Derby (England)
THE DESIGN AND DEVELOPMENT OF HIGH PERFORMANCE COMBUSTORS
A B Wassell *In* Von Karman Inst for Fluid Dyn Combust Probl in Gas Turbine Appl 1977 65 p refs

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Design considerations for combustors have grown in importance namely Weight Production Cost and Pollutant Emissions The inter-relation between these factors are discussed in general terms, but most attention is focused on two factors which are critical in combustor development programmes for high duty systems - Linear Cooling and Combustor Outlet Temperature Distribution The advent of pollution controls re-emphasised the need for minimising the quantity of air required for linear cooling and the operation at increasing turbine inlet temperature requires improvements in the pattern factor Thus the accurate quantification of the pattern factor has become important Past methods failed to define the pattern factor with sufficient accuracy but new statistical appraisals of temperature distribution have been developed to enable them to be quantified with more precision L S

N79-19385# Von Karman Inst for Fluid Dynamics Rhode-Saint-Genese (Belgium)
INDUSTRIAL CENTRIFUGAL COMPRESSORS, VOLUME 1
1977 215 p refs Proc of lectures held on 21-25 Feb 1977 2 Vol
(VKI-Lecture-Series-95) Avail NTIS HC A10/MF A01

Flow modeling and design techniques for centrifugal compressors are discussed as well as the perspectives opened up by the application of boundary layer calculations

N79-19386# Von Karman Inst for Fluid Dynamics Rhode-Saint-Genese (Belgium)
FLOW MODELLING AND AERODYNAMIC DESIGN TECHNIQUES FOR CENTRIFUGAL COMPRESSORS
R vandenBraembussche *In its* Ind Centrifugal Compressors Vol 1 1977 77 p refs

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The differences between industrial and advanced application centrifugal compressors are summarized In comparison to axial flow compressors, the main difficulties for centrifugal compressors are the complexity of the flow and the complexity of the boundaries The latter may be simplified by using one-dimensional approximations including incidence losses friction and eventual separation Flow equations may be simplified by using quasi - or fully- three dimensional calculations of inviscid flow Singularity conformal transformation streamline curvature finite difference, and finite element methods are used to follow a flow from inlet to diffuser outlet The local behavior of the flow is discussed and relevant applicable design methods are examined A R H

N79-19387# Ecole Centrale de Lyon (France)
VISCOUS FLOWS IN CENTRIFUGAL COMPRESSORS
K D Papailiou *In* Von Karman Inst for Fluid Dyn Ind Centrifugal Compressors, Vol 1 1977 58 p refs

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Although the calculation of the flow in a radial compressor is actually realized on the basis of a quasi-three dimensional model which results from the superposition of two two-dimensional models the flow in a radial compressor does not behave in this simple way Factors that must be considered include the influence of the hub and tip wall shear layers boundary layer separation and its behavior and the effect of blade curvature and Coriolis effect on turbulence The flow in the meridional plane is considered Secondary flow behavior is calculated by averaging circonferentially the turbulent Navier-Stokes equations The flow in the blade-to-blade plane is considered Accurate calculations of separation and acceptable calculations of the

separated boundary layer are obtained The curvature and Coriolis effect are determined using an integral method of boundary layer calculation A R H

N79-19388# Societe Creusot-Loire Paris (France) Div Energie
APPLICATION OF AERODYNAMIC DESIGN TECHNIQUES TO PROCESS COMPRESSOR DESIGN
J M Duchemin J Jehl, and M Roustan *In* Von Karman Inst for Fluid Dyn Ind Centrifugal Compressors Vol 1 1977 66 p refs
Copyright Avail NTIS HC A10/MF A01
The computing system developed at Creusot-Loire to accurately predict performances upgrade existing machinery and establish new designs is described Some theoretical results and a comparison between performance testing and calculation are shown Author

N79-19389# Von Karman Inst for Fluid Dynamics, Rhode-Saint-Genese (Belgium)
INDUSTRIAL CENTRIFUGAL COMPRESSORS, VOLUME 2
1977 335 p refs Proc of lectures held on 21-25 Feb 1977 2 Vol
(VKI-Lecture-Series-95) Avail NTIS HC A15/MF A01
Factors to be considered for optimal design and performance of turbocompressors are discussed with emphasis on thermodynamic properties and component configurations

N79-19390# Gutehoffnungshuette Sterkrade A G Oberhausen (West Germany)
DESIGN OF MULTISTAGE COMPRESSORS WITH CONSIDERATION OF THE REAL BEHAVIOR OF GAS AND GAS MIXTURES
L Turanskyj *In* Von Karman Inst for Fluid Dyn Ind Centrifugal Compressors, Vol 2 1977 102 p refs In BELORUSSIAN

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The thermodynamic equations of state provide the basis for correlations used to describe the p-v-T behavior of real gases and their mixtures With the help of these equations the enthalpy and entropy are determined and used in a design procedure to calculate multistage compressors The design procedure is fundamentally explained Problems involved in real gas behavior are considered in the prediction of the off-design behavior of multistage turbocompressors Typical machines in practical service are described to indicate the variety of uses of modern turbocompressors Author

N79-19391# Ruhr Univ Bochum (West Germany)
A STRESS AND STRAIN ANALYSIS OF INDUSTRIAL RADIAL COMPRESSOR IMPELLERS USING THE FRAMEWORK METHOD
W Fister and H Heiderich *In* Von Karman Inst for Fluid Dyn Ind Centrifugal Compressors, Vol 2 1977 58 p

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The simplified strength analysis of impellers is based on classical computational methods of shell theory leading to the analytical solution of differential equations However, the state of stress of the whole impeller particularly the regions of maximum stress are decisively influenced by the inherent strength of the blades The blading arrangement and geometry must be considered according to the actual design A computational procedure is described that makes possible an approximated strength determination of radial compressor impellers of an industrial geometry with and without a cover disk and subjected to centrifugal forces A R H

N79-19392# Nuovo Pignone S p A Florence (Italy)
DEVELOPMENT TESTING OF STAGES FOR CENTRIFUGAL PROCESS COMPRESSORS
E Benvenuti *In* Von Karman Inst for Fluid Dyn Ind Centrifugal Compressors, Vol 2 1977 130 p refs

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The features and capabilities of test rigs designed and set up for systematically testing industrial centrifugal compressor stages are discussed and an outline of testing requirements and limitations associated with the use of results both for manufacturing design and for component development is given Some types of instrumentation and particular equipment used in testing are described and the complexity of flow fields existing in some relevant areas along the gas flowpath is shown, for evaluating measurement reliability and outlining some related component development problems Test data reduction methods and correlation requirements are presented and the convenience of setting up standard stage series of known or reliably predictable performance is assessed An example of agreement between predicted and experimental performance is shown for a multi-stage compressor consisting entirely of standard stages directly derived from tested configurations A R H

N79-19393# Creare, Inc Hanover N H
TURBOCHARGER DESIGN AND DEVELOPMENT
D Japikse and J Goebel *In* Von Karman Inst for Fluid Dyn Ind Centrifugal Compressors Vol 2 1977 41 p refs

Copyright Avail NTIS HC A15/MF A01
Turbocharging diesel engines as a retrofit method of increasing maximum engine output usually result in better fuel economy Turbocharger/engine system performance is examined and different matching issues are discussed A sample turbocharger aerodynamic design is pursued through each design phase Highlights of the aerodynamic technology base are presented Topics covered in design optimization include impeller performance, vaneless and semivaneless space recovery and channel diffuser recovery A R H

N79-19396# Northwestern Univ Evanston Ill Dept of Mechanical Engineering and Astronautical Sciences
THERMOELASTIC AND DYNAMIC PHENOMENA IN SEALS Special Report, Jan - Sep 1978
Yih-Tsuen Wu and Ralph A Burton Sep 1978 49 p refs
(Contract N00014-75-C-0761)
(AD-A061754 Rept-5341-427-3) Avail NTIS HC A03/MF A01 CSCL 21/5
An analysis of a seal model is made where the rotating element has both fixed tilt and two-lobe waviness The stator is assumed to be gimbal mounted and to have inertial mass Hydrodynamic lubrication is assumed following the short bearing or narrow seal model Conditions are examined where the stator precesses in synchronism with the rotor rotation Particular interest is given to operating conditions where such behavior appears to degenerate Author (GRA)

N79-19412 Kansas Univ Lawrence
EXPERIMENTAL AND FINITE ELEMENT INVESTIGATION OF THE BUCKLING CHARACTERISTICS OF A BEADED SKIN PANEL FOR A HYPERSONIC AIRCRAFT Ph D Thesis
William Harry Siegel 1978 149 p
Avail Univ Microfilms Order No 7904230
The project reported on involved the testing of a hypersonic beaded skin panel to failure The primary interest was focused upon the buckling characteristics of the panel under pure compression with boundary conditions similar to those found in a wing mounted condition Three primary phases of analysis are included These phases include Experimental testing of the panel to failure, Finite element structural analysis of the beaded panel with the computer program NASTRAN, A summary of the semiclassical buckling equations for the beaded panel under purely compressive loads A comparison of each of the analysis methods is also included Dissert Abstr

N79-19414*# California Univ at Los Angeles
NONLINEAR EQUATIONS OF EQUILIBRIUM FOR ELASTIC HELICOPTER OR WIND TURBINE BLADES UNDERGOING MODERATE DEFORMATION Final Report
Avin Rosen and Peretz P Friedmann Dec 1978 104 p refs
(Grant NsG-3082 Contract E(49-26)-1028)

(NASA-CR-159478 UCLA-ENG-7718,
DOE/NASA/3082-78/1) Avail NTIS HC A06/MF A01 CSCL 20K

A set of nonlinear equations of equilibrium for an elastic wind turbine or helicopter blades are presented These equations are derived for the case of small strains and moderate rotations (slopes) The derivation includes several assumptions which are carefully stated For the convenience of potential users the equations are developed with respect to two different systems of coordinates, the undeformed and the deformed coordinates of the blade Furthermore, the loads acting on the blade are given in a general form so as to make them suitable for a variety of applications The equations obtained in the study are compared with those obtained in previous studies L S

N79-19418# Lockheed-California Co Burbank
FRACTURE MECHANICS FOR STRUCTURAL ADHESIVE BONDS, PART 2, PHASE 2 Final Report, 1 Jul 1977 - 30 Jun 1978
T R Brussat, S T Chiu and S Mostovoy Aug 1978 107 p refs
(Contract F33615-75-C-5224)
(AD-A061805, LR-28652-Pt-2 AFML-TR-77-163-Pt-2) Avail NTIS HC A06/MF A01 CSCL 13/5

Research results are presented of crack propagation tests and fracture mechanics analysis of laboratory joints and specimens bonded with FM-73 adhesive and containing bondline cracks New baseline specimens and tests are developed analyzed and used for Mode I and mixed-mode fracture mechanics testing of adhesives Baseline test data are reported for FM-73 including increasing load (fracture toughness) tests in laboratory air and sustained-load hot-water-immersed tests Results of fatigue crack growth tests are presented at two stress ratios two environments, and three cyclic frequencies for three different baseline specimen geometries and three different mixes of Modes I and II Fracture mechanics prediction methodology is demonstrated using results of nine da/dN tests of structural joint specimens immersed in hot water Two different finite element analysis procedures are used to calculate strain energy release rate as a function of crack size Then the baseline data enables crack growth rate estimation Multiple cracking is considered based on measurements of final crack sizes on the fracture surfaces on the failed specimens The estimated crack growth rates correlate well with the experimental data Author (GRA)

N79-19606# German Army Hospital, Munich (West Germany) Rescue Center
RESCUE HELICOPTERS IN PRIMARY AND SECONDARY MISSIONS
B Gorgass G Frey, W Stotz G Kugler, and I Karger *In* AGARD Operational Helicopter Aviation Med Dec 1978 5 p refs Prepared in cooperation with Allgemeiner Deutscher Automobil-Club-e V, Munich West Ger

Avail NTIS HC A99/MF A01

The experience of the Federal Republic of Germany in the use of rescue helicopters in the civilian rescue service on a trial basis in 1967 and 1968 is summarized The area of operations of rescue helicopter bases is considered in terms of geographical distribution of hospitals and special clinics as well as the population density and airspeed of the helicopter The composition of the technical and medical crew the range of functions and operation tactics the range of patients transported and the medical equipment onboard the rescue helicopter are among the topics covered J M S

N79-19614# Sikorsky Aircraft, Stratford, Conn Dept of Engineering
UH-60A MEDEVAC KIT
Horace T Hone *In* AGARD Operational Helicopter Aviation Med Dec 1978 9 p

Avail NTIS HC A99/MF A01

A kit designed for converting the standard BLACK HAWK aircraft to medical evacuation configuration, after removal of eight troop seats is described Four crash-attenuated litters are carried, plus a 60 Hz, 115 volt power pack that permits the use of regular hospital equipment by casualities in transit Litters can be loaded transversely from either side of the aircraft A lifting facility is provided for the upper litters J M S

N79-19615# Societe Nationale Industrielle Aerospatiale Marignane (France) Helicopter Div
CASUALTY EVACUATION BY HELICOPTER
Louis Vachon and Wilfrid Messens *In* AGARD Operational Helicopter Aviation Med Dec 1978 18 p ref In ENGLISH and FRENCH
Avail NTIS HC A99/MF A01

Casualty evacuation procedures which allow in-flight performance of all medical actions required for reanimation and small surgery together with transmission of medical data to the hospital are described An in-flight test of DAUPHIN, a modern ambulance installation for helicopters, on the occasion of a traffic accident simulation and, at the same time, an actual evacuation mission, is documented A full success demonstrated the validity of the concept J M S

N79-19616# Canadian Armed Forces Base Hospital, Bushell Park (Saskatchewan)
DEVELOPMENT OF CASUALTY EVACUATION KIT FOR THE LIGHT OBSERVATION HELICOPTER (KIWA)
R M Goede *In* AGARD Operational Helicopter Aviation Med Dec 1978 5 p refs

Avail NTIS HC A99/MF A01

The design and testing of a casualty evacuation kit utilizing the Kiowa helicopter is described This kit consisted of a stretcher support frame, aluminum stretcher and two rear doors with bubble extensions to ensure the necessary width to transport one patient across the rear passenger compartment Flight testing was carried out to determine the aerodynamic characteristics of the Kiowa aircraft with the kit installed This kit was designed to fit any Kiowa helicopter in the Canadian Forces fleet In the event of an aircraft crash, this kit could be installed in the first available aircraft in approximately fifteen minutes J M S

N79-19621# Army Aeromedical Research Lab Fort Rucker, Ala
US ARMY AVIATION FATIGUE-RELATED ACCIDENTS, 1971 - 1977
Gerald P Krueger and Yvonna F Jones *In* AGARD Operational Helicopter Aviation Med Dec 1978 11 p refs

Avail NTIS HC A99/MF A01

An accident data survey was made to determine how frequently aviator crew fatigue may have contributed to US Army aviation accidents from 1971 to 1977 All accident reports in the US Army Agency for Aviation Safety (USAAAVS) data base were reviewed Aviator fatigue was deemed to be a contributing factor in 42 rotary wing accidents which resulted in a total of 51 fatalities and 63 personnel injuries Fatigue contributed to 10 fixed wing accidents resulting in three fatalities and five injuries These fatigue related accidents are categorized by aircraft and mission type and by time of day and day of week of the accident Pilots activities prior to the accidents which promote the likelihood of pilot fatigue contributions are described The personnel and equipment costs of these accidents to the Army are estimated, and the relative importance of such accidents to the total US Army aviation accident picture is assessed J M S

N79-19625# Sikorsky Aircraft Stratford, Conn
ADVANCEMENTS IN HELICOPTER COCKPIT TECHNOLOGY
Howard P Harper *In* AGARD Operational Helicopter Aviation Med Dec 1978 7 p refs

Avail NTIS HC A99/MF A01

The requirements of future missions are discussed in terms of the need for advanced controls and displays and improvements in cockpit vision, workload, and comfort A number of technological areas are reviewed as candidates for inclusion in an advanced cockpit A cockpit design incorporating this technology is presented J M S

N79-19631# Naval Air Development Center Warminster Pa Aircraft and Crew Systems Technology Directorate
DESIGN PROCEDURE FOR AN INFORMATION TRANSFER METHOD CUBITS FOR ALLOCATING PANEL AREA FOR AIRCREW STATION CONTROLS AND DISPLAYS
Patrick M Curran *In* AGARD Operational Helicopter Aviation Med Dec 1978 10 p refs

Avail NTIS HC A99/MF A01

A systematic and objective method for the allocation of panel areas in aircrew workspaces was developed The developed procedure is based on (1) the criticality of the control or display on crew safety and mission effectiveness (2) the frequency of utilization and (3) the amount of information which is conveyed by the operator to the system through control actuation or which is conveyed to the operator by the display presentation This procedure utilizes a computational method called CUBITS to establish a single figure of merit for the allocation of panel space This method also deals with the number of control settings and accuracy required in the computation of the amount of information being transferred J M S

N79-19641# Army Aeromedical Research Lab, Fort Rucker Ala
VISUAL POCKETS A DESIGN PARAMETER FOR HELICOPTER INSTRUMENT PANELS
R W Bailey and David D Glick *In* AGARD Operational Helicopter Aviation Med Dec 1978 4 p refs

Avail NTIS HC A99/MF A01

The concept of fixation points between instruments ('Visual Pockets') for instrument flight of helicopters was proposed as a new concept to reduce pilot workload and improve performance It was also proposed that this concept be applied to cockpit instrument panel design In view of the significance attached to this revolutionary concept of Visual Pockets' a review and perspective of helicopter pilot visual information requirements are presented with special emphasis on the impact of Visual Pocket concepts J M S

N79-19643# Human Engineering Labs Aberdeen Proving Ground Md
INTERNAL COCKPIT REFLECTIONS OF EXTERNAL POINT LIGHT SOURCES FOR THE MODEL YAH-64 ADVANCED ATTACK HELICOPTER
Christopher C Smyth *In* AGARD Operational Helicopter Aviation Med Dec 1978 16 p refs

Avail NTIS HC A99/MF A01

The US Army Human Engineering Laboratory (HEL) developed a computer program for computing the internal cockpit reflections on the transparent canopy surfaces of external point light sources Computations were completed for the YAH-64 advanced attack helicopter (low glare canopy design) The results show that primary reflections as seen from the pilot's position are possible on (1) the upper rear corners of the forward side canopy surfaces (2) the upper edges of the rear sides, and (3) the sides of the top surface Computations were also completed for the copilot's position and show possible reflections on the front and side surfaces A computer graphics output is used to show reflection points on canopy layouts and perspectives of the cockpit J M S

N79-19646# Army Avionics Research and Development Activity, Fort Monmouth N J
A SURVEY OF COMMUNICATIONS IN THE HIGH NOISE ENVIRONMENT OF ARMY AIRCRAFT
Mitchell S Mayer and Arthur W Lindberg *In* AGARD Operational Helicopter Aviation Med Dec 1978 18 p refs

Avail NTIS HC A99/MF A01

In Army aircraft, the noise environment consists of a continuous noise level comprised of a mixture of random (broadband) and periodic frequencies (the aircraft noise signature or whine) and in the case of gunships, transient high-level noise bursts generated by the weapons systems The noise environment reaching the aviator s ear is comprised of direct ambient noise penetration and communications systems processed noise (during periods of communications use, or open mike operations) The most insidious impact of the high noise levels is the long-term permanent hearing threshold shift, or hearing loss that the aviator may incur from his prolonged exposure to the aircraft s interior sound pressure levels Improvement of speech intelligibility under all flight conditions will improve the aviator's effectiveness by reducing the number of transmission repetitions necessary to assure that a message is correctly conveyed, thus reducing the distraction level during critical mission phases Reducing the ambient aircraft noise processed by the communications system will further improve speech intelligibility and reduce this particular increased noise contribution to pilot stress Author

N79-19647# Royal Aircraft Establishment Farnborough (England) Human Engineering Div
SOME ASPECTS OF HELICOPTER COMMUNICATIONS

G M Rood and E J Lovesey *In* AGARD Operational Helicopter Aviation Med Dec 1978 7 p refs

Avail NTIS HC A99/MF A01

Factors that influence helicopter radio communications are examined These include the characteristics of the signal transmitter and receivers and their siting, the effects of noise and distortion of the signals, and the ability of the operator to perceive the signals while performing other tasks The interface of the man with the equipment and the helicopter environment and the effect of the helicopter environment upon his ability to receive and process audio signals is emphasized Helicopter noise levels helmet attenuation, signal masking total operator noise dose, and crew task difficulty are considered in terms of improving the overall helicopter/crew efficiency J M S

N79-19653# Michigan Univ Ann Arbor Inst of Highway Safety Research
OCCUPANT INJURY MECHANISMS IN CIVIL HELICOPTER ACCIDENTS
Richard G Snyder *In* AGARD Operational Helicopter Aviation Med Dec 1978 14 p refs Sponsored in part by FAA and NTSB
Avail NTIS HC A99/MF A01

Mechanisms incurred in several selected accidents involving roll-over, rotor blade strike and seat and restraint system failures are discussed The present injury and fatality rate could be reduced in civil accidents by improved restraints including use of upper-torso belts energy-absorbing seats, crashworthy fuel systems and increased use of protective helmets J M S

N79-19654# Army Agency for Aviation Safety Fort Rucker, Ala
COMPARATIVE INJURY PATTERNS IN US ARMY HELICOPTERS
Laurel D Sand *In* AGARD Operational Helicopter Aviation Med Dec 1978 7 p refs

Avail NTIS HC A99/MF A01

The type of injuries body area injured, and cause of injuries to 740 U S Army aviators involved in 388 rotary wing accidents from 1 January 1972 through 30 September 1977 are examined Considerations are given to two main areas (1) relationship to injury regarding the aviator s height, weight and location aboard the aircraft, cockpit condition, and aircraft altitude, and (2) comparison of present injury experience with previous injury studies The results, through statistical analyses show that not one or even combinations of those factors listed were significant in injury causation Further, comparisons of injuries show that the overall injury pattern has not changed significantly in the past 20 years For example, injuries to the extremities the head, and the spine continue to be among the leading body areas to be injured Also, 94 percent of all accidents from 1957 to the present were classified as survivable but produced 33 percent of all fatalities J M S

N79-19655# Army Agency for Aviation Safety Fort Rucker Ala

ENGINEERING ANALYSIS OF CRASH INJURY IN ARMY AIRCRAFT

James E Hicks *In* AGARD Operational Helicopter Aviation Med Dec 1978 11 p refs

Avail NTIS HC A99/MF A01

A methodology for identification of crashworthiness deficiencies in Army aircraft is discussed The methodology provides for injury and impact data to be extracted from accident reports using a specially developed injury coding system Personnel injuries are costed through a technique which provides for consideration of each injury based on its relative severity as determined by medical examination Crash injury causes are identified and ranked according to the magnitude of their effect and probability of occurrence The technique is designed to provide recommendations as to the most urgent crashworthiness research/development/procurement efforts for consideration by aircraft systems managers and aviation research laboratories An application of the methodology to an operated Army aircraft is shown *Preliminary results as to the more significant crash hazards* in this aircraft are discussed Recommendations are made as to the use of the methodology and to additional investigation aids which would improve the future identifications of crash hazards J M S

N79-19657# Army Agency for Aviation Safety, Fort Rucker Ala

ASSESSMENT OF THE BENEFITS OF AIRCRAFT CRASHWORTHINESS

Andrew E Gilewicz *In* AGARD Operational Helicopter Aviation Med Dec 1978 8 p refs

Avail NTIS HC A99/MF A01

An assessment is made of the economic benefits of providing crashworthiness improvements within future Army helicopters *Crashworthiness features which would be most worthwhile in* preventing or reducing injury and hardware damage are discussed from a cost effectiveness standpoint Predictions of future accident losses for a number of candidate utility helicopter replacements are given Projections were derived based on each helicopter s crashworthiness design features and the effectiveness in injury and hardware damage prevention The technical adequacy of the design requirements is verified based on typical Army helicopter crash impacts J M S

N79-19658# Army Aviation Research and Development Command, Fort Eustis Va Applied Technology Lab

CRASHWORTHY HELICOPTER SEATS AND OCCUPANT RESTRAINT SYSTEMS

George T Singley, III and Stanley P DesJardins (Simula Inc , Tempe, Ariz) *In* AGARD Operational Helicopter Aviation Med Dec 1978 32 p refs

Avail NTIS HC A99/MF A01

Seats and restraint systems offering substantial improvements in comparison to existing helicopters with respect to strength body restraint, and crash force attenuation are described These seat and restraint systems are capable of retaining the seated occupant in the same relative position within the aircraft throughout the 95th percentile potentially survivable accident without the occupant being subjected to conditions in excess of human tolerance Cockpit and cabin seat and restraint systems retention strengths are shown to withstand drop and sled tests with velocity changes of 50 ft/sec and peak accelerations of 48G for drop tests and 30G for sled tests This increased strength is achieved with lightweight designs and is made possible by the application of load limiting principles This crash force attenuation characteristic limits the impact loading not only of the seat structure but also of the seat occupant J M S

N79-19659# Royal Air Force Inst of Aviation Medicine Farnborough (England)

SOME IMPROVEMENTS TO THE UK HELICOPTER COCKPIT

D C Reader *In* AGARD Operational Helicopter Aviation Med Dec 1978 3 p refs

Avail NTIS HC A99/MF A01

The human-factor aspects of helicopters are discussed These include improvements to the restraint harnesses the location and methods of stowage of the survival aids, and the strength, adjustment and anti-vibration properties of the crew seats Experiments conducted to investigate the feasibility of different configurations of flight control are described J M S

N79-19660# Army Aeromedical Research Lab Fort Rucker, Ala

HELICOPTER CRASHWORTHY FUEL SYSTEMS AND THEIR EFFECTIVENESS IN PREVENTING THERMAL INJURY

Stanley C Knapp, Pierre Allemond (Army Agency for Aviation Safety, Ft Rucker, Ala) and David H Karney *In* AGARD Operational Helicopter Aviation Med Dec 1978 7 p refs

Avail NTIS HC A99/MF A01

All Army helicopter accidents during the period 1968-1976 are reviewed and classified by survivability and whether or not the aircraft was equipped with a crashworthy fuel system Accident associated fatalities and injuries are reclassified as to the primary injury involved and its relationship to the existence of any postcrash fire The direct costs involved in the care of thermal fatalities and thermal injuries are calculated using the most conservative estimates It is shown that the helicopter crashworthy fuel system essentially eliminated postcrash fatalities and injuries in accidents involving helicopters equipped with the new system J M S

N79-19661# Arizona State Univ , Tempe Engineering Safety Center

A METHOD FOR SELECTING A CRASHWORTHY FUEL SYSTEM DESIGN

S Harry Robertson and James W Thurbow *In* AGARD Operational Helicopter Aviation Med Dec 1978 6 p

Avail NTIS HC A99/MF A01

A rating method that a crashworthy fuel system designer can use to help determine the amount of hardware and special design considerations needed to obtain a desired reduction in the fuel system fire hazard level is discussed Man's tolerance to the thermal environment, and the escape time available to the aircraft occupants are among the factors considered J M S

N79-19663# Sikorsky Aircraft, Stratford, Conn Systems Engineering Branch

CRASH SURVIVABILITY OF THE UH-60A HELICOPTER

Brian L Carnell *In* AGARD Operational Helicopter Aviation Med Dec 1978 10 p

Avail NTIS HC A99/MF A01

The Sikorsky UH-60A or BLACK HAWK is designed to minimize the hazards found in the many accidents that occurred in the combat environment of Southeast Asia Its crash survivability design features are discussed These include (1) a protective shell is maintained around the occupants the energy absorbing landing gear cushions the crash impact and the structure is *designed to minimize penetration by rotor blades transmissions* and engines, (2) the loads on the occupants are limited to noninjurious levels, all seats are energy attenuating, (3) major postcrash fires are prevented a complete crash survivable fuel system is installed (4) the interior is noninjurious, no hard structure is in the head strike zones Padding and shielding in the cockpit protect the aircrew from injury and entrapment, and (5) adequate emergency escape capability is provided, jettisonable cockpit doors and cabin windows allow rapid emergency egress J M S

N79-19664# Hughes Helicopters, Culver City Calif Structural Analysis Section

THE APPROACH TO CREW PROTECTION IN THE CRASH ENVIRONMENT FOR THE YAH-64

John M McDermott *In* AGARD Operational Helicopter Aviation Med Dec 1978 7 p refs

Avail NTIS HC A99/MF A01

The approach to crashworthiness in protecting the crew of the advanced attack helicopter is described Basic requirements of crash criteria specified by the Army are presented Impact modes and impact velocities are discussed The means used to meet these requirements using a total systems approach (i e landing gear, plus fuselage crushing and energy absorbing seats all in series) are presented Crash pulses felt by the occupants during the various crash impacts are presented Design of energy absorbing seats is discussed Protection of the crew by use of turnover structure and by means of high load factors on heavy mass items which could penetrate the cockpit is illustrated Maintaining living space during crash barrier impacts, and protection against blade strikes using the roll over structure are discussed J M S

N79-19665# Naval Training Equipment Center Orlando Fla
HELICOPTER UNDERWATER ESCAPE TRAINER (9D5)

William F Cunningham *In* AGARD Operational Helicopter Aviation Med Dec 1978 3 p refs

Avail NTIS HC A99/MF A01

A helicopter equivalent of the Navy Dilbert Dunker long used as an underwater escape procedures trainer is described The same principles of of the Dilbert Dunker apply to the helicopter escape trainer Aircrews ride the trainer from different seat positions thoroughly gaining confidence in their ability to successfully escape from anywhere in the helicopter This training reflects the belief that successful escape from a ditched/sinking helicopter depends largely on spontaneous action achieved through repetitive drills The results tend to prove this true J M S

N79-19666# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany)
BAILOUT FROM AUTOROTATING HELICOPTERS
H D Melzig U Schmidt, and E A Bockemuller *In* AGARD Operational Helicopter Aviation Med Dec 1978 9 p refs

Avail NTIS HC A99/MF A01

Parachute jumps were conducted from an autorotating helicopter to prove the possibility of bailout with a parachute as a means of rescue in emergency cases The tests were conducted at glide angles of 17 deg proving by their good agreement with the computed results the general applicability of the computational method to glide angles up to 90 deg The results show that bailout from autorotating helicopters is possible for all glide angles It is recommended, however that crew members are taught to perform the ball attitude and give a delay of 3 sec before releasing their parachute J M S

N79-19814*# MAN-Acoustics and Noise Inc Seattle Wash
A COMMERCIAL AIRPORT NOISE ENVIRONMENT MEASUREMENT, PREDICTION AND CONTROL
Final Report
J E Mabry and B U Sullivan Feb 1979 72 p refs
(Contract NAS1-14404)
(NASA-CR-3107 MAN-1023-B) Avail NTIS HC A04/MF A01 CSCL 20A

The data for a commercial airport noise measurement program included approximately 1,100 calibrated tape recordings at three observer positions and some 1500 supplementary peak level measurement at ten additional measurement points For some individual airplane categories there were substantial differences between results based on state-of-the-art noise prediction technology and those based on actual measurements Certain takeoff procedures resulted in significant noise reductions for particular airplane types Also, there was some evidence that specific categories of airplanes can be flown with reduced ranges of peak noise levels Author

N79-19815*# United Technologies Research Center, East Hartford, Conn
AIRFRAME NOISE COMPONENT INTERACTION STUDIES
Final Report
Martin R Fink and Robert H Schlinker Mar 1979 138 p refs
(Contract NAS1 15083)
(NASA-CR-3110 R78-912996-12) Avail NTIS HC A07/MF A01 CSCL 20A

Acoustic wind tunnel tests were conducted of a two-dimensional wing section with removable high-lift leading and trailing edge devices and a removeable two-wheel landing gear with open cavity An array of far field conventional microphones and an acoustic mirror directional microphone were utilized to determine far field spectrum levels and noise source distribution Data were obtained for the wing with components deployed separately and in various combinations The basic wing model had 0 305 m (1 00 ft) chord, which is roughly 1/10 scale for a one-hundred passenger transport airplane Most of the data were obtained at 70 7 and 100 m/sec (232 and 328 ft/sec) airspeeds which bracket the range of practical approach speeds for such aircraft Data were obtained at frequence to 40 kHz so that when scaled to s typical full-airframe the frequency region which strongly influences preceived noise level woud be included Author

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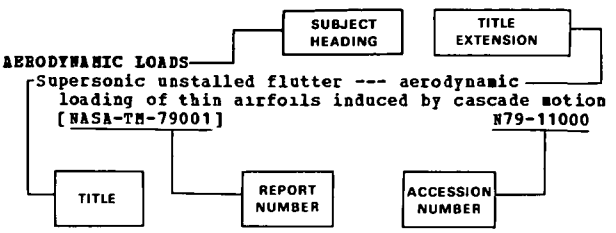

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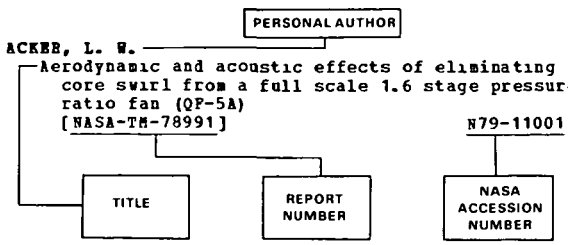

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