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A Continuing Bibliography with Indexes

NASA SP-7037 (106)
February 1979

National Aeronautics and Space Administration

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Aeronautical Engineering Pages 1–50 February 1979

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Accession numbers cited in this Supplement fall within the following ranges.

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IAA (A-10000 Series)	A79-10001 – A79-12976

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NASA SP-7037(106)

AERONAUTICAL ENGINEERING

A Continuing Bibliography

Supplement 106

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 January 1979 in

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

NASA Scientific and Technical Information Branch 1979
National Aeronautics and Space Administration
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INTRODUCTION

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

This supplement to *Aeronautical Engineering -- A Continuing Bibliography* (NASA SP-7037) lists 388 reports, journal articles, and other documents originally announced in January 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

Three indexes -- subject, personal author, and contract number -- are included

An annual cumulative index will be published.

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TABLE OF CONTENTS

IAA Entries **1**
STAR Entries **31**

Subject Index **A-1**
Personal Author Index **B-1**
Contract Number Index **C-1**

TYPICAL CITATION AND ABSTRACT FROM *STAR*

NASA SPONSORED DOCUMENT — AVAILABLE ON MICROFICHE

NASA ACCESSION NUMBER — **N79-10024*#** Northrop Corp Hawthorne Calif Aircraft Group — CORPORATE SOURCE

TITLE — **STUDY OF AERODYNAMIC TECHNOLOGY FOR VSTOL FIGHTER/ATTACK AIRCRAFT HORIZONTAL ATTITUDE CONCEPT Final Report** — PUBLICATION DATE

AUTHOR — S H Brown May 1978 242 p refs Sponsored in part by the David Taylor Naval Ship Research and Development Center Bethesda Md

CONTRACT OR GRANT — (Contract NAS2-9771)

REPORT NUMBERS — (NASA-CR 152130 NOR78-54) Avail NTIS — AVAILABILITY SOURCE

HC A11/MF A01 CSCL 01A — COSATI CODE

A horizontal attitude VSTOL (HAVSTOL) supersonic fighter attack aircraft powered by RALS turbofan propulsion system is analyzed Reaction control for subaerodynamic flight is obtained in pitch and yaw from the RALS and roll from wingtip jets powered by bleed air from the RALS duct Emphasis is placed on the development of aerodynamic characteristics and the identification of aerodynamic uncertainties A wind tunnel program is shown to resolve some of the uncertainties Aerodynamic data developed are static characteristics about all axes control effectiveness drag propulsion induced effects and reaction control characteristics G Y

TYPICAL CITATION AND ABSTRACT FROM *IAA*

NASA SPONSORED — AVAILABLE ON MICROFICHE

AIAA ACCESSION NUMBER — A79-10266 * # An experimental study of three-dimensional turbulent boundary layer and turbulence characteristics inside a turbomachinery rotor passage A K Anand and B Lakshminarayana — AUTHORS

TITLE — (Pennsylvania State University, University Park, Pa) *(American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9-13, 1978, Paper 78-GT-114) ASME, Transactions, Journal of Engineering for Power,* — AUTHOR'S AFFILIATION

TITLE OF PERIODICAL — vol 100, Oct 1978, p 676 687, Discussion, p 688 690 19 refs

Grant No NGL 39 009 007 — PUBLICATION DATE

Three dimensional boundary layer and turbulence measurements of flow inside a rotating helical channel of a turbomachinery rotor are described The rotor is a four-bladed axial flow inducer operated at large axial pressure gradient The mean velocity profiles, turbulence intensities and shear stresses, and limiting stream line angles are measured at various radial and chordwise locations, using rotating triaxial hot wire and conventional probes The radial flows in the rotor channel are found to be higher compared to those at zero or small axial pressure gradient The radial component of turbulence intensity is found to be higher than the streamwise component due to the effect of rotation Flow near the annulus wall is found to be highly complex due to the interaction of the blade boundary layers and the annulus wall resulting in an appreciable radial inward flow and a large defect in the mainstream velocity Increased level of turbulence intensity and shear stresses near the midpassage are also observed near this radial location (Author)

AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 106)

FEBRUARY 1979

IAA ENTRIES

A79-10257 # **Development of gas turbine performance seeking logic** D Jordan (Connecticut, University, Storrs, Conn) and G J Michael (United Technologies Research Center, East Hartford, Conn) *(American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9-13, 1978, Paper 78-GT-13) ASME, Transactions, Journal of Engineering for Power,* vol 100, Oct 1978, p 571-575, Discussion, p 575 NSF Grant No SER-76 05002

Adaptive control logic has been defined for static performance optimization of variable geometry gas turbine engines The control logic is directed toward (1) in-flight minimization of thrust specific fuel consumption, (2) test stand automatic trimming, and (3) generation of optimum control schedules The algorithm was evaluated by application to a nonlinear digital dynamic simulation of the F100/F401 turbofan engine throughout a range of representative flight conditions Engine component degradations as well as mistrimmed control schedules were introduced to assess algorithm performance Results indicate that the performance seeking algorithm offers promise for steady state performance optimization for in flight, test-stand, and set point design optimization applications (Author)

A79-10260 # **Asymmetric swirling flows in turbomachine annuli** E M Greitzer (United Technologies Research Center, East Hartford, Conn) and T Strand (Stal-Laval Turbin AB, Finspong, Sweden) *(American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9-13, 1978, Paper 78-GT-109) ASME, Transactions, Journal of Engineering for Power,* vol 100, Oct 1978, p 618-629 14 refs

An analytical and experimental investigation of asymmetric annular swirling flows is presented It is shown that, in contrast to the situation in nonswirling flow, the different types of flow disturbances (pressure and vorticity) are not separable in a swirling flow but are strongly coupled The flows that occur due to this coupling are inherently three-dimensional and exhibit new features not seen in the nonswirling case The theoretical predictions are in good agreement with experimental measurements carried out in an annular swirl rig (Author)

A79-10261 # **The effects of aircraft engine pollutant emission measurement variability on engine certification policy.** A B Wassell and D C Dryburgh (Rolls-Royce, Ltd , Derby, England) *(American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9-13, 1978, Paper 78-GT-86) ASME, Transactions, Journal of Engineering for Power,* vol 100, Oct 1978, p 630 639 12 refs

Divergence between aircraft engine emission regulations proposed by EPA and ICAO is discussed Every engine, upon entering service, requires a certificate as to its compliance with emission standards It is shown that despite the large variability in the measurements, it is possible to devise a certification procedure requiring the testing of one engine only Statistical modeling of such a test at the 5% significance level is described Values of the parameter standard deviation/mean recommended as certification standards for various pollutants are given Features of a rational certification scheme to be formulated are outlined S D

A79-10262 # **The effects of ambient conditions on gas turbine emissions - Generalized correction factors** P Donovan (Calspan Corp , Buffalo, N Y) and T Cackette (U S Environmental Protection Agency, Emission Control Technology Div , Ann Arbor, Mich) *(American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9-13, 1978, Paper 78-GT-87) ASME, Transactions, Journal of Engineering for Power,* vol 100, Oct 1978, p 640-646 8 refs U S Environmental Protection Agency Contract No 68 03-2159

A set of factors which reduces the variability due to ambient conditions of the hydrocarbon, carbon monoxide, and oxides of nitrogen emission indices has been developed These factors can be used to correct an emission index to reference day ambient conditions The correction factors, which vary with engine rated pressure ratio for NOx and idle pressure ratio for HC and CO, can be applied to a wide range of current technology gas turbine engines The factors are a function of only the combustor inlet temperature and ambient humidity (Author)

A79-10263 # **Significance of disk flexing in viscous-damped jet engine dynamics** N Klompas (General Electric Co , Gas Turbine Div , Schenectady, N Y) *(American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9-13, 1978, Paper 78-GT-107) ASME, Transactions, Journal of Engineering for Power,* vol 100, Oct 1978, p 647-654 10 refs

A new method of analyzing multishaft jet engine critical speeds and unbalance response is derived to account for flexible bladed disks, asymmetric mounting, and squeeze film bearing damping The resulting elliptical shaft whirling drives traveling waves in disks at speeds equal to the sum and the difference of the rotating speed and the whirling speed To illustrate a possible problem that cannot be predicted by current methods, a sample calculation shows a simplified model representing possible engine parameters tuned so that a critical speed associated with backward whirling is lowered into the operating range by reduction in disk stiffness In contradiction to the current literature, the rotor is shown highly responsive to unbalance at this critical speed (Author)

A79-10266 * # **An experimental study of three-dimensional turbulent boundary layer and turbulence characteristics inside a turbomachinery rotor passage** A K Anand and B Lakshminarayana (Pennsylvania State University, University Park, Pa) *(American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9-13, 1978, Paper*

78-GT-114) ASME, Transactions, Journal of Engineering for Power, vol 100, Oct 1978, p 676-687, Discussion, p 688-690 19 refs Grant No NGL 39 009-007

Three-dimensional boundary layer and turbulence measurements of flow inside a rotating helical channel of a turbomachinery rotor are described The rotor is a four-bladed axial flow inducer operated at large axial pressure gradient The mean velocity profiles, turbulence intensities and shear stresses, and limiting stream-line angles are measured at various radial and chordwise locations, using rotating triaxial hot-wire and conventional probes The radial flows in the rotor channel are found to be higher compared to those at zero or small axial pressure gradient The radial component of turbulence intensity is found to be higher than the streamwise component due to the effect of rotation Flow near the annulus wall is found to be highly complex due to the interaction of the blade boundary layers and the annulus wall resulting in an appreciable radial inward flow, and a large defect in the mainstream velocity Increased level of turbulence intensity and shear stresses near the midpassage are also observed near this radial location (Author)

A79-10267 # **A gas path performance diagnostic system to reduce J75-P-17 engine overhaul costs** G R Lazalier, J O Jacox (ARO, Inc , Arnold Engineering Development Center, Arnold Air Force Station, Tenn), and E C Reynolds, Jr (USAF, Air Logistics Center, Oklahoma City, Okla) *(American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9-13, 1978, Paper 78-GT-116) ASME, Transactions, Journal of Engineering for Power,* vol 100, Oct 1978, p 691-697 7 refs

The objective of this program was to develop a performance diagnostic system to analyze gas path performance and to recommend economical component replacement and/or modifications to minimize overhaul costs by increasing post-overhaul acceptance rates at the Oklahoma City Air Logistics Center (OCALC) The diagnostic system utilizes a computer simulation of the J75-P-17 engine which was developed using experimental data from five J75-P-17 engine builds tested at the AEDC The computer simulation is the heart of the diagnostic system and provides performance partial derivatives to aid in evaluating changes in component behavior Implementation of the diagnostic system at the OCALC is in progress (Author)

A79-10268 # **A new stage stacking technique for axial-flow compressor performance prediction** A R Howell and W J Calvert (National Gas Turbine Establishment, Farnborough, Hants , England) *(American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9-13, 1978, Paper 78-GT-139) ASME, Transactions, Journal of Engineering for Power,* vol 100, Oct 1978, p 698-703 16 refs

Modern through-flow solutions, with allowances for losses, etc , give good predictions around design conditions They are more difficult to apply effectively when individual blade rows are operating under positive stall, negative stall or choke conditions, as can happen off-design in multistage axial-flow compressors of medium and high pressure ratios A return has been made at the National Gas Turbine Establishment to stage stacking techniques to help solve the off design performance problems Basically a new mean radius or one-dimensional analysis has been developed with particular reference to the stall and choke conditions corrections are then introduced for radial variations and for stage parameters such as blockage and work done factors Examples on the use of the technique have been selected to illustrate both its success and difficulties (Author)

A79-10270 # **Small perturbation analysis of nonuniform rotating disturbances in a vaneless diffuser** M Inoue and N A Cumpsty (Cambridge University, Cambridge, England) *(American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9 13, 1978, Paper 78-GT-154) ASME, Transactions, Journal of Engineering for Power,* vol 100, Oct 1978, p 711-721

The behavior of the distorted flow discharged from a centrifugal impeller within a vaneless diffuser is examined theoretically by assuming small disturbances to a main flow The inlet static pressure distribution is found in the calculation, and allowance is made for circumferential nonuniformity in the relative flow angle The flow is treated as incompressible and inviscid The analysis shows that the decay of irrotational disturbances is more rapid with increasing disturbance wave number (e g , more impeller blades), and that the effect of the main flow condition on this behavior is very small With rotational disturbances, however, the decay is slower than in the irrotational case and the effect of wave number is less However, the phase angle between radial and tangential velocity fluctuations is found to have a strong influence on the decay processes for rotational disturbances It is shown that the present small perturbation theory predicts results very similar to the Dean and Senoo (1960) theory for impellers with large blade numbers (over 20) For small numbers of blades the large circumferential nonuniformity in relative flow angle appears at smaller radii and the inaccuracy of the Dean and Senoo theory becomes pronounced (Author)

A79-10283 **Polish radar developments** J J Kroszczynski (Przemyslowy Instytut Telekomunikacji, Warsaw, Poland) In Radar-77, Proceedings of the International Conference, London, England, October 25 28, 1977 London, Institution of Electrical Engineers, 1977, p 3-7

The paper outlines the development of radar technology and equipment in Poland Attention is given to radar systems for air traffic control including the air-route surveillance radar AVIA C and the airport-area surveillance radar AVIA D These systems are further discussed with reference to antenna drive systems, rotation rates, and radar displays Installations built for testing large microwave antennas are noted The design of marine radar systems is considered noting SRN 600 radars, receiver systems, and operation under various climatic conditions S C S

A79-10299 **Enhancements of radar data-handling networks** A P Young (Marconi Radar Systems, Ltd , Chelmsford, Essex, England) In Radar-77, Proceedings of the International Conference, London, England, October 25-28, 1977 London, Institution of Electrical Engineers, 1977, p 86-89

In recent years the 'central computer' method of designing data-handling systems in which a central computer complex was used to provide all the computing services has been replaced by the 'distributed' method in which each operator's position and each major technical service has its own local computing system which is linked to the others by communicating channels In a major project for the British Civil Aviation Authority, configurations of the data-bus product organization now known as Locus 16 are used to reequip the Scottish Air Traffic Control Centre for its task of providing control and advisory service Naval uses of Locus 16 are also considered along with the employment of Locus 16 configurations in air defense Attention is given to radar display methods and development areas G R

A79-10318 **Moving target detector data utilization study** F R Castella and J T Miller, Jr (Johns Hopkins University, Laurel, Md) In Radar 77, Proceedings of the International Conference, London, England, October 25-28, 1977 London, Institution of Electrical Engineers, 1977, p 182-185 U S Department of Transportation Contract No FA74WA-3423

Experimental data gathered with an FPS-18 radar was used to evaluate the potential benefits of moving target detector (MTD) data on the air traffic control (ATC) tracking operation The MTD, which interfaces between the analog radar system and the digital automatic tracking system to provide automatic target detection and false alarm regulation, provides Doppler information on detected targets as well as range, bearing, and amplitude data The described investigation focused on the development of a centroid algorithm for extracting significant target features and on the utilization of these target features The study indicates that MTD data can enhance the operation of the Automated Radar Terminal System III ATC M L

A79-10320 **Multi-filter MTI system** H Fancy (Marconi Radar Systems, Ltd , Chelmsford, Essex, England) In Radar-77, Proceedings of the International Conference, London, England, October 25-28, 1977 London, Institution of Electrical Engineers, 1977, p 191-194

An outline is presented of a new type of signal processor called a Multifilter MTI, which has a performance superior to that of the elementary system involving the use of digitized double-cancellation Moving Target Indication (MTI) equipment with the current pulse surveillance radar The new processor, which combines the actions of MTI and the First Threshold of a plot extractor, provides outputs for use on a Plan Position Indicator or for the pulse-to-pulse integration required to complete the extraction function The limitations of the double-cancellation system are examined It is pointed out that the worst deficiencies of this system may be reduced by making use of modern digital components The multifilter system operates with a more complex filter response than is generally used at present An adaptive constant false-alarm rate technique is used G R

A79-10329 **A technical review of the radar systems implemented by Eurocontrol** E Morgan (EUROCONTROL, Brussels, Belgium) In Radar 77, Proceedings of the International Conference, London, England, October 25-28, 1977 London, Institution of Electrical Engineers, 1977, p 232-237 11 refs.

The paper deals with radar systems employed at three ATC centers established by Eurocontrol in Maastricht, the Netherlands, Shannon, Ireland, and Karlsruhe, FRG The design concepts and important technical features of the operational radar systems are discussed Attention is given to the advanced automatic display and data processing systems developed for treating flight plans and radar data V P

A79-10330 **Developments in radar data processing at the London Air Traffic Control Centre** N H A Smith (Plessey Radar, Ltd , Weybridge, Surrey, England) In Radar 77, Proceedings of the International Conference, London, England, October 25-28, 1977 London, Institution of Electrical Engineers, 1977, p 238-242

Air Traffic Control for the London Flight Information Region (FIR), covering England and Wales, is exercised from the London Air Traffic Control Centre (LATCC) at West Drayton near London Airport, Heathrow Radar, both primary and secondary, is the prime source of positional information available to the air traffic controller The present paper reviews the evolution of the radar processing and display facilities in use at LATCC and describes a major new system now being introduced for the 1980s (Author)

A79-10332 **Multisensor utilization investigation** J T Miller, Jr and J P Berry (Johns Hopkins University, Laurel, Md) In Radar-77, Proceedings of the International Conference, London, England, October 25 28, 1977 London, Institution of Electrical Engineers, 1977, p 248-252 U S Department of Transportation Contract No FA74WA 3423

An overview is presented of the key results of an evaluation of the advantages and problems connected with the introduction of approaches which will lead to increased automation of the Air Traffic Control (ATC) system The developments considered are related to the multisensor combination of airport and en route radar/beacon air space surveillance systems in an environment characterized by heavy traffic loads, severe terrain limitations, and a high potential for interference and anomalous propagation Data for the evaluation was collected by simultaneously recording both digital and analog data from 12 sensors located at seven sites throughout the Los Angeles basin Data from each sensor was tracked off line and then combined into multisensor track files, one for each of the multisensor combinations considered It was found that combining sensor data from the various sites in the Los Angeles basin has the potential for improving overall automated ATC surveillance by improving coverage capability and enhancing track accuracy G R

A79-10341 **Stochastic Response Secondary Surveillance Radar /S R S S R /** L Milosevic and M Lenoir (Thomson-CSF, Division Systemes Electroniques, Bagneux, Hauts-de-Seine, France) In Radar-77, Proceedings of the International Conference, London, England, October 25 28, 1977 London, Institution of Electrical Engineers, 1977, p 298 302

Consideration is given to a method for the elimination of garbling caused by the overlapping of responses from aircraft The method involves the separation of responses of aircraft which are in a response overlapping configuration aircraft are interrogated and asked to respond randomly The method is able to ensure separation of responses and improve radar operation under dense traffic conditions Attention is given to the theoretical performance, interrogation/response procedures, and flight testing of this stochastic response method B J

A79-10363 **Some novel techniques for avoiding antenna obscurations and E M C effects** R H J Cary (Royal Signals and Radar Establishment, Malvern, Worcs , England) In Radar-77, Proceedings of the International Conference, London, England, October 25-28, 1977 London, Institution of Electrical Engineers, 1977, p 419-422

An interference from rods, or rod antennas of diameter small compared with the wavelength but of length much greater than the wavelength is considered If a metallic rod is surrounded by a low-loss dielectric material whose dimensions are such as to give rise to a matching capacitative susceptance, a parallel tuned circuit can be formed at the radiation frequency, resulting in a low admittance which makes the combination appear invisible at the selected wavelength and maintains the phase front Applications of this dielectric compensation technique are examined Interference from metallic elements of diameter large compared with the wavelength is also investigated The radiation pattern of a source close to an interfering surface large compared with the wavelength, unless made electrically transparent to the source wavelength, will suffer severe shadowing and pattern distortion A solution could be to break up the metallic surface into a grid and compensate its inductive susceptance by a suitable dielectric layer G R

A79-10364 **A yaw stabilised S A R aerial** J Thraves (EMI Electronics, Ltd , Wells, Somerset, England) In Radar 77 Proceedings of the International Conference, London, England, October 25-28, 1977 London, Institution of Electrical Engineers, 1977, p 423-426

An aerial is described which is used in an airborne synthetic aperture radar It is stabilized against aircraft yaw and roll motions by mechanical means The radiating structure is made up out of a number of separate 2D waveguide slot arrays which are in turn fed via a waveguide corporate feed structure Resonant arrays are used to simplify the radiating panels and to keep them compact Yaw stabilization is obtained by mechanically steering individual panels together with compensating phasers to maintain control over the beam shape (Author)

A79-10381 **Experimental design study of an airborne interferometer for terrain avoidance** K E Potter (Royal Signals and Radar Establishment, Malvern, Worcs , England) In Radar 77, Proceedings of the International Conference, London, England, October 25-28, 1977 London, Institution of Electrical Engineers, 1977, p 508 512

Terrain-avoidance radar presents the pilot with a 3-D picture of the terrain ahead of him By observing the display the pilot can choose a flight path such as to maintain maximum cover by flying between mountains at low level The third dimension (elevation angle) is achieved by means of some form of angle sensitive processing The method considered for doing this in the reported study makes use of the phase difference of target returns This is an application of the interferometer principle Attention is given to design considerations, slot conductance determination, the determination of the slot parameters and the antenna design, the interferometer characteristics, and glinting targets In order to measure accurately the interferometer characteristics a 'free space' measurement was performed to keep reflections to a minimum G R

A79-10390 * Operational benefits from the Terminal Configured Vehicle J P Reeder and R A Schmitz (NASA, Langley Research Center, Terminal Configured Vehicle Program Office, Hampton, Va) *Society of Automotive Engineers, Air Transportation Meeting, Boston, Mass , May 1-4, 1978, Paper* 30 p 18 refs

The objective of Terminal Configured Vehicle (TCV) research activity is to provide improvements which lead to increased airport and runway capacity, increasing air traffic controller productivity, energy efficient terminal area operations, reduced weather minima with safety, and reduced community noise by use of appropriate measures Some early results of this research activity are discussed, and present and future research needs to meet the broad research objectives are defined Particular consideration is given to the development of the TCV B 737 aircraft, the integration of the TCV with MLS, and avionics configurations, flight profiles, and manually controlled approaches for TCV Some particular test demonstrations are discussed B J

A79-10391 The CF6-32 as a derivative engine of the CF6-6 I Mendelson (General Electric Co , Cincinnati, Ohio) *Society of Automotive Engineers, Air Transportation Meeting, Boston, Mass , May 1-4, 1978, Paper 780511* 15 p 6 refs

The CF6-32, a derivative of the CF6-6D high bypass turbofan, is considered as a new 30,000 lb thrust class engine for commercial transport service in the early 1980s CF6-32 is discussed and compared with other candidate engines in terms of cycles, controls, satisfaction of environmental conditions, and reliability and maintenance costs Economic justification is developed for the CF6-32 It is found that using the CF6-6D mature core with an initial capability of low shop visit rate more than offsets the performance advantage that would be inherent in a new engine tailored to the new aircraft thrust requirements and available in the early 1980s B J

A79-10392 The RB211-535 - New member of the family S C Miller (Rolls Royce, Ltd , Aero Div , Filton, Bristol, England) *Society of Automotive Engineers, Air Transportation Meeting, Boston, Mass , May 1-4, 1978, Paper 780512* 17 p

The paper discusses the RB211 535 commercial aircraft engine which extends the thrust of the RB211 model to the 30,000-36,000-lb range The engine is suitable for 160 to 200 seat medium-range twin-engine jet and 200 to 240 seat wide body tri-jet aircraft The thermodynamic cycle of the engine is discussed with reference to engine airflow, propulsive efficiency, and the advantages and disadvantages of the core engine size Engine performance is reviewed in terms of specific fuel consumption at cruise speeds and the effects of installation losses Environmental factors are noted including noise levels and atmospheric pollution The final selection of engine weight is assessed on the basis of the potential weight effect of the rejected options Mechanical design characteristics, such as the front end, turbine life, bearings, oil system, external gearbox, fuel control system, and thrust reverser are considered S C S

A79-10393 Planning the passenger terminal D Turner (British Airports Authority, London, England) *Society of Automotive Engineers, Air Transportation Meeting, Boston, Mass , May 1-4, 1978, Paper 780517* 10 p

Various aspects of passenger terminal design are addressed noting airline requirements, corporate objectives, and service standards Passenger traffic and its influence on service levels is considered with reference to check in procedures, baggage claim, and seating needs Terminal characteristics are reviewed in terms of the various types of passengers serviced for both domestic and international flights S C S

A79-10394 Cascade Queue model of airport users W J Dunlay, Jr (Pennsylvania, University, Philadelphia, Pa) *Society of Automotive Engineers, Air Transportation Meeting, Boston, Mass, May 1-4, 1978, Paper 780518* 18 p 19 refs U S Department of Transportation Contract No OS-50232

A deterministic, cascade or network queueing algorithm is presented that relates, using a recursive formula, the passenger arrival patterns at components of any two successive stages of airport terminal building processors as a function of the service times, service rates, and waiting times of components in the first stage and the passenger flow distribution pattern The effects of ancillary activities between two stages are treated with a stimulus-response model, the stimulus is time before departure and the response is ancillary activity usage An attempt to implement the model using a discrete-time flow model is described (Author)

A79-10395 Issues in the design and analysis of airport ground transport systems M S Daskin (MIT, Cambridge, Mass) *Society of Automotive Engineers, Air Transportation Meeting, Boston, Mass , May 1-4, 1978, Paper 780519* 24 p 7 refs

Loop transportation systems are studied The standard critical link analysis is evaluated and found to be deficient in several ways The concepts of spatial and temporal service variability are introduced and means of quantifying these phenomena are presented A simulation model is used to assess the effects of service variability on performance or waiting times The models presented are designed to augment the critical link analysis and to allow designers to gain a better feel for the system behavior before running detailed simulations (Author)

A79 10396 Commercial STOL - The airplane, the airport M C W Davy (de Havilland Aircraft of Canada, Ltd , Downsview, Ontario, Canada) *Society of Automotive Engineers, Air Transportation Meeting, Boston, Mass , May 1 4, 1978, Paper 780520* 7 p

On the assumption that further building of large airports will be denied the paper examines the scope for upgrading the efficiency of existing terminals by the addition of short runways within their boundaries It is found that runways of about 2000 feet in length can frequently be placed so as to avoid interference with existing flight paths, particularly when account is taken of the compact maneuvering capability of typical short field aircraft This blend of land availability and existing airplane types is proposed as an economically viable near term relief to terminal congestion (Author)

A79-10397 A method for assessing turbine engine run-up noise impact on airport neighbors R W Tagg (USAF, Propulsion Performance/Stability Div , Wright-Patterson AFB, Ohio) *Society of Automotive Engineers, Air Transportation Meeting, Boston, Mass , May 1-4, 1978, Paper 780522* 7 p 6 refs

A methodology for assessing ground run-up noise exposure/impact resulting from turbine engine performance testing on outdoor facilities was developed The overall methodology consists of three calculation procedures using dBA levels (measured or estimated) to predict the Day-Night Level (LDN) at any location across existing terrain The methodology provides the analysis capability required to (1) study noise suppressor requirements in order to minimize costs, (2) locate run-up and test-cell pads, and (3) study the impact of run-up operations changes It also provide a potential capability for assessing noise exposure from (1) takeoff power check run ups, or (2) other (non turbine) static noise sources (Author)

A79-10398 * Simulation study of the effect of fuel-conservative approaches on ATC procedures and terminal area capacity L Tobias, E A Palmer (NASA, Ames Research Center, Moffett Field, Calif), and P J O'Brien (FAA, National Aviation Facilities Experimental Center, Atlantic City, N J) *Society of Automotive Engineers, Air Transportation Meeting, Boston, Mass , May 1-4, 1978, Paper 780523* 13 p 6 refs

Fuel-conservative procedures have been investigated using real-time air traffic control simulations linked to two piloted simulators The fuel conservative procedures studied were profile descents and two types of landing approaches The investigation determined the effect of these procedures on the ATC system and terminal area capacity It examined the mixing of aircraft executing fuel-conservative approaches with those executing conventional approaches The results indicate a systems fuel savings for the landing approaches under all tested conditions except at, or near, maximum system capacity Also, there is a fuel savings and reduced controller workload for the profile descent procedures (Author)

A79-10400 **Airport development in Micronesia** C T Argue (Continental Air Lines, Inc , Los Angeles, Calif) *Society of Automotive Engineers, Air Transportation Meeting, Boston, Mass , May 1-4, 1978, Paper 780530* 18 p 7 refs

While jet aircraft can be operated into and from short unpaved runways in regular airline service, increased costs and other limitations dictate improved airfields and minimum terminals Airport development in areas such as the islands of Micronesia in the Pacific requires considering of many factors Realistic forecasts of requirements are necessary due to high construction costs for improvements and limited financing alternatives User airline input and participation must be included in the planning and design process To maintain maximum flexibility in the air service offered, airports in a region should be studied and developed on a system basis (Author)

A79-10401 **Planning, design and construction of the Queen Alia International Airport** R J Hodge (Tippetts Abbett-McCarthy Stratton, Washington, D C) *Society of Automotive Engineers, Air Transportation Meeting, Boston, Mass, May 1-4, 1978, Paper 780531* 10 p

The Queen Alia International Airport is being designed to replace the existing Amman airport This paper describes pertinent background information, conditions encountered, design approaches and construction considerations The 'special environment' factors include location in a Zone III earthquake region, hot and semi-arid climate, adverse water supply conditions, the type and quality of locally available construction materials, and, local customs and procedures Proper solutions are being achieved through the performance of investigations, the experience of the local prime contractor, and, cooperation by the several governmental and local organizations (Author)

A79-10402 **Planning the high elevation/high temperature airport** R J Francillon and J P Beatty (International Engineering Co , Inc , San Francisco, Calif) *Society of Automotive Engineers, Air Transportation Meeting, Boston, Mass , May 1-4, 1978, Paper 780532* 20 p

The airport planner working with airports at high elevations is faced with existing conditions that require careful consideration Of primary concern is the safety of airspace procedures in mountainous areas which are critical and difficult Another serious consideration is that construction in these areas is expensive both for the airport and for the facilities that are required for its operation This paper describes experiences and the approach employed in undertaking site selection and master planning for future airport development at Quito, Ecuador, which is at 2812 meters elevation The city's airport has experienced major impacts from commercial aviation growth in the last two decades As commercial aircraft traffic increases, the airport is becoming overtaxed physically and environmentally Major improvements are required to remedy this situation Since this same problem may be facing other airports in similar regions, the experiences at Quito may be of interest (Author)

A79-10404 **Rotorcraft for transport use - European requirements** D F Huggett (British Airways Helicopters, Ltd , Horley, Surrey, England) *Society of Automotive Engineers, Air Transportation Meeting, Boston, Mass , May 1-4, 1978, Paper 780535* 10 p

The employment of rotorcraft for transport applications in Europe is discussed About 63% of civil helicopter operations are related to aerial work This includes such activities as filming, crop spraying, and powerline inspection Offshore support operations in the search for oil and gas reserves account for 22% of all operations Another 5% are taken up by executive transport operations, while scheduled services and air taxis operations comprise 10% The operational requirements of rotorcraft are related to integration within the established aviation complex, environmental acceptability, and operating considerations The overall economic acceptability of the helicopter is also evaluated, giving attention to considerations of maintainability, reliability, and availability G R

A79-10405 **Helicopter transport efficiency payoffs from advanced technology** L G Knapp and E J Nesbitt (United Technologies Corp , Sikorsky Aircraft Div , Stratford, Conn) *Society of Automotive Engineers, Air Transportation Meeting, Boston, Mass , May 1 4, 1978, Paper 780536* 27 p

Advances in helicopter technology are discussed with attention to rotor blade lifting efficiency, main rotor head bearings, tail rotor design, light weight materials and synthetics, vibration reduction, and aerodynamic drag These advances in technology will be incorporated in the S 76, and the technology payoffs are examined Cost benefit information is presented, and the operating cost per passenger seat mile is estimated to be 16 cents for the S 76 M L

A79-10406 **Overview of the small package air carrier industry - A study of the operations in Federal Express** Y Chan (Pennsylvania State University, University Park, Pa) and R J Ponder (Federal Express Corp , Memphis, Tenn) *Society of Automotive Engineers, Air Transportation Meeting, Boston, Mass , May 1 4, 1978, Paper 780540* 12 p 7 refs

A79-10408 **Certification-compliance demonstration by flight or simulation** D M Archibald (Lockheed California Co , Burbank, Calif) *Society of Automotive Engineers, Air Transportation Meeting, Boston, Mass , May 1-4, 1978, Paper 780549* 11 p

The certification of an aircraft has progressed from demonstrations which were performed entirely upon the first flight article to those in recent years which apply varying degrees of ground based test facilities (simulators) This paper, based primarily on the development and certification of the Lockheed L 1011, concludes that increased simulation to show compliance is not only possible but in many instances is cost effective as well This conclusion is based on a review of the requirements set down by FAR 25, the methods used to certify the L-1011, and the relative costs of compliance demonstration by flight testing and simulation The present industry trend toward the derivative aircraft is making the argument for increased simulation for certification even stronger The data base for the baseline aircraft has usually been well established by the time the derivative comes from the drawing board Thus simulation, with supporting flight test, may well be the most cost effective means of certification (Author)

A79-10409 **The role of flight dynamic modeling in helicopter certification** K C Hansen (United Technologies Corp , Sikorsky Aircraft Div , Stratford, Conn) and G Mulcahy (FAA, Burlington, Mass) *Society of Automotive Engineers, Air Transportation Meeting, Boston, Mass , May 1 4, 1978, Paper 780550* 14 p

The paper describes the development of the Sikorsky Aircraft's Helicopter Flight Dynamics Model (Gen Hel), validation of the model, how Sikorsky anticipates that it could be used for helicopter certification, and how the FAA foresees the use of flight dynamics models in supporting certification Gen Hel is intended to generate the flight characteristics of single-rotor helicopters with specified geometric, aerodynamic, and mass properties The model uses a hybrid computer facility consisting of two analog computers, a digital computer, a helicopter flight simulator, a hybrid interface unit, and an input/output equipment composed of a teletype console, a Brush recorder, and a line printer It is shown that Gen Hel has and can be used for correct prediction of the primary aircraft dynamic response to control inputs, thereby reducing the matrix of flight testing required for certification The FAA stipulates that simulation results must be comparable to test results S D

A79-10410 **The need and impact of long-term advances in aircraft technology - The airlines' point of view** R R Shaw (International Air Transport Association, Geneva, Switzerland) *Society of Automotive Engineers, Air Transportation Meeting, Boston, Mass , May 1-4, 1978, Paper 780554* 8 p

The paper examines airline requirements for advanced aircraft technology in the time frame 10-20 years from the present Special emphasis is on the energy problem and in particular the question of the availability and price of jet fuel in the 1990s The main position of the paper is that in the foreseeable future, the commercial airlines of the world will have to continue using liquid hydrocarbon fuel that is essentially similar to the fuel in use today Attention is also given to possible developments in the pricing and marketing of airline services and the effect on the demand of the airlines for very high speed aircraft and very long range aircraft P T H

A79-10411 **Directions for developing an air cargo system planning model** P A Kivestu, D F X Mathaisel, and N K Taneja (MIT, Cambridge, Mass) *Society of Automotive Engineers, Air Transportation Meeting, Boston, Mass, May 1 4, 1978, Paper 780556* 12 p 13 refs

This paper highlights the need and provides a direction for formulating a system planning model to assess the requirements in all segments of the air cargo industry Currently operational models of the demand for and the supply of air cargo services are neither sufficiently policy-sensitive nor detailed enough to be responsive to the interactions of both supply and demand Thus, based on classical economic theory an interactive framework for a system planning model is suggested Techniques ranging from mathematical programming to econometrics are proposed to develop the various components within the system (Author)

A79-10412 **A Hub operator's view of small aircraft operations** L E Wagener (Broward County, Aviation Div, Broward County, Fla) *Society of Automotive Engineers, Air Transportation Meeting, Boston, Mass, May 1-4, 1978, Paper 780562* 5 p

The formal definition of a Hub Airport, according to federal authorities, is an airport which enplanes over 05 percent of the total enplaned domestic airline passenger traffic in the United States during a given year Hub Airports may be subdivided into categories of Small, Medium, and Large Hubs and these category classifications are dependent upon the number of passengers enplaned As advances are made in airport design and air traffic control techniques, it may be expected that small aircraft, reciprocating engine aircraft of less than 12,500 lb, can be better assimilated into the environment of a Hub Airport without unduly burdening the total aircraft operating system (Author)

A79 10414 **The airport capacity increasing potential of angled runway exit designs** M H Coggins (FAA, Washington, D C) *Society of Automotive Engineers, Air Transportation Meeting, Boston, Mass, May 1 4, 1978, Paper 780567* 10 p 19 refs

This report presents the results of an investigation to determine the causes of low utilization of angled runway exits on air carrier airports, to identify feasible measures to increase their utilization and to assess the probable resultant increase in runway capacity The areas considered included aircraft runway occupancy time and travel time influence factors including taxiway networks, landing and deceleration procedures, cornering acceleration constraints, approach profiles and present and possible improvements in future supportive equipment such as glide slope and approach control No field data was collected (Author)

A79-10415 **Relative pavement bearing strength requirements of aircraft** R C O'Massey (Douglas Aircraft Co, Long Beach, Calif) *Society of Automotive Engineers, Air Transportation Meeting, Boston, Mass, May 1-4, 1978, Paper 780568* 9 p 6 refs

Techniques for developing index numbers used in reporting airfield bearing strength are considered Attention is given to the aircraft classification number and the pavement classification number Calculations are presented for both rigid and flexible pavements and tire pressure adjustments are noted S C S

A79-10416 **Possible near-term solutions to the wind shear hazard** H G Tinsley, F G Coons, and L W Wood (FAA, Washington, D C) *Society of Automotive Engineers, Air Transportation Meeting, Boston, Mass, May 1-4, 1978, Paper 780572* 9 p

The Federal Aviation Administration's Wind Shear Program has developed three potential near term solutions to the aviation problems created by hazardous low-level wind shear They include development of a ground based Low Level Wind Shear Alert System to detect and track shear through the terminal areas, development of a Hazardous Wind Shear Advisory Service in cooperation with the National Weather Service to alert pilots when strong wind shear conditions are going to affect airport operations and development of on-board displays to assist pilots in coping with shear during approach and landing Each of the above potential solutions are reviewed (Author)

A79-10453 # **Pollution sources caused by aviation (Les sources de pollution causees par le transport aérien)** S Y Piotte In Urbanization and pollution, Symposium, Saint-Jovite, Quebec, Canada, May 29-31, 1977, Proceedings
Montreal, Association pour l'Assainissement de l'Air, 1977, p 12-24 17 refs In French

The significance of pollution with respect to the planning and operation of air travel is discussed with attention to several forms of pollution Effects and measurement of noise pollution are described, and characteristics of pollutants produced during airflight are described The extent that pollution sound pollution especially limits land use near airports is considered M L

A79-10568 # **Determination of the aerodynamic damping of turbine blade vibrations with allowance for the pitch, exit blade angle, and blade curvature (Otsenka aerodinamicheskogo dempfirovaniia kolebanii lopatok turbomashin s uchetom shaga, ugla vynosa reshetki i krivizny lopatok)** V A Balalaev (Akademiia Nauk Ukrainskoi SSR, Institut Problem Prochnosti, Kiev, Ukrainian SSR) *Problemy Prochnosti*, Aug 1978, p 98 103 10 refs In Russian

A79-10618 # **On the conventional definitions of thrust/drag of an aircraft equipped with a turbojet engine** M Cassetti (International Astronautical Federation, Flight Test Dept, Paris, France) *Aircraft Engineering*, vol 50, Sept 1978, p 4 7

The paper examines the possibility of overcoming the difficulties involved in the determination of propulsion forces from the aerodynamic forces of an aircraft, due to the interaction between airframe and engine aerodynamics The problem is approached by proposing new thrust and drag definitions which correspond better to the physical aspects of the problem than the conventional classical definitions 'Modernized' definitions are obtained by means of the 'MCA method' a currently accepted method for measuring aircraft performance through flight testing, developed by Cassetti, 1977 The advantages of the new thrust and drag definitions are elimination of theoretical assumptions, elimination of ambiguous physical results, and harmony with the physical problem V P

A79-10619 # **All weather cockpit canopies I - The F16** F Burnham *Aircraft Engineering*, vol 50, Sept 1978, p 10 12

The paper deals with a program initiated to develop a new generation of advanced supersonic fighter aircraft windshields and canopies, using advanced materials, technology, and manufacturing techniques Specifically examined is a research and development effort to produce polycarbonate windshields and canopies that are bird-proof at near supersonic speeds, provide 360 degree visibility (as in the case of the F 16, where the pilot sits on top of the aircraft in a transparent bubble) by eliminating the bow frame, meet the minimum weight requirement, and the requirement of maximum structural integrity V P

A79-10620 # **All weather cockpit canopies II - 'The Challenger'** F Burnham *Aircraft Engineering*, vol 50, Sept 1978, p 12-14

The Canadair CL-600 Challenger is an advanced technology wide-body executive jet/feeder transport featuring a supercritical wing and high-bypass-ratio turbofan engines The present paper deals with the development and design of the cockpit windshield and side windows which are made of laminated acrylic The windshield consists of a thin faceply and two mainplies bonded with polyvinyl butyral interlayers The faceply has a Sieracotte-303 anti-ice heating film deposited on its inner surface Side windows are of similar construction but do not have the acrylic faceply V P

A79-10621 # **Hazard criticality analysis** R A Collacott *Aircraft Engineering*, vol 50, Sept 1978, p 18-23 18 refs

Many techniques can be used for the surveillance and monitoring of process plant as a basis for integrity control associated with on condition maintenance and safety appraisal However, before any technique is chosen an analysis must be made which rates the hazard in terms of its criticality and thus establishes the situation with the greatest likelihood of occurrence, the gravest consequence, and the mode of its appearance The present paper describes some of the procedures which have been used, and indicates some means by which they can be further developed for effective use by designers and operators of process plants and machinery V P

A79-10757 # **A rotating stall control system for turbojet engines** G R Ludwig and J P Nenni (Calspan Corp, Buffalo, N Y) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England Apr 9-13, 1978, Paper 78-GT-115* 9 p Members, $1 50, nonmembers, $3 00 Contract No F3615-73 C 2046

This paper describes the operating principle of a rotating stall control system and the results of testing a prototype control on a low-speed research compressor and on a J-85 5 turbojet engine The control is an electrical feed back control system which uses unsteady pressure signals produced by sensors within the compressor to detect the presence of stall and provide a correction signal when stall occurs In the prototype system, the correction signal is used to drive a hydraulic actuator which provides a mechanical operation on some variable geometry feature of the compressor being controlled On the low-speed research compressor the variable geometry was the stagger angle of the stator rows On the J-85 engine, the control was installed to override the normal operating schedule of the compressor bleed doors and flaps on the inlet guide vanes Both series of tests were successful in that the control rapidly eliminated rotating stall when it occurred and in some cases did not allow rotating stall to occur at all (Author)

A79 10759 # **A digital fuel control system for gas turbines** P G Harrison (Hawker Siddeley Dynamics Engineering, Ltd, Hatfield, England) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9-13, 1978, Paper 78-GT-99* 9 p Members, $1 50, nonmembers, $3 00

Control of any gas turbine requires the measurement of a number of engine parameters All of the parameters must be measured by suitable transducers, often in an analog form, and must be linked to the fuel control system where the parameter analog values will be converted to digital values for use by the control computer An approach involving the employment of an integrated engine fuel controller is considered In one physical interpretation of this concept, both electronic and hydromechanical controls are integrated with the fuel control valve as a bolt on package The characteristics of incoming transducer signals are examined and a description of the digital processing system is presented A microcomputer with the 8080 microprocessor is used Attention is given to aspects of interfacing to the processor, the analog to digital converter, fuel valve position measurement, temperature measurement, spool speed measurement, the stepper motor drive system, and the power supply G R

A79-10760 # **Recent developments in sensors for the gas turbine engine** P D Baker and R A Masom (Smiths Industries, Ltd, Aviation Div, Basingstoke, Hants, England) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9 13, 1978, Paper 78-GT-52* 15 p Members, $1 50, nonmembers, $3 00

A review of current technology applied to sensors for the measurement of speed, temperature, and pressure in gas turbine engines The use of suitable materials and designs to overcome the hostile environments is discussed The desirability of obtaining a simple interface with control systems is considered (Author)

A79-10761 # **Jet curtain flameholder for aircraft afterburners** K Sridhara, M S Chidananda, and P A Paranjpe (National Aeronautical Laboratory, Bangalore, India) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9 13, 1978, Paper 78-GT-95* 6 p Members, $1 50, nonmembers, $3 00

The similarity of flow behind V gutter flameholders and the proposed jet curtain flameholders has been demonstrated from flow visualization studies The effective blockage of jet curtain flameholders can be varied by varying the jet pressure ratio The jet curtain flameholder gives the same stability limits as the V-gutter if the mixture strength in the recirculation zones is identical, while it has negligible cold pressure loss Thus, the use of the jet curtain flameholder offers the possibility of significant reduction in overall weight of an aircraft for a given range, if the afterburning duration is short (Author)

A79-10762 # **Propeller unsteady thrust due to operation in turbulent inflows** D E Thompson (Pennsylvania State University, State College, Pa) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9 13, 1978, Paper 78-GT-94* 21 p 15 refs Members $1 50, *nonmembers,* $3 00 *Navy supported research*

In order to better understand the broadband radiated sound and vibrations due to a propulsor blade row operating in a turbulent inflow, an experimental and analytical investigation of the unsteady thrust response of a series of propellers due to operation in turbulent inflows having various characteristic parameters was conducted The propeller variable considered was blade spacing The turbulence variables considered were characteristic length scale and intensity Homogeneous, isotropic turbulence was considered The propeller unsteady thrust spectra were measured for each propeller over a range of turbulent inflow conditions Comparisons of experimental spectra with those due to two different analytical methods are made Conclusions are drawn regarding the accuracy of the two analytical methods (Author)

A79-10764 # **Propulsion cycle and configuration commonality considerations for subsonic V/STOL design** J D Louthan (Vought Corp, Dallas Tex) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9-13, 1978, Paper 78 GT-88* 7 p Members, $1 50, nonmembers, $3 00

The result of recent investigations indicates that current and anticipated technology options may at last combine to permit the achievement of a multimission V/STOL weapon system with impressive operational capabilities A description of the tandem fan design concept is presented, taking into account aspects of mission growth, weight growth in design, and problems of thrust deterioration The selection of propulsion cycle parameters is considered, giving attention to thrust geometry, studies on fan pressure ratio, the control scheme, core engine operating temperatures, the relative sizing of core engines and fans, the number of core engines, and the incorporation of commonality into the design It is found that propulsion system parameter selection for a V/STOL design must recognize a set of priorities somewhat different from those identified with classical engine cycle analysis Propulsion and airframe design parameters interplay to a major extent in driving the configuration G R

A79-10767 # **An axial compressor end-wall boundary layer calculation method** J De Ruyck, C Hirsch, and P Kool (Brussel, Vrije Universiteit, Brussels, Belgium) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9 13, 1978, Paper 78 GT-81* 13 p 27 refs Members $1 50, nonmembers $3 00

A method is described for calculating the evolution of an end-wall boundary layer in an axial compressor with unshrouded blades A new heuristic velocity profile model equation is introduced for higher flexibility Defect forces and tip leakage effects are taken into consideration It is shown that this method allows correct prediction of the qualitative evolution of the boundary layer

parameters along the end walls, effective simulation of tip clearance effects and stall limit, and prediction of detailed flow distributions
S D

A79-10768 # **Flight and propulsion control integration for selected in-flight thrust vectoring modes** C J Yi (Honeywell Systems and Research Center, Minneapolis, Minn), R L Heimbold (Lockheed California Co , Burbank, Calif), R J Miller (United Technologies Corp , Pratt and Whitney Aircraft Group, East Hartford, Conn), and E Rachovitsky (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9-13, 1978, Paper 78-GT-79* 9 p 7 refs Members, $1 50, nonmembers, $3 00

The synthesis of a flight control system for an advanced air superiority fighter equipped with jet flaps, and its flight simulator performance, is reported in this paper Several control modes which integrate aerodynamic surfaces and engine thrust vector control are designed to enhance performance in maneuvering flight Sustained load factor, maximum load factor, and deceleration capability are improved with the coordinated deployment of aerodynamic and propulsive control effectors Feasibility of the control modes was verified by a fixed-base pilot-in-the-loop simulation Air-to-air tracking results show substantial differences in fuel consumption and engine cycle fatigue rates depending on mode selection and pilot technique Emergency modes and handling characteristics are also discussed (Author)

A79-10769 # **A high temperature turbine research module** A W H Morris and N E P Waldren (National Gas Turbine Establishment, Farnborough, Hants , England) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9-13, 1978, Paper 78-GT-73* 9 p Members, $1 50, nonmembers, $3 00

Existing experimental techniques are reviewed to stress the need for a research module (test rig) in which the performance of a cooled high-temperature high pressure turbine may be accurately determined under conditions which correctly simulate the interaction between the aerodynamics of the mainstream and coolant flows, at realistic temperatures and pressures and with turbulence characteristics typical of combustion chamber outflow The combustion system and high-pressure turbine of the Rolls Royce RB211 engine are selected as the basis of the high-temperature turbine research module Installation, instrumentation and aerodynamic performance assessment are highlighted Data acquisition and control for the module will be achieved by a minicomputer-logger system S D

A79-10772 # **Military engine usage monitoring developments in the United Kingdom** M F Hurry (Ministry of Defence /Procurement Executive/, London, England) and M Holmes (National Gas Turbine Establishment, Farnborough, Hants , England) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9-13, 1978, Paper 78 GT-65* 11 p Members, $1 50, nonmembers, $3 00

The application of engine usage monitoring systems in U K military aircraft for the purpose of reducing life cycle costs is discussed Recent developments in the airborne recording equipment and ground data processing facility are described, and some results from analysis of recorded flight data aimed at identifying component fatigue life consumption are presented The use of equipment dedicated to component life monitoring is discussed and the development of a low cycle fatigue counter is described in more detail Finally, the prospects for extending engine usage monitoring equipment to take advantage of future developments in microelectronics are considered (Author)

A79-10774 # **Simulation of helicopter powerplant performance** B V Baxendale and M E Inglis (National Gas Turbine Establishment, Farnborough, Hants , England) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9-13, 1978, Paper 78 GT 51* 9 p Members, $1 50, nonmembers, $3 00

A hybrid computer real time simulation is described for studying powerplant performance and control in helicopter applications The simulation concerns the components of the Sea King and the Lynx helicopters The components simulated are tail rotor aerodynamics, main rotor aerodynamics, airframe dynamics, transmission, engines, engine controls, main rotor controls, and fuel system In both simulations the dynamic and steady state behavior of the aircraft and its engines are described by sets of equations and data based on information supplied by the helicopter and engine manufacturers Both simulations are validated against flight data S D

A79-10776 # **Analysis of the flow field in a radial compressor** C Fradin (ONERA, Châtillon-sous Bagneux, Hauts de-Seine, France) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9-13, 1978, Paper 78-GT-7* 13 p 5 refs Members, $1 50, nonmembers, $3 00 (ONERA, TP No 1978 17)

Using pressure transducers and hot wire anemometers, the flow and pressure field in a subsonic centrifugal compressor is analyzed Detailed pressure, velocity, and flow angle maps are given for the compressor inlet section, along the shroud, in the outlet section of the rotor, and also in the vaneless diffuser These measurements show how flow heterogeneities are generated in the compressor and how they decay in the vaneless diffuser (Author)

A79 10777 # **Aircraft fuel pumps Where we're at /A review of some problems and their current solutions/** J S Thompson (Plessey Co , Ltd , Fuel Management Group, Titchfield, Hants , England) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9-13, 1978, Paper 78-GT-10* 8 p Members, $1 50 nonmembers, $3 00

The paper addresses design considerations associated with aircraft fuel pumps developed in European industries It is noted that the two stage, double ended boost pump offers the same negative G capacity as the conventional double ended pump but consumes only three fourths of the power in normal flight conditions Savings in weight and cost over the conventional heat exchanger are provided by a 2 2 lb thermal diffuser Two stage, engine driven fuel backing pumps fitted between the high pressure pump and the tank boost pump are found to provide a pressure rise of 60 120 psi The pumps operate to higher vapor/liquid ratios than conventional backing pumps Gear pumps are described in terms of the side (axial) entry and gear scallops which reduce the required inlet pressure, sideplates separate from the journal bearings, temperature compensation, and the effects of a low lubricity fuel S C S

A79-10787 # **Application of nonseries airfoil design technology to highly loaded turbine exit guide vanes** J A Monello, W S Mitchell (United Technologies Corp , Pratt and Whitney Aircraft Group, West Palm Beach, Fla), and W A Tall (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9 13, 1978, Paper 78-GT-108* 10 p 8 refs Members, $1 50, nonmembers, $3 00

Common practice in turbine exit guide vane design is to utilize standard series airfoils This paper presents results of an analytical and experimental program where the performance of a series airfoil is compared to an equivalent nonseries airfoil The nonseries airfoil is designed by selecting airfoil camber and thickness distributions which reduce the potential for suction surface separation Airfoil pressure distribution and boundary layer analysis techniques are used to identify the optimum nonseries airfoil Back to-back annular cascade tests of equivalent series and nonseries airfoils substantiate analytical predictions The tests indicate nonseries airfoil design technology enables diffusing airfoils to be designed with improved performance at higher loading levels than presently obtainable with equivalent series airfoils (Author)

A79-10788 # **Powerplant integration - The application of current experience to future developments** T W Brown and J E Talbot (British Aircraft Corp , Ltd , Commercial Aircraft Div , Filton, Bristol, England) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9-13, 1978, Paper 78-GT 113* 11 p 8 refs Members, S1 50, nonmembers, S3 00

The paper reviews the basic operation and function of the current Concorde powerplant and describes some advances in aerodynamic and control system philosophy for better performance with reduced weight and complexity The discussion is limited to air intake design and powerplant control With low risk aerodynamic modifications to provide enhanced performance, the current twin nacelle unit can be improved to give overall characteristics at full scale within an acceptable margin of current proposals for so called advanced supersonic transport aircraft In the future, any alternative proposals for a powerplant installation must show a significant margin in terms of theoretical/wind tunnel performance before it can be recognized as a viable alternative S D

A79-10789 # **Development of an inlet for a tilt nacelle subsonic V/STOL aircraft** H C Potonides (Grumman Aerospace Corp , Bethpage, N Y) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9 13, 1978, Paper 78 GT 121* 8 p Members, S1 50, nonmembers, S3 00

A fixed geometry inlet capable of efficient operation to very high angles-of attack has been developed by the Grumman Aerospace Corporation for a tilt nacelle subsonic V/STOL airplane The inlet, sized to fit a 5 5-in (13 97 cm) diameter fan, has been extensively tested and demonstrated very high pressure recoveries and low distortions at higher angles of attack than any of the published inlet data to date, including an inlet with the very high contraction ratio of 1 78 on the windward lip This inlet capability has been achieved by judicious selection of the inlet design parameters affecting flow separation The substantial angle of attack capability of the inlet provides the opportunity for trading off some of the margin at low speed to reduce nacelle maximum diameter, hence weight, and to increase the estimated drag divergence Mach number of 0 75 to higher than Mach 0 80 Tests with lower lip contraction ratio show that this may be possible and investigations exploring this possibility are now in progress at NASA/Lewis (Author)

A79-10790 # **Performance and design of transpiration-cooled turbine blading** F J Bayley (Sussex, University, Brighton, England) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9-13, 1978, Paper 78-GT 122* 11 p 8 refs Members, $1 50, nonmembers, $3 00 Research supported by the Ministry of Defence (Procurement Executive)

This paper reports recent experimental and theoretical studies of transpiration cooled turbine blades, and on the basis of this and earlier work in the total research program proposes a design method for such cooling systems An integral boundary-layer method of analysis is shown to produce good agreement between observed and predicted heat transfer coefficients over most of the blade section where the effect of the coolant flow is significant, while a simple momentum-mixing theory appears adequate for assessing the effects of the coolant on the blade profile loss (Author)

A79-10792 * # **Wide range operation of advanced low NOx aircraft gas turbine combustors** P B Roberts, R J Fiorito (Solar Turbines International, San Diego, Calif), and H F Butze (NASA, Lewis Research Center, Air Breathing Engines Div , Cleveland, Ohio) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9-13, 1978, Paper 78-GT-128* 13 p 6 refs Members, S1 50, nonmembers, S3 00 NASA supported research

The paper summarizes the results of an experimental test rig program designed to define and demonstrates techniques which would allow the jet induced circulation and vortex air blast com bustors to operate stably with acceptable emissions at simulated engine idle without compromise to the low NOx emissions under the high altitude supersonic cruise condition The discussion focuses on the test results of the key combustor modifications for both the simulated engine idle and cruise conditions Several range augmentation techniques are demonstrated that allow the lean reaction premixed aircraft gas turbine combustor to operate with low NOx emissons at engine cruise and acceptable CO and UHC levels at engine idle These techniques involve several combinations, including variable geometry and fuel switching designs S D

A79-10793 # **Turbine engine automated trim balancing and vibration diagnostics** R McTasney (USAF, Engine Test Facility, Oklahoma City, Okla), R A Rio (Mechanical Technology, Inc Latham, N Y), and W A Troha (USAF, Aero Propulsion Labora tory, Wright Patterson AFB, Ohio) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9-13, 1978, Paper 78 GT-129* 8 p Members, S1 50, nonmembers, S3 00 USAF-supported research

Current Air Force policy requires that aircraft jet engines, at specific intervals, be removed from service and returned to an overhaul depot to undergo an engine teardown and rebuild Following final assembly, engines undergo an acceptance test Engines frequently experience vibrations which exceed allowable technical order limits Depending upon the amplitude, frequency, and location of the vibrations, the engine is either balanced while on test, defined as trim balancing, or returned to the final assembly area for corrective rework Additional costs arise in connection with repetitive rework of engines rejected for vibration related problems An automated trim balancing and diagnostic system was, therefore, developed to reduce the time required to perform the necessary operations and to obtain the diagnostic information needed Atten tion is given to aspects of vibration analysis, trim balancing and diagnostics, and questions of trim-balancing system design G R

A79-10794 # **Demonstration of ceramic design methodology for a ceramic combustor liner** G Trantina and C Grondahl (General Electric Co , Schenectady, N Y) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9 13, 1978, Paper 78-GT-137* 6 p 9 refs Members, S1 50, nonmembers, S3 00

Different ceramic structures for use in a hybrid ceramic metal combustion system were considered The objectives of the risk (failure probability) analysis were to compare the advantages and disadvantages of tube, ring, and stave combustor designs, to assess the feasibility of scale-up by a factor of 2 7 from a 152-mm-diam combustor, to determine the effect of a hot streak temperature distribution, and to establish necessary proof test levels The final objective was to demonstrate the expected performance of the ceramic liner in a combustion system The results indicate that (1) the stress levels are relatively low for an assumed axial and radial temperature gradient, (2) the ring design seems to have the greatest potential for scaling to larger sizes, (3) increase in the Weibull coefficient or the fracture strength lowers the failure probability, and (4) successful ceramic performance in the combustion system tends to confirm the risk analysis predictions S D

A79-10797 # ***Computations of three-dimensional gas-turbine combustion chamber flows*** M A Serag-Eldin and D B Spalding (Imperial College of Science and Technology, London, England) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9-13, 1978, Paper 78-GT 142* 11 p 16 refs Members, S1 50, nonmembers, S3 00

The paper deals with the presentation, application, and valida tion of a mathematical model for three dimensional swirling recircu-lating turbulent flows inside can combustors The model simulates the actual physical processes by means of differential equations for the dependent variables The simultaneous solution of these equa tions by a finite-difference scheme yields the values of the dependent variables at all internal grid nodes The values of the auxiliary variables are derived from the computed values of the dependent variables using algebraic equations The reliability of the model is assessed experimentally, where temperature profiles are measured downstream of the dilution-air ports for different experimental conditions The model is then applied to predict the resulting variable profiles, along with a comparison of the measured and predicted temperatures It is found that the measured temperature distributions display markedly different trends, and that the computations predict these trends correctly S D

A79-10798 # **Weak extinction limits of turbulent flowing mixtures** D R Ballal (Cranfield Institute of Technology, Cranfield, Beds, England) and A H Lefebvre (Purdue University, West Lafayette, Ind) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9-13, 1978, Paper 78-GT 144* 6 p 14 refs Members, $1 50, nonmembers, $3 00

An equation has been derived for predicting the weak extinction limits of stabilized flames supplied with turbulent, flowing mixtures of uniform composition Experiments have been conducted to investigate the influence on weak extinction limits of wide variations in inlet air pressure, temperature, velocity, and turbulence level The apparatus comprised a flameholder, in the form of a hollow cone, which was mounted at the center of a circular pipe with its apex pointing upstream Fourteen, geometrically similar, conical baffles were manufactured to various sizes and used in conjunction with three different pipe diameters in order to allow the effects of baffle size and blockage ratio to be studied independently over a fairly wide range The fuel employed was gaseous propane The experimental results obtained on weak extinction limits were found to be in close agreement with the corresponding predicted values (Author)

A79-10799 # **Development of a compact gas turbine combuster to give extended life and acceptable exhaust emissions** D McKnight (Rolls Royce, Ltd, Industrial and Marine Div, Ansty, Warwicks, England) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9-13, 1978, Paper 78-GT-146* 9 p Members, $1 50, nonmembers, $3 00

The paper describes the development history of the Olympus gas turbine combustor from the time that it was first applied to an industrial application in the early 1960s The design improvements made (1) to permit a change in fuel (from kerosene to diesel and/or natural gas), (2) a 60 percent increase in engine performance, and (3) to reduce emission levels are detailed, and the in service problems associated with these changes are also discussed The emphasis is placed upon improvements in combustor life and capability to produce smoke levels well below the visible threshold, and significant success is shown to have been achieved in these two factors The final sections of the paper are concerned with the latest on going development effort, which is primarily to produce a low emission combustor that can be retrofitted into today's engines (Author)

A79-10802 * # **A design point correlation for losses due to part-span dampers on transonic rotors** W B Roberts (Notre Dame, University, Notre Dame, Ind) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9 13, 1978, Paper 78-GT-153* 7 p 20 refs Members, $1 50, nonmembers, $3 00 Grant No NsG-3133

The design point losses caused by part span dampers were correlated for 21 transonic axial flow fan rotors that had tip speeds varying from 350 to 488 meters per second and design pressure ratios of 1 5 to 2 0 The additional loss attributable to the damper and the total region along the blade height influenced were correlated with selected aerodynamic and geometric parameters The maximum damper loss correlated well with the mean inlet Mach number at the damper location, the geometric parameters of leading and trailing-edge damper radius normalized by mean passage height and damper aerodynamic chord, respectively, and the aerodynamic loading parameter of the blade camber divided by the solidity at the damper location The region of damper influence extended over a mean passage height of the order of 10 to 15 times the maximum damper thickness (Author)

A79-10805 # **Turbine blade tip clearance measurement utilizing borescope photography** A L Chandler and A R Finkelstein (Solar Turbines International, San Diego, Calif) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9-13, 1978, Paper 78-GT-164* 10 p Members, $1 50, nonmembers, $3 00

In this paper, a technique is presented for the determination of turbine rotor blade tip-to-stationary shroud clearance requirements utilizing fiber optics To accomplish these tip clearance determinations, special rub pins were installed in the turbine shrouds, or tip-shoes, of a 10,000 hp engine A test procedure was created based upon a transient dimensional analysis, and a cooled borescope and camera were developed The clearances are presented from a series of successive engine tests (Author)

A79-10806 # **An evaluation technique for determining the cost effectiveness of condition monitoring systems** P T George and A T Parker (United Technologies Corp, Pratt and Whitney Aircraft Group, East Hartford, Conn) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9-13, 1978, Paper 78 GT 166* 8 p Members, $1 50, nonmembers, $3 00

A technique for analyzing the cost effectiveness of condition monitoring systems has been developed both to provide a quantitative assessment of the value of condition monitoring and to guide the selection of items to be monitored by the system The technique uses historical data combined with catalog cost estimating to estimate both the life cycle cost of the condition monitoring system and the potential cost savings offered by the system for commercial engines The results are obtained in a form that can be easily converted to any of the primary cost effectiveness parameters in current use by industry Key to the technique is the definition of a series of condition monitoring system concepts of increasing complexity for analysis, with each increase representing a logical step with respect to cost effectiveness This feature permits the results of the cost-effectiveness analysis to be applied directly to the design definition process without iteration or further cost analysis (Author)

A79-10807 # **Time-phased development methodology - The key for reliable engines in future military aircraft weapons systems** J L Price, I J Gershon, C E Meece, Jr (United Technologies Corp, Government Products Div, West Palm Beach, Fla), and L D McKenny (USAF, Aero Propulsion Laboratory, Wright Patterson AFB, Ohio) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9 13, 1978, Paper 78-GT-167* 10 p Members, $1 50, nonmembers, $3 00

In today's propulsion system, the turbine designer is confronted with a complex interactives structural design task Simultaneous evaluation of the combined effects of multiple design parameters has required the development of highly specialized automated computer analysis systems The methodology for integration of advanced structural and material concepts into advanced turbine engines attempts to eliminate structural risks at the lowest possible development level In this approach, a systematic time phased development plan is employed to ensure that a particular concept progresses systematically, in stages of increasing complexity, from conception of the ideas to maturity Steps in engineering development are considered, taking into account initial engine design, aerodynamic and structural rig tests, structural environmental verification, and operational life verification G R

A79-10809 # **Influence of geometric effects on the aspect ratio optimization of axial turbine bladings** D Rist (Munchen, Technische Universitat, Munich, West Germany) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9-13, 1978, Paper 78-GT-173* 12 p 28 refs Members, $1 50, nonmembers, $3 00

In order to illustrate optimization possibilities, the cooled axial turbine stage has been investigated regarding aerothermodynamics Aims of the study are (a) to estimate the range of the aspect ratio in which the aerothermodynamic efficiency, under comparable conditions, is not less than 0 2 percent under the best value in order to acquire tolerances for the best possible blading design when considering other design and aspects, (b) to acquire the relationship of the turbine loss coefficients and efficiencies to the absolute size of the flow channels, i e, (also) to the hot gas flowrate This is important for fair comparison of smaller and larger machines as well as for realistic judgments and prognosis pertaining especially to small units (Author)

A79-10812 # **Aerodynamic force and moment on oscillating airfoils in cascade** H Atassi and T J Akai (Notre Dame, University, Notre Dame, Ind) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9 13, 1978, Paper 78 GT-181* 12 p 17 refs Members, $1 50, nonmembers, $3 00 Grant No AF-AFOSR-74 2675

A systematic theory is developed for airfoils in cascade oscillating about their mean position with constant interblade phase angle in a uniform incompressible flow The theory fully accounts for the effect of angle of attack of the mean flow, the airfoils' thickness and camber, and the cascade solidity and stagger The formulation leads to two singular integral equations in the complex plane which are solved numerically by collocation The results show that for certain values of the interblade phase angle, the airfoils' thickness and incidence have a significant influence on the unsteady lift and moment particularly for staggered cascades (Author)

A79-10813 # **Propulsion test facilities technical capabilities and international use** J S Kamchi and F E Compitello (USAF, Washington, D C) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9-13, 1978, Paper 78-GT-184* 8 p 15 refs Members, $1 50, nonmembers, $3 00

The requirements for additional test facilities for propulsion systems in the U S are identified in connection with the National Aeronautical Facilities Program (NAFP) The status of NAFP is examined and a description of the NAFP capabilities is presented Attention is given to the National Transonic Facility, the Ames tunnel, the Turbine Engine Load Simulator, an aircraft turbine engine compressor test facility, a fuels and lubricants laboratory, and test facilities in the UK, France, Holland, and Germany It is pointed out that there is a need for government and industry to support the facility investment necessary to make progress in aerospace technology and then to schedule as many test programs as possible in the facility G R

A79-10816 # **Advanced turbofan engines for low fuel consumption** W Sens (United Technologies Corp , Commercial Products Div , East Hartford, Conn) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9-13, 1978, Paper 78 GT 192* 12 p Members, $1 50, nonmembers, $3 00

A projection of jet fuel usage by the free world commercial fleet shows that the fuel used by new advanced turbofan engines developed from technology advances anticipated in the next six to eight years would become significant toward the end of this century assuming that the advanced turbofans start entering the fleet by approximately 1990 During the time period 1980 to the year 2000 approximately 90 percent of the total will be burned by engines in existence today, or new engines based on existing design technology Only about 10 percent would be used by advanced turbofan engines designed in the mideighties or later Means of improving the fuel consumption of current engines by as much as 5 percent are identified and attention is given to an advanced turbofan configuration which has the potential of providing a reduction in fuel consumption of 20 percent G R

A79-10817 # **Dynamic stall of an airfoil with leading edge bubble separation involving time dependent re attachment** H Tokel and F Sisto (Stevens Institute of Technology, Hoboken, N J) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9 13, 1978, Paper 78 GT-194* 13 p 10 refs Members, $1 50, nonmembers, $3 00 Contract No N00014 76-C-0540

The dynamic stall of an airfoil with leading edge bubble separation is analyzed The stall flutter of turbomachine blading may involve periodic growth and collapse of such a bubble The mathematical model representing the physical problem is presented A flat plate undergoing harmonic oscillations with time dependent point of re attachment is studied for the perturbed aerodynamic reactions and applications to the stall flutter problem (Author)

A79-10818 # **Making turbofan engines more energy efficient** M C Hemsworth and M A Zipkin (General Electric Co , Cincinnati, Ohio) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9-13, 1978, Paper 78-GT-198* 13 p 10 refs Members, $1 50, nonmembers, $3 00

A review of transport aircraft gas turbine engine development and evolution during the past two decades is presented in terms of energy consumption The interaction and effects of cycle pressure ratio, firing temperature, bypass ratio, and component efficiencies on installed fuel consumption are reviewed The possibilities for further substantial improvement in energy efficiency with improved operating economics and with improved environmental characteristics are identified and evaluated Parametric data are presented showing trade offs in the areas of efficiency and economics Environmental considerations are also discussed The balance of these factors in a cost effective advanced turbofan is discussed In conclusion, projections are made for the capability of an advanced turbofan engine compared with the goals established by NASA for their Energy Efficient Engine Program The characteristics of this more efficient, cost effective power plant, that can be operational in the late 1980's are shown in relationship to current turbofan engines (Author)

A79-10819 # **Research of the XF3-1 turbofan engine** M Kohzu, H Chinone, M Miyake (Japan Defense Agency, Technical Research and Development Institute, Tokyo, Japan), K Murashima, K Yamanaka, and T Ishigaki (Ishikawajima-Harima Heavy Industries Co , Ltd , Tokyo, Japan) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9-13, 1978, Paper 78-GT 199* 8 p Members, $1 50, nonmembers, $3 00

A research program of low bypass ratio small front fan engines has been in process at Third Research Center of Technical Research and Development Institute of Japan Defence Agency since 1975 The final target of this program is the development of the propulsion engine for the high subsonic small aircraft As the first phase of this program, the bench test engine XF3 1 was manufactured and the basic studies of the overall engine matching performance and the effect of each component on the engine performance have been carried out This paper describes the XF3 1 engine, reviews the status of the research and presents the major engineering progress attained through the research (Author)

A79-10820 # **20 hp mini-RPV demonstrator engine programs** E T Johnson, K F Smith (U S Army, Applied Technology Laboratory, Fort Eustis, Va), and J K Marstiller (U S Army, RPV Program Office, St Louis, Mo) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9 13, 1978, Paper 78-GT-200* 10 p Members, $1 50, nonmembers, $3 00

This paper presents the selection, design, and initial test of two 15 kw (20-hp), two cylinder, two stroke demonstrator engines for use on mini RPV aircraft The objectives are (1) to provide a technology base for mini RPV engines using current high-production components, (2) to identify areas where future development and procurement costs can be reduced without compromising the propulsion system's ability, and survivability of the concepts Future development work must, therefore, be aimed at applying this technology base to a propulsion system design to meet specific mini RPV applications (Author)

A79-10821 # **Evolution of the turboprop for high speed air transportation** G E Holbrook (General Motors Corp , Detroit Diesel Allison Div , Indianapolis, Ind) and G Rosen (United Technologies Corp , Hamilton Standard Div , West Hartford, Conn) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9-13, 1978, Paper 78-GT-201* 14 p 20 refs Members, $1 50, nonmembers, $3 00

The paper reviews the historical development of the turboprop, with special emphasis on technology development and advanced turboprop projections The status and ultimate potential of an advanced turbine engine and propeller fan propulsion system are described Also discussed are prop-fan efficiency, prop fan noise and fuselage attenuation, maintenance costs, and public acceptance It is concluded that the turboprop, with the prop fan concept, can achieve higher propulsive efficiencies with significant improvements in cost, mission effectiveness, and flight speed S D

A79-10822 # **The application of low cost manufacturing technology to a turbine gas generator** H F Due (Teledyne CAE, Toledo, Ohio) and E Buchanan (USAF, Aero Propulsion Laboratory, Wright Patterson AFB, Ohio) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9 13, 1978, Paper 78-GT-202* 9 p Members, $1 50, nonmembers, $3 00

Low system cost is one of the primary criteria for most future unmanned mission applications involving the use of missiles, drones, and remotely piloted vehicles (RPV's) Propulsion system cost accounts for a significant portion of the total system cost The development of low cost propulsion systems becomes in this connection a crucial factor for the feasibility of such applications An investigation was conducted with the objective to design such a low cost propulsion system The studies led to the preliminary design of a short life turbojet engine applicable to subsonic missions The gas generator portion of this engine is also applicable for use in a turbofan engine Component efficiencies were traded off for designs which could be fabricated using low cost manufacturing processes Attention is given to compressor design, combustor design, turbine design, mechanical design features, aspects of material and fabrication process selection, and a manufacturing and cost analysis G R

A79-10824 * # **Alternative aircraft fuels** J P Longwell (MIT, Cambridge, Mass) and J Grobman (NASA, Lewis Research Center, Cleveland, Ohio) *American Society of Mechanical Engineers, Gas Turbine Conference and Products Show, London, England, Apr 9-13, 1978, Paper* 21 p 11 refs

In connection with the anticipated impossibility to provide on a long term basis liquid fuels derived from petroleum, an investigation has been conducted with the objective to assess the suitability of jet fuels made from oil shale and coal and to develop a data base which will allow optimization of future fuel characteristics, taking energy efficiency of manufacture and the tradeoffs in aircraft and engine design into account The properties of future aviation fuels are examined and proposed solutions to problems of alternative fuels are discussed Attention is given to the refining of jet fuel to current specifications, the control of fuel thermal stability, and combustor technology for use of broad specification fuels The first solution is to continue to develop the necessary technology at the refinery to produce specification jet fuels regardless of the crude source G R

A79-10850 # **Operational reliability of climate and pressure control equipment for passenger aircraft (Ekspluatatsionnaia nadezhnost' vysotnogo oborudovaniia passazhirskikh samoletov)** I N Antipenko and V I Kuznetsov Moscow, Izdatel'stvo Transport, 1978 224 p 12 refs In Russian

The book gives a systematic analysis of the reliability aspects of aircraft climate control and pressurization systems Procedures to be instituted for operating this equipment with sufficiently high reliability and for estimating the state of the equipment during the service cycle are set forth Examples are drawn from experience with the air conditioning and pressurization systems of the Yak 40, Tu-154, and Il 62 aircraft A section is also devoted to reliability considerations during the system design stage Equipment repair philosophy is discussed P T H

A79-10867 # **A general correction method of the interference in 2 dimensional wind tunnels with ventilated walls** H Sawada (National Aerospace Laboratory, Tokyo, Japan) *(Japan Society for Aeronautical and Space Sciences, Annual Meeting, 8th, Tokyo, Japan, Apr 4 6, 1977) Japan Society for Aeronautical and Space Sciences, Transactions,* vol 21, Aug 1978, p 57 68 8 refs

A new method of correcting for wind tunnel wall interference in subsonic flow is presented Wall characteristics are expressed in terms of pressure distributions on the flow boundaries Numerical simulation studies show the method to be as accurate as previous methods In view of the nonlinear and unknown characteristics of porous walls, the method has certain advantages over previous ones P T H

A79 10868 # **Measurement of flow fields around an airfoil section with separation** M Hayashi (Kyushu University, Fukuoka, Japan) and E Endo (National Space Development Agency of Japan, Tsukuba Space Center, Tsukuba, Japan) *(Japan Society for Aeronautical and Space Sciences, Annual Meeting, 8th, Tokyo, Japan, Apr 4-6, 1977) Japan Society for Aeronautical and Space Sciences, Transactions,* vol 21, Aug 1978, p 69 75

Detailed measurements of flow fields associated with boundary layer separation have been made for an NACA 4412 airfoil section at an angle of attack of 15 deg, Reynolds number 320,000, for two cases with and without ground effect Total pressure contours, static pressure field contours, time-average velocity plots, and rms velocity fluctuations are presented for each case The shape of wake region is compared with calculation by the wake source method proposed in the former paper The results show the effectiveness of the calculation method for outer region of wake (Author)

A79-10869 # **Aerodynamic response for the airfoil experiencing sudden change in angle of attack** S Kawashima, M Yamasaki (Kyushu University, Fukuoka, Japan), and Y Ando (Ishikawajima Harima Heavy Industries Co , Ltd , Yokohama, Japan) *Japan Society for Aeronautical and Space Sciences, Transactions,* vol 21, Aug 1978, p 76 86 10 refs

An experimental investigation was conducted to study dynamic stall phenomenon The force normal to the chord of an airfoil was obtained directly by means of strain gages cemented on the beam springs attached within the floating test section of the airfoil model and also from the pressure distribution It is found that the velocity parameter 2 x (semichord) x (angular velocity)/U is the dominant factor determining the maximum normal force coefficient for the airfoil during dynamic stall process For an airfoil experiencing a sudden change in the angle of attack with constant speed from the state of static stall, the slope of the normal force coefficient curve versus the angle of attack increases gradually with an increase in angular velocity, and eventually becomes equal to the slope for static unstalled condition (Author)

A79-10896 * **The solid state remote power controller - Its status, use and perspective** G R Sundberg (NASA, Lewis Research Center, Cleveland, Ohio) and W W Billings (Westinghouse Electric Corp , Aerospace Electrical Div , Lima, Ohio) In Power Electronics Specialists Conference, Palo Alto, Calif , June 14 16, 1977, Record New York, Institute of Electrical and Electronics Engineers, Inc , 1977, p 244 253 16 refs

Remote power controllers (RPCs) are solid state devices that combine in one unit the capability to perform all the needed functions of load switching, overload protection, and a direct indication of whether the load is on or off They provide total system protection of equipment and wires RPCs are designed to be located near the load and communicate control and status information remotely via low level signals of a few milliwatts The design and operation of the RPC are considered, taking into account the operation of an RPC, the RPC power switch and drive circuits, control and trip circuits, fail-safe devices, and RPC overcurrent protection Attention is given to the RPC development status, RPC applications, and RPC perspectives G R

A79 10903 * Conference on Helicopter Structures Technology, Moffett Field, Calif , November 16 18, 1977, Proceedings Conference sponsored by the American Helicopter Society and NASA Moffett Field, Calif , U S Army Air Mobility Research and Development Laboratory, 1978 211 p $10 00

Work on advanced concepts for helicopter designs is reported Emphasis is on use of advanced composites, damage-tolerant design, and load calculations Topics covered include structural design flight maneuver loads using PDP 10 flight dynamics model, use of 3 D finite element analysis in design of helicopter mechanical components, damage tolerant design of the YUH 61A main rotor system, survivability of helicopters to rotor blade ballistic damage, development of a multitubular spar composite main rotor blade, and a bearingless main rotor structural design approach using advanced composites P T H

A79-10904 # The effects of latest military criteria on the structural weight of the Hughes advanced attack helicopter - YAH-64 J M McDermott and E Vega (Summa Corp , Hughes Helicopters Div , Culver City, Calif) In Conference on Helicopter Structures Technology, Moffett Field, Calif , November 16-18, 1977, Proceedings Moffett Field, Calif , U S Army Air Mobility Research and Development Laboratory, 1978 12 p 8 refs

The effects of new military requirements for helicopters concerning crashworthiness and ballistic tolerance and fail safety on the structural design of the YAH 64 advanced attack helicopter are examined Values are derived for the additional weight required to meet the new requirements Without a growth factor taken into account, the increase in empty weight due to structures specifically intended to meet the above-mentioned requirements is calculated to be 11% P T H

A79-10905 # Structural design flight maneuver loads using PDP-10 flight dynamics model E C McLaud, K C Hansen, and W J Jackson, Jr In Conference on Helicopter Structures Technology, Moffett Field, Calif , November 16-18, 1977, Proceedings Moffett Field, Calif , U S Army Air Mobility Research and Development Laboratory, 1978 13 p

In order to achieve more accurate predicted applied loads and inertial reactions during structural design, a nonlinear flight dynamics model for evaluation of helicopter handling qualities and control system design has been developed The flight maneuvers conducted consist of the design specification requirements for symmetrical pullup and pushover, rolling pullouts, vertical takeoff, yaw maneuvers both in sideward flight and at forward speed, gusts, and the effects of tail rotor loss The program provides data on accelerations, rates, attitudes, and applied loads at all critical points within the maneuver The correlation of the flight dynamics model with UH-60A Black Hawk flight test data for longitudinal, lateral, and rudder inputs is generally good P T H

A79-10906 # Derivation of control loads for bearingless rotor systems P G C Dixon (Boeing Vertol Co , Philadelphia, Pa) In Conference on Helicopter Structures Technology, Moffett Field, Calif November 16 18, 1977, Proceedings Moffett Field, Calif , U S Army Air Mobility Research and Development Laboratory, 1978 7 p

The paper presents a method for calculating the torsional stiffness of a bearingless rotor system flexure Simple analyses of the torque required to produce axial deformation in a uniformly twisted flexure, nonuniform torsion of members of symmetrical open cross section without applied axial loading, and the rigidifying effects of axial tension on the flexure are performed From these analyses, the constants in the expression for torque to twist a bearingless rotor blade flexure that is axially loaded by the blade centrifugal force are calculated P T H

A79-10907 Impact of operational issues on design of advanced composite structures for Army helicopters T L House and T E Condon (U S Army, Applied Technology Laboratory, Fort Eustis, Va) In Conference on Helicopter Structures Technology, Moffett Field, Calif , November 16 18, 1977, Proceedings Moffett Field, Calif , U S Army Air Mobility Research and Development Laboratory, 1978 12 p

The paper reviews the potential benefits available from composite structures for military aircraft and discusses those issues which must ultimately be considered in establishing realistic design criteria and related operational concepts The interrelationships among operational damage, repair limitation, and overall aircraft operational effectiveness and maintenance support costs are discussed along with how each of these issues might affect design requirements P T H

A79-10908 # A study of structural concepts for low radar cross section /LRCS/ fuselage configurations B W Scruggs, Jr (U S Army, Applied Technology Laboratory, Fort Eustis, Va) and D W Lowry (United Technologies Corp , Sikorsky Aircraft Div , Stratford, Conn) In Conference on Helicopter Structures Technology, Moffett Field, Calif , November 16-18, 1977, Proceedings Moffet Field, Calif , U S Army Air Mobility Research and Development Laboratory, 1978 20 p 5 refs

Three low radar cross section (LRCS) fuselage configurations were developed with the current UH 60A as a baseline, and several structural concepts were developed for these configurations and analyzed with respect to their effect on weight, cost, fail safety, and maintainability The effects on weight and cost of using advanced materials in the configurations were also evaluated P T H

A79-10909 # The use of 3-D finite element analysis in the design of helicopter mechanical components P P Dinyovszky and S W McKellip (United Technologies Corp , Sikorsky Aircraft Div , Stratford, Conn) In Conference on Helicopter Structures Technology, Moffett Field, Calif , November 16 18, 1977, Proceedings Moffett Field, Calif , U S Army Air Mobility Research and Development Laboratory, 1978 5 p

The results are presented of a research and development program directed at the evaluation of NASTRAN for the efficient finite element analysis of three dimensional mechanical components commonly found in helicopter structures The procedures developed during this study were used for the NASTRAN analysis of the CH-53A/D rotating swashplate Comparison of the NASTRAN results for the stresses with experimental results demonstrate that excellent accuracy can be obtained with NASTRAN (Author)

A79-10910 # A glance at Soviet helicopter design philosophy W Z Stepniewski In Conference on Helicopter Structures Technology, Moffett Field, Calif , November 16-18, 1977, Proceedings Moffett Field, Calif , U S Army Air Mobility Research and Development Laboratory, 1978 12 p

The author gives a report on what current trends in Soviet helicopter design are, as judged from the contents of the book 'Helicopters' by Tischenko et al The optimization criteria that Soviet designers appear to be concerned with are (1) weight and transport effectiveness, (2) an economic integration of functional, producible, and operational effectiveness, and (3) general economic effect of total cost of all machines of a given type on the economy Most attention in the review is directed at the studies of maximization of useful load P T H

A79-10911 # Damage tolerant design of the YUH-61A main rotor system J S Hoffrichter and C M McCracken (Boeing Vertol Co , Philadelphia, Pa) In Conference on Helicopter Structures Technology, Moffett Field, Calif , November 16 18, 1977, Proceedings Moffett Field, Calif , U S Army Air Mobility Research and Development Laboratory, 1978 8 p

Design features of the main rotor system of the YUH-61A helicopter incorporated in order to achieve defect tolerance are discussed A defect-tolerant structure can be achieved by failsafety, safe crack growth, and by nonpropagating defects, and all three of these concepts are at work in some way in the design of the YUH-61A main rotor system The components discussed include the upper control assembly, pitch link, swashplate rings, swashplate lugs, stationary scissors, rotating scissors, control actuators and actuator support structure, rotor head, rotor blade attachment pins, rotor hub and pitch shaft, hub to rotor shaft connection, pitch arm, tip fitting, and aft fairing P T H

A79-10912 # **Improved ballistic damage tolerant design through laminated metal construction** W G Degnan (United Technologies Corp, Sikorsky Aircraft Div, Stratford, Conn), C F Hickey, Jr, and A A Anctil (U S Army, Army Materials and Mechanics Research Center, Watertown, Mass) In Conference on Helicopter Structures Technology, Moffett Field, Calif, November 16-18, 1977, Proceedings Moffett Field, Calif, U S Army Air Mobility Research and Development Laboratory, 1978 12 p 13 refs

This paper presents the results of research conducted on adhesively bonded sheet metal laminate construction to increase ballistic damage tolerance Test results are presented that show ballistic damage reduced by factors of 3 1 for 7 62mm and 4 1 for 12 7mm armor piercing projectile impact on laminated aluminum specimens Modes of failure for monolithic and laminated structures are presented and discussed Analysis of the test results shows a reduction of ballistic damage effects of 5 1 laminate-to-monolithic, with potential for even greater gains Reduced lateral ballistic damage and increased residual static strength, both compared to monolithic structures, combine to give the desired improvement in post ballistic damage strength (Author)

A79-10913 # **The survivability of helicopters to rotor blade ballistic damage** H Zinberg, J Johnson (Bell Helicopter Textron, Fort Worth, Tex), and H Reddick (U S Army, Air Mobility Research and Development Laboratory, Fort Eustis, Va) In Conference on Helicopter Structures Technology, Moffett Field, Calif, November 16 18, 1977, Proceedings Moffett Field, Calif, U S Army Air Mobility Research and Development Laboratory, 1978 12 p 11 refs

This paper describes a program to investigate the survivability of helicopters to rotor blade ballistic damage The ballistic threat used in the investigation was the 23mm HEI-T Ballistic damage to the rotor blade will alter the dynamics of the helicopter, impair the strength of the rotor, and change the aerodynamics in the region of the damage These results were studied parametrically and the results are presented A survivability model was developed to compute the damage inflicted by the projectile and to assess the capability of the helicopter to survive This required developing a new helicopter dynamic simulation program and separate fatigue analyses for metal and composite blades Ballistic and fatigue tests were performed to evaluate predictions made by the survivability model (Author)

A79 10914 # **Damage tolerant design of the YAH-64 main rotor blade** M F Symonds (Summa Corp, Hughes Helicopters Div, Culver City, Calif) In Conference on Helicopter Structures Technology, Moffett Field, Calif, November 16-18, 1977, Proceedings Moffett Field, Calif, U S Army Air Mobility Research and Development Laboratory, 1978 10 p

One of the main design goals for the YAH-64 helicopter was the capability for continued safe operation for at least 30 minutes after damage from any single hit by a 12 7mm armor piercing incendiary (API) projectile and minimization of damage effects from an impact by a 23mm high explosive incendiary (HEI) missile The paper describes how this and other design goals were attained in the main rotor blade Damage tolerant design concepts incorporated in the main rotor blade include deep structural chord of 50 5% of blade chord, multispar design with redundancy and crack retardant, orient failure in spanwise direction, and vent pressure in spanwise direction, use of AM355CRT stainless steel, fiberglass used as crack retardant, redundant root fittings and root doublers, and redundant tip design P T H

A79 10915 **Damage tolerance - in advanced composite materials** G Dorey (Royal Aircraft Establishment, Farnborough, Hants, England) In Conference on Helicopter Structures Technology, Moffett Field, Calif, November 16 18, 1977, Proceedings Moffett Field, Calif, U S Army Air Mobility Research and Development Laboratory, 1978 9 p 6 refs

Investigations have been made into the residual strengths of a number of composite laminates that had machined notches or had been damaged by foreign object impact The laminates contained carbon, polyaramid or glass fibers in epoxy resin matrices and had 0/90, 0/+ or -45 or 0/90/+ or -45 lay ups Fracture mechanics could be applied readily to the laminates with fracture toughnesses less than 25 MN/m to 3/2 power but, for tougher laminates, corrections were needed to allow for the size of damage zones at the tips of notches The size of the damage zone depended on the interfacial bond strength, the lay-up and the ply thickness as well as the fiber and matrix properties The correlation between impact resistance and fracture toughness is discussed (Author)

A79-10916 # **Composite rotor hub I, II** R J Mayerjak (Kaman Aerospace Corp Bloomfield, Conn) and G T Singley, III (U S Army, Applied Technology Laboratory, Fort Eustis, Va) In Conference on Helicopter Structures Technology, Moffett Field, Calif, November 16-18, 1977, Proceedings Moffett Field, Calif, U S Army Air Mobility Research and Development Laboratory, 1978 8 p Grant No DAAJ02 75 C 0013

The paper describes the testing in fatigue at design loads and the static testing under limit loads of the composite hub being developed for the CH 54B helicopter The tests were designed so as not to destroy the single specimen in existence The tests demonstrated fatigue strength sufficient to survive 1 million cycles of the fatigue design loads A residual strength after fatigue testing sufficient to support the most critical flight loads was demonstrated Adequate stiffness for dynamic compatibility with the rotor controls and drive train was also demonstrated Information on the importance of secondary bending in the plates was obtained P T H

A79-10917 # **Survey of the application of reinforced composites in European helicopters** G C Alling, Jr (U S Army, Foreign Science and Technology Center, Charlottesville, Va) In Conference on Helicopter Structures Technology, Moffett Field, Calif, November 16 18, 1977, Proceedings Moffett Field, Calif, U S Army Air Mobility Research and Development Laboratory, 1978 6 p 13 refs

The paper discusses briefly some of the uses to which composite materials have been put in helicopter rotor blades and main rotor hubs The BO 105 rotor blade is an all composite structure consisting of a C spar, a foam stabilized trailing edge, and a glass-cloth skin Fabrication is entirely by hand The main rotor blade for the AS-350 has a mechanically wound spar and skin, and may be one of the least expensive blades in the world The Starflex rotor hub employs S-glass-reinforced epoxy and elastomeric bearings to achieve a drastic simplification of the rotor head The hub star consists of a built-up laminate of glass cloth This hub is only 60% as heavy as a comparable fully articulated hub and costs only one-fourth as much to produce P T H

A79-10918 # **Advanced technology helicopter landing gear** W T Alexander, Jr (U S Army, Aviation Research and Development Command, Fort Eustis, Va) and R E Goodall (Summa Corp, Hughes Helicopters Div, Culver City, Calif) In Conference on Helicopter Structures Technology, Moffett Field, Calif, November 16-18, 1977, Proceedings Moffett Field, Calif, U S Army Air Mobility Research and Development Laboratory, 1978 9 p 6 refs

This report covers work performed on the advanced helicopter landing gear program The objectives of the program were to design, fabricate, and test a wheel-type advanced main landing gear concept possessing high-energy-absorbing characteristics for helicopters in the 15,000-pound class These objectives were achieved by formulating design criteria through a data search, choosing the most cost effective composite material, and by design analysis, selecting the most promising landing gear concept This concept used graphite epoxy as a structural material to fabricate the trailing arm of the main landing gear of the Hughes YAH-64 helicopter by wet-filament winding (WFW) The graphite arm was successfully tested, demonstrating the practicality of employing composite structures in the construction of high-energy-absorbing landing gear components (Author)

A79-10919 # **Development of a multitubular spar composite main rotor blade** R E Head (Summa Corp, Hughes Helicopters Div, Culver City, Calif) and N J Calopodas (U S Army, Applied Technology Laboratory, Fort Eustis, Va) In Conference on Helicopter Structures Technology, Moffett Field, Calif, November 16-18, 1977, Proceedings Moffett Field, Calif, U S Army Air Mobility Research and Development Laboratory, 1978 9 p

A multitubular spar (MTS) composite main rotor blade was developed for the AH 1G helicopter in the original production metal geometry To minimize material cost, the wet filament winding (WFW) technique was used The spar structure is spread over the forward half of the chord to provide ballistic survivability against the 23mm HEI T threat The blade passed all fatigue, static, repairability, and ballistic tolerance tests Radar absorbing material moded into the leading edge made a significant reduction in radar cross section Flight tests exploring 80% of the AH-1G flight envelope were conducted A comparison of blade loads in similar flight conditions shows that the MTS and the metal blade loads are similar Cost analysis showed that the MTS blade could be produced and sold for a lower price than the metal blade P T H

A79-10920 # **Boeing Vertol bearingless main rotor structural design approach using advanced composites** G J Wehnert, M W Sheffler (Boeing Vertol Co, Philadelphia, Pa), and H K Reddick (U S Army, Air Mobility Laboratory, Fort Eustis, Va) In Conference on Helicopter Structures Technology, Moffett Field, Calif, November 16 18, 1977, Proceedings Moffett Field, Calif, U S Army Air Mobility Research and Development Laboratory, 1978 8 p

The bearingless main rotor (BMR) system has no pitch, flap, or lead/lag bearings The twin fiberglass channel beams are the principal structural members which accommodate pitch inputs and normal flap and lag motions, as well as provide for the retention of the blades against centrifugal force The material is tailored to meet the frequency criteria and still have low stress levels by placing the peak flap, chord, and torsional stress levels at different spanwise locations The paper describes methods of analyzing the loads on the system and also the results of testing the system for its load responses This formed the basis for life calculations for the components Verification of fatigue analysis is in progress P T H

A79-10921 # **Ultrasonic welding /solid state bonding/ of aircraft structure - Fact or fancy** J Devine, G K Dingle (Summa Corp, Hughes Helicopters Div, Culver City, Calif), and R G Vollmer (U S Army, Aviation Research and Development Command, Fort Eustis, Va) In Conference on Helicopter Structures Technology, Moffett Field, Calif, November 16 18, 1977, Proceedings Moffett Field, Calif, U S Army Air Mobility Research and Development Laboratory, 1978 24 p 8 refs

The paper describes the ultrasonic welding of an inner skin to an outer skin of a YAH-64 helicopter access door It was found that the ultrasonically welded access door had superior strength, reduced weight, and reduced cost as compared with other joining techniques P T H

A79-10991 **Nondestructive inspection of aircraft structures and materials via acoustic emission** A T Green, H L Dunegan (Dunegan Research Corp, Livermore, Calif), and A S Tetelman (California, University, Los Angeles, Calif) *International Advances in Nondestructive Testing*, vol 5, 1977, p 275 289 7 refs

The paper deals with acoustic emission results for nondestructive inspection of typical aircraft structural materials such as aluminum, titanium, steel, and metal honeycomb Attention is given to the influence of temperature, welds, fatigue cycles, and other parameters on acoustic emission data A damage concept based on combined fracture mechanics and acoustic emission technologies is presented Application of acoustic emission to the detection of propagating flaws in simple and complex aircraft structures is successfully demonstrated However, it is presently not possible to make acoustic emission tests on disks that are actually in service S D

A79-11006 # **Detached flow about an opening canopy (Ob otryvnom obtekanii raskryvaiushchegosia kupola)** N V Akrushkin, A K Kuchugura, and N K Tsyganov In Waves in continua Kiev, Izdatel'stvo Naukova Dumka, 1978, p 60-67 5 refs In Russian

The problem of detached flow about intermediate phases of an opening parachute canopy is analyzed in the framework of perfect-fluid theory A criterion that permits the unique determination of the computed time interval in the numerical solution to the flow problem is introduced, which makes it possible to obtain exact values for the flow characteristics in both the modeled region and the transition region Results are presented for calculations of the potential flow about uniformly permeable shells of revolution used to approximate a parachute canopy in the process of opening It is shown that the permeability parameters and the size of the parachute vent have a substantial effect on the flow characteristics F G M

A79 11008 # **Parachute canopy opening dynamics (K dinamike raskrytiia kupola parashiuta)** N K Tsyganov In Waves in continua Kiev, Izdatel'stvo Naukova Dumka, 1978, p 71 78 5 refs In Russian

Formulas for calculating the law of motion, the loads on a parachute, and the parachute canopy opening time are obtained on the basis of the equation of motion for a parachute-load system in the horizontal part of the trajectory as well as the air balance equation The canopy at any arbitrary moment is considered as a thin walled permeable axisymmetric shell of revolution with an ellipsoidal generatrix An additional assumption concerning the flow speed at the canopy vent and the law of canopy opening is introduced in order to derive the formulas The theoretical results are used to analyze parachute opening dynamics in a wind tunnel The calculations are found to be in quite good agreement with the experimental results F G M

A79-11125 **The Wright brothers' flight-control system** F J Hooven (Dartmouth College, Hanover, N H) *Scientific American*, vol 239, Nov 1978, p 166 168, 170 (8 ff)

The various developments with respect to flight control systems used by the Wright brothers are examined It is found that there remain several questions concerning the Wrights' pitch control system The questions are partly related to the persistence of the Wright brothers to mount the canard elevator on the powered Flyers and partly to the placement of the center of gravity to the rear when it should have been moved forward An investigation was in this connection conducted of the pitch stability and the control characteristics of the canard type Flyers It was found that the Flyers were indeed unstable as they were flown but that their instability decreases as the center of gravity is moved forward G R

A79 11132 # **Calculation of transonic flows around wings (Calculs d'ecoulements transsoniques autour d'ailes)** J -J Chattot, C Coulombeix, and C da Silva Tome (ONERA, Châtillon sous-Bagneux, Hauts de-Seine, France) *La Recherche Aerospatiale*, July Aug 1978, p 143-159 17 refs In French

A full potential equation is chosen as mathematical model for simulating transonic flows past symmetrical wings set without side slip in a uniform subsonic free stream Two relaxation methods are presented In the first method, the equation is written in quasi linear form and is discretized using a mixed scheme of the Murman Cole type The algebraic set of difference equations is solved by line relaxation In the second method, the equation is written in conservative form as well as an artificial viscosity term, and is discretized using a centered scheme An approximate factorization method is used to solve the difference equations Results obtained with the two methods are presented in the case of a rectangular wing, the M6 wing, and the AFV-D wing as well as comparisons with experimental data (Author)

A79-11175 **The electronic flight deck** M Hurst *Flight International,* vol 114, Oct 14, 1978, p 1405 1408

A brief overview is presented of the current status of electronic flight decks, particularly in military aircraft Particular consideration is given to an advanced flight deck with seven identical CRT displays, a fighter cockpit with a head-up display and color head down display, the displays of the F 18, the A-7 Corsair HUD, and the head down displays in the YC 14 prototype B J

A79-11239 **An instrumentation modeling technique used in the identification of aerodynamic coefficients from flight test data** W E Williamson, Jr (Sandia Laboratories, Albuquerque, N Mex) *International Astronautical Federation, International Astronautical Congress, 29th, Dubrovnik, Yugoslavia, Oct 1-8, 1978, Paper 78-99* 14 p 8 refs Research supported by the U S Department of Energy

A model is proposed to serve in the computation of aerodynamic coefficients of flight vehicles from flight test data The output of each set of instruments is modeled as the solution to a second order linear differential equation with constant coefficients This allows the data from different instruments to be shifted relative to each other by the differing natural frequencies or constant coefficients associated with each differential equation Phase shifts are modeled directly and multiple frequencies in the vehicle motion are accounted for The method is demonstrated on the computation of aerodynamic coefficients of a spinning vehicle P T H

A79-11294 **Cyclic linkage of finite elements with application** B Atanackovic (Aerotechnical Institute, Belgrade, Yugoslavia) *International Astronautical Federation, International Astronautical Congress, 29th, Dubrovnik, Yugoslavia, Oct 1-8, 1978, Paper 78-213* 20 p 8 refs

Two models for linking finite elements in the analysis of aircraft structures are proposed in which a polygonal element is the basic carrier of information on the structure Information on the structure is obtained by optimal organization of the elements Cyclic linkage of the polygonal elements is used to model two-dimensional geometric aircraft structures, it also provides graphical representation of stress and geometric data The method is illustrated by examples V P

A79-11366 # **Aircraft lighting equipment (Oswietlenie samolotu)** K Zuchowicz (Instytut Techniczny Wojsk Lotniczych, Warsaw, Poland) *Technika Lotnicza i Astronautyczna,* vol 33, Sept 1978, p 7 9 6 refs In Polish

The paper reviews technology for the interior illumination (passenger compartments, pilot cabins, and signal lights) and exterior illumination of aircraft Particular attention is given the retinal adaptation of passengers and pilots to different lighting conditions Flashing lights, electroluminescent illumination, and exterior projector lights are all discussed B J

A79-11367 # **Experimental method for investigating pre-intake vortex circulation (Eksperymentalna metoda oszacowania cyrkulacji wiru przedwlotowego)** S Szczecinski (Wojskowa Akademia Techniczna, Warsaw, Poland) and R Szczepanik (Instytut Techniczny Wojsk Lotniczych, Warsaw, Poland) *Technika Lotnicza i Astronautyczna,* vol 33, Sept 1978, p 9 11 5 refs In Polish

A simple method for investigating vortex flow fields at air intakes is described The experimental part of the method consists of potential energy measurements of the intake vortex, while the analytical part consists of a mathematical model of vortex circulation based on experimental results Photographs of the intake vortex experiment are presented B J

A79-11368 # **Some aspects of aircraft jet engine fuels (Niektore zagadnienia paliw do lotniczych silnikow turbinowych)** R Bekiesinski (Instytut Techniczny Wojsk Lotniczych, Warsaw, Poland) *Technika Lotnicza i Astronautyczna,* vol 33, Sept 1978, p 11, 12 5 refs In Polish

The paper reviews technologies for improving the thermal stability of jet fuels, with reference to the overheating of fuel tanks in supersonic aircraft Consideration is given to the development of a new jet fuel with high thermal stability by the Polish petroleum industry B J

A79-11369 # **Aircraft electric power networks - Structures I (Wezly elektroenergetyczne samolotow - Struktury I)** W Jarominek (Wojskowa Akademia Techniczna, Warsaw, Poland) and Z Zmudzinski (Instytut Techniczny Wojsk Lotniczych, Warsaw, Poland) *Technika Lotnicza i Astronautyczna,* vol 33, Sept 1978, p 13 15 In Polish

The paper presents and discusses block diagrams of several types of aircraft electric power networks In particular, network designs for such aircraft as Il-62, Comet 4, and Yak 40 are considered Consideration is given to the electrical parameters, and control and stability characteristics of system components B J

A79-11370 # **Method for determining maximum allowable stress for preliminary aircraft wing design (Metoda okreslenia maksymalnych naprezen do projektu wstepnego skrzydla samolotu)** *Technika Lotnicza i Astronautyczna,* vol 33, Sept 1978, p 23 26 6 refs In Polish

The paper presents a method for estimating the fatigue life of wings subjected to variable (gust) loading Critical loading parameters are determined for aluminum alloy wings Consideration is given to wing loading characteristics for fighter, patrol, utility, and transport aircraft B J

A79-11392 # **Control and stabilization in aerodynamics (Upravlenie i stabilizatsiia v aerodinamike)** N F Krasnov and V N Koshevoi Moscow, Izdatel'stvo Vysshaia Shkola, 1978 480 p 64 refs In Russian

The book gives a systematic exposition of the stability and control problem for general aerodynamic bodies The main areas of study are the aerodynamics of lifting surfaces, aerodynamics of control organs, gasdynamic control organs, hybrid controls, frontal drag and lift force control, and friction control Special topics investigated include aerodynamic interference of flat empennage and fuselage, the method of additional masses, characteristics of fuselage-wing empennage combinations, pivoted nozzles, use of jets for control, gas blowing schemes, and experimental studies of laminarization of boundary layer by suction P T H

A79-11439 # **Aircraft radio equipment (Radiooborudovanie samoletov)** N A Sofronov Moscow, Izdatel'stvo Mashinostroenie, 1978 216 p 35 refs In Russian

The text book deals with the essential features of piloting and navigatior systems Radio navigation systems and their use for guiding an aircraft within a prescribed accuracy to a prescribed point along a path most favorable for the prevailing conditions are discussed Particular attention is given to the principals of operation, physical processes, and structural and engineering characteristics of radio communication, navigation, and landing aids V P

A79-11441 # **Turbine-driven refrigeration units in gas turbine engine cooling systems (Turbokholodil'nye mashiny v sistemakh okhlazhdeniia gazoturbinnykh dvigatelei)** O N Emin Moscow, Izdatel'stvo Mashinostroenie, 1978 176 p 34 refs In Russian

The general principles, design, thermodynamic calculation, and optimization of open circuit turbine driven refrigeration units for cooling gas turbine engines are the subject of this book The refrigerators are based on the Carnot cycle Various compressor designs are studied A method for calculating the main parameters of a turbine-driven refrigerator unit is given Brief attention is given to the joint operation of aircraft engine and refrigeration unit P T H

A79-11442 # **Aircraft air conditioning systems (Aviatsonnye sistemy konditsionirovaniia vozdukha)** Iu M Shustrov and M M Bulaevskii Moscow, Izdatel'stvo Mashinostroenie, 1978 160 p 24 refs In Russian

Design and evaluation of aircraft air conditioning systems with air cooling cycle are the subject of this book The heat balance equation is derived, which is used to determine the loading of an air conditioning system Special attention is given to the thermal design of cabins in panel construction Methods for calculating the power requirements of air conditioning systems and of analyzing the weight problems associated with air conditioning systems are set forth Procedures for evaluating the effect of the air conditioning system on other operating characteristics of the aircraft are proposed P T H

A79-11444 # **Aspects of short-takeoff aircraft (Problemy korotkogo vzleta samoleta)** I N Kolpakchiev Moscow, Izdatel'stvo Mashinostroenie, 1978 160 p 83 refs In Russian

In this book, an attempt is made to treat systematically the principle features of V/STOL aircraft, with emphasis on factors that are decisive in the selection of the parameters and type of transport aircraft for a specific passenger flow Attention is given to the design and construction of runways and platforms for V/STOL aircraft and to domestic and foreign technical requirements on the aircraft The parameters of STOL aircraft are analyzed, and their optimal ranges are identified The technical efficiency of STOL aircraft in civil aviation is assessed V P

A79-11449 **Near-net-shape engine methods emerge** E H Kolcum *Aviation Week and Space Technology*, vol 109, Oct 30, 1978, p 42-46

The paper discusses the emergence of aircraft engine parts fabrication techniques by which a significant fraction, sometimes as much as 75%, of the input weight is saved Powder metallurgy techniques that reduce machining losses are the hot isostatic pressing (HIP) process and the HIP-plus-hot-die forging process An advanced powder-metal superalloy, AF115, for turbine disks is being developed which, like Rene 95, is nickel-based and is designed to operate at temperatures 200 F higher than Rene 95 Other advanced-technology programs being studied are discussed, including direct numerical control, computerized electron-beam welding, net-shape rolled rings, laser machining and joining, and inertia welding P T H

A79-11481 **Experimental design for real-time simulations of air traffic control concepts** E H Stevens (FAA, National Aviation Facilities Experimental Center, Atlantic City, N J) In Winter Simulation Conference, Gaithersburg, Md, December 5-7, 1977, Proceedings Volume 2 New York, Institute of Electrical and Electronics Engineers, Inc, 1977, p 668-674

The mission of the Digital Simulation Facility (DSF) at the FAA's National Aviation Facilities Experimental Center is to provide the FAA with a realistic real-time experimentation capability in which advanced concepts and their related operational procedures can be evaluated and refined A unique feature of DSF simulations is the presence of the man-machine interface The ATC controller is an integral component of the control loop with which new ATC concepts must be compatible Experiments must be designed which accurately measure the controllers' subjective response, while at the same time, reduce the random variation due to the controller in the system responses An overview of the DSF is presented and a description is provided of the experiment design and analysis activities Attention is given to the formulation of goals and objectives, the selection of the test environment, the development of experimental design, the development of traffic samples, quality control, contingency planning, and questions of data reduction and analysis G R

A79-11488 **On-line computer for transient turbine cascade instrumentation** M L G Oldfield, T V Jones, and D L Schultz (Oxford University, Oxford, England) *(International Congress on Instrumentation in Aerospace Simulation Facilities, Shrivenham, England, Sept 6-8, 1977) IEEE Transactions on Aerospace and Electronic Systems*, vol AES 14, Sept 1978, p 738-749 14 refs Science Research Council Grant No B/SR/89866

A 32-channel computer based data acquisition and processing system has been developed for use with the new type of transient cascade facility at Oxford This is used for testing turbine blades and nozzle guide vanes at full scale engine Reynolds and Mach numbers with correct wall to-flow temperature ratios A novel technique for processing transient heat transfer data from thin film surface resistance thermometers has been developed Measurements of surface pressure around blades, and of the upstream turbulence level have been made The cascade and instrumentation are shown to have advantages both in cost and effectiveness over continuous running cascades (Author)

A79 11492 **Track-while scan algorithm in a clutter environment** A Farina and S Pardini (Selenia S P A, Rome, Italy) *IEEE Transactions on Aerospace and Electronic Systems*, vol AES-14, Sept 1978, p 769 779 11 refs

A track while scan (TWS) algorithm is developed for targets in a clutter environment The problem has been studied using only the position measurements, but the simulation results have not been satisfactory Modern processing techniques (FFT processor) in air traffic control and surveillance radar receivers provide both position and radial velocity The radial velocity measurement may be conveniently used in the target-track correlation process, which will reduce the association ambiguity in the clutter environment In the clear environment the algorithm using the position and radial velocity measurements has been treated previously A TWS algorithm, using both position and radial velocity measurements for targets in a clutter environment, is presented here The algorithm obtained is nonlinear and adaptive In order to evaluate the improvement due to radial velocity measurement a simulation has been performed on a digital computer The algorithm was run with and without radial velocity measurements to compare its performances An improvement was noted especially when the target path included an accelerated portion (Author)

A79-11494 * **A performance measure for evaluating aircraft landing trajectories** R M Witt (Mechanics Research, Inc, McLean, Va) and G Cook (Virginia, University, Charlottesville, Va) *IEEE Transactions on Aerospace and Electronic Systems*, vol AES-14, Sept 1978, p 789-795 6 refs Contract No NAS1-10210, Grant No NsG-1101

A general performance index is developed for evaluating aircraft landing trajectories The primary term in the index is the effect of noise on people residing near the air terminal Other terms included are passenger comfort, fuel consumed, and the time spent in the near-terminal area Models are developed for aircraft engine noise, passenger comfort, the population distribution about a specific airport, and the aircraft flight behavior While this performance index may be used in computing optimal trajectories, it is also useful for comparing nonoptimal trajectories which, for one reason or another, may be worthy of consideration Some examples of such comparisons are included through simulations of landing The aircraft considered is a Boeing 737 (Author)

A79-11549 * # **Recent theoretical developments and experimental studies pertinent to vortex flow aerodynamics - With a view towards design** J E Lamar and J M Luckring (NASA, Langley Research Center, Hampton, Va) *NATO, AGARD, Symposium on High Angle-of-Attack Aerodynamics, Sandefjord, Norway, Oct 4-6, 1978, Paper* 32 p 49 refs

A review is presented of recent progress in a research program directed towards the development of an improved vortex-flow technology base It is pointed out that separation induced vortex-flows from the leading and side edges play an important role in the high angle-of-attack aerodynamic characteristics of a wide range of modern aircraft In the analysis and design of high-speed aircraft, a detailed knowledge of this type of separation is required, particularly with regard to critical wind loads and the stability and performance at various off design conditions A description of analytical methods is presented The theoretical methods employed are divided into two classes which are dependent upon the underlying aerodynamic assumptions One conical flow method is considered along with three different nonconical flow methods Comparisons are conducted between the described methods and available aerodynamic data Attention is also given to a vortex flow drag study and a vortex flow wing design using suction analogy G R

A79-11571 # **Application of the lifting line concept to helicopter computation** J J Costes (ONERA, Châtillon-sous-Bagneux, Hauts de Seine, France) *(European Rotorcraft and Powered Lift Aircraft Forum, 4th, Stresa, Italy, Sept 13-15, 1978) ONERA, TP* no 1978 90, 1978 18 p 9 refs

This paper presents some comparisons between theory and experiment for the lifting force on the blade of a model of helicopter in forward flight It is shown that the accuracy of the results obtained by the lifting line method decreases for high advance ratio flights, especially at the blade tip The coupling of 3-D and skewed flow effects, added to unsteady aerodynamics which occurs there, is studied on a simplified model (Author)

A79 11572 # **Energy conservation aircraft design and operational procedures** P Poisson Quinton (ONERA, Châtillon sous-Bagneux, Hauts-de Seine, France) *(NATO, AGARD, Lecture Series on Energy Conservation in Aircraft Propulsion, Munich, West Germany, Oct 26, 27, 1978) ONERA, TP* no 1978 107, 1978 48 p 90 refs

The paper reviews studies associated with improved fuel efficiency Several aircraft design concepts are described including (1) increases in aerodynamic efficiency through decreased friction drag, parasitic drag, and drag due to lift, (2) structural efficiency and the implementation of composite materials, (3) active control technology, (4) the optimization of airframe engine integration, and (5) VTOL and STOL concepts Consideration is also given to operational procedures associated with flight management, terminal area operations, and the influence of environmental noise constraints on fuel economy S C S

A79 11599 * # **Characteristics and combustion of future hydrocarbon fuels** R A Rudey and J S Grobman (NASA, Lewis Research Center, Cleveland, Ohio) *NATO, AGARD, Lecture Series on Energy Conservation in Aircraft Propulsion, Munich, West Germany, Oct 26, 27, 1978, Paper* 25 p 19 refs

Dwindling supply of high quality crude is beginning to manifest itself in the form of crude oils containing higher percentages of aromatic compounds, sulfur, nitrogen, and trace constituents In the present paper, problems which have arisen with regard to the hydrogen content in jet fuels derived from these crude oil sources are discussed, with particular reference to the effects of varying the fuel properties on the combustion and thermal stability characteristics of a fuel The importance of knowing how severe the effects of variations in hydrogen content, fuel-bound nitrogen content, and boiling range are on such combustion phenomena as soot and carbon formation, emissions, and ignition is pointed out V P

A79-11600 * # **Impact of future fuel properties on aircraft engines and fuel systems** R A Rudey and J S Grobman (NASA, Lewis Research Center, Cleveland, Ohio) *NATO, AGARD, Lecture Series on Energy Conservation in Aircraft Propulsion, 96th, Munich, West Germany, Oct 26, 27, 1978, Paper* 32 p 20 refs

From current projections of the availability of high quality petroleum crude oils, it is becoming increasingly apparent that the specifications for hydrocarbon jet fuels may have to be modified The problems that are most likely to be encountered as a result of these modifications relate to engine performance, component durability and maintenance, and aircraft fuel system performance The effect on engine performance will be associated with changes in specific fuel consumption, ignition at relight limits, at exhaust emissions Durability and maintenance will be affected by increases in combustor liner temperatures, carbon deposition, gum formation in fuel nozzles, and erosion and corrosion of turbine blades and vanes Aircraft fuel system performance will be affected by increased deposits in fuel system heat exchangers and changes in the pumpability and flowability of the fuel The severity of the potential problems is described in terms of the fuel characteristics most likely to change in the future Recent data that evaluate the ability of current-technology aircraft to accept fuel specification changes are presented, and selected technological advances that can reduce the severity of the problems are described and discussed (Author)

A79-11623 **Gas turbine jet exhaust noise prediction** *SAE Aerospace Recommended Practice,* ARP 876, Mar 1978 41 p

The document presents sources of exhaust noise and notes on the use of prediction methods in order to gain a clearer picture of the influence of factors other than the noise due to the external mixing process A method is described for the prediction of single stream jet mixing noise from shock free circular nozzles Pertinent data on gas turbine jet exhaust noise prediction are presented in graphical and tabular forms S D

A79-11624 **Gas turbine engine inlet flow distortion guidelines** *SAE Aerospace Recommended Practice,* ARP 1420, Mar 1978 16 p 5 refs

Guidelines for the evaluation of gas turbine engine stability and performance are established Consideration is given to a distortion descriptor which identifies critical inlet flow distortions in terms of intensity, extent, and multiple-per revolution elements Stability and performance are assessed on the basis of a surge margin, the surge pressure ratio loss, and estimates of the effects of inlet distortion of engine thrust, airflow, and fuel consumption form the basis for performance assessment Test procedures are outlined with reference to inlet and aircraft component tests, engine and engine component tests, and propulsion system tests Guidelines are recommended for data scaling, total-pressure instrumentation, data acquisition, and data processing S C S

A79-11625 **Arresting hook installation, land based aircraft, emergency** *SAE Aerospace Recommended Practice,* ARP 1538, Apr 1978 8 p

Criteria and requirements for the design of emergency arresting hooks for land based aircraft are proposed The recommendations concern definition of purpose of the hooks, load capacity of the hooks, arresting hook geometry, definition of ground lines, ancillary components of the arresting hook system, and quality assurance provisions P T H

A79-11913 **Antenna to IMU mounting for SAR motion compensation** L C Milier and V M Foxwell (Westinghouse Defense and Electronics Systems Center, Baltimore, Md) In Mechanical Engineering in Radar Symposium, Arlington, Va , November 8-10, 1977 Record New York, Institute of Electrical and Electronics Engineers, Inc , 1977, p 80 84 7 refs Contract No F33615-74 C-1040

Motion compensation for a synthetic aperture radar requires careful installation of the inertial navigation system (INS) used for sensing antenna motion Limits on relative motion between the INS and antenna, and typical environments are presented An approach for analyzing the differential motion is discussed and two example configurations are considered It is demonstrated that the mounting problem is critical to good imaging performance but that acceptable performance can be achieved with reasonable designs (Author)

A79-11919 **Thermal design of airborne radars - Present and future** F E Altoz (Westinghouse Defense and Electronics Systems Center, Baltimore, Md) In Mechanical Engineering in Radar Symposium, Arlington, Va , November 8-10, 1977 Record New York, Institute of Electrical and Electronics Engineers, Inc , 1977, p 110-113

The significant factors relating to the thermal design of radar equipment is presented along with an identification of potential areas for improvement The cooling techniques described emphasize the microcircuit packaging area, one which impacts the greatest on radar system reliability The paper also examines emerging developments most likely to influence the future thermal design of radars (Author)

A79-11923 **E-3A antenna pedestal turntable** C M Fritz (Keystone Engineering Co, Los Angeles, Calif) In Mechanical Engineering in Radar Symposium, Arlington, Va, November 8 10, 1977 Record New York, Institute of Electrical and Electronics Engineers, Inc, 1977, p 136-144

The development of an airborne four-point contact moment load bearing employing hollow ring sections is described The E-3A (AWACS) antenna pedestal turntable transfers the aerodynamic loads from, and provides rotation to, the 30-ft diameter rotodome, mounted on the Boeing E 3A (modified 707) airplane Engineering support included material selection and stress, fatigue, failsafe, and finite element analyses A test and extrapolation approach was followed Turntable moment loads cause ring prying The resulting ring distortions affect the bearing race geometry and ball load distribution, hence bearing life Rotation subjects the rings to fatigue Concentrated load points affect the limit load race geometry Bearing performance and stiffness are traded off against weight (Author)

A79-11934 **The control of tolerances in an array antenna** W R Fanning, G N Tsandoulas, and M A Nader (MIT, Lexington, Mass) In Mechanical Engineering in Radar Symposium, Arlington, Va, November 8-10, 1977 Record New York, Institute of Electrical and Electronics Engineers, Inc, 1977 p 236 241 USAF sponsored research

The design and testing of an L band airborne phased array antenna is described The array uses the displaced phase center antenna mode, and the working of this system, in which two beams, each originating from different but overlapping parts of the aperture, are produced and radiated sequentially is explained The array, which requires tight mechanical tolerances and a high degree of component similarity, provides high subclutter visibility of moving targets Phase and amplitude measurement errors are limited to about 0 1 deg and 0 01 dB, respectively M L

A79-12033 **Present and potential capabilities of three-dimensional displays using sequential excitation of fluorescence** C M Verber (Battelle Columbus Laboratories, Columbus, Ohio) In Three dimensional imaging, Proceedings of the Seminar, San Diego, Calif, August 25, 26, 1977 Bellingham, Wash, Society of Photo-Optical Instrumentation Engineers, 1977, p 62-67

A three dimensional display utilizing the sequential excitation of fluorescence at predetermined controlled location within a display volume is presented The display is achieved by causing fluorescence to appear at the intersection point of two energy beams within a display volume By scanning the point of intersection, figures are created in three dimensions Five subelements are used the transparent display medium, the light beam sources, beam modulators, beam deflectors, and digital electronics The parameters necessary to characterize the display are identified as the number of simultaneously displayed spots, the rate at which the display is refreshed, the length of the display along the direction of the ground state pump, the spot diameter, the spot brightness, and the visible fluorescence wavelength S C S

A79-12093 **Infrared landing system for a mini remotely-piloted vehicle** R Paulson, E Price, H Hodor, and J Barney (Lockheed Missiles and Space Co, Inc, Sunnyvale, Calif) In Modern utilization of infrared technology III Civilian and military, Proceedings of the Third Seminar, San Diego, Calif, August 25, 26, 1977 Bellingham, Wash, Society of Photo-Optical Instrumentation Engineers, 1977, p 214-220

An infrared automatic landing system for guiding a mini remotely piloted vehicle (RPV) into a net has been designed and conceptually tested The system consists of a ground-based pulsed GaAs laser transmitter illuminating a cooperative RPV, and a ground-based tracking receiver sensing the position of the RPV This position information is telemetered back through the control link to the RPV to guide it down A key element in the system is a state-of art tracking receiver that has no moving parts, but uses a holographic field lens to do the real-time signal processing The receiver, besides providing position data, also gives ranging information The complete landing system is packaged in a battery operable box critically placed on the ground at the landing area (Author)

A79-12126 # **Method of calculating potential flows of an incompressible fluid past a wing with a high-lift device (Metodras-cheta potentsial'nogo obtekaniia profil'ia s mekhanizatsiei v neszhimaemoi zhidkosti)** M A Kozorezov, Iu S Mikhailov, and Ia M Serebriiskii *TsAGI, Uchenye Zapiski*, vol 8, no 1, 1977, p 1-5 In Russian

The method proposed in the present paper for calculating ideal incompressible flows past wings of arbitrary configuration fitted with a high lift device is based on alternate conformal mapping of the exterior of each contour on the exterior of a near circular plane The complex potential of the flow in the mapped planes is then computed by the vortex layer method The method proposed is shown to be superior to a method by Hess and Smith (1966) with respect to the accuracy of the total and distributed aerodynamic characteristics It can be readily extended to wings with several high lift devices V P

A79-12127 # **Contribution to the asymptotic theory of flows at the trailing edge of a slender wing (K asimptoticheskoi teorii techeniia vblizi zadnei kromki tonkogo profiliia)** A I Ruban *TsAGI, Uchenye Zapiski*, vol 8, no 1, 1977, p 6 11 8 refs In Russian

The present analysis deals with the laminar incompressible flow at the trailing edge at large Reynolds numbers The wing thickness is assumed to be on the order of Re to the 1/4 power, which corresponds to the conditions for transition to separated flow The value of the asymptotic similarity criterion that corresponds to the onset of separation is determined by integrating numerically the relations describing such flows V P

A79-12135 # **Determination of inspection intervals for aircraft structures with allowance for the two-stage nature of fatigue damage (Opredelenie srokov osmotrov aviatsionnykh konstruktsii s uchetom dvukhstadiinosti ustalostnogo povrezhdeniia)** E L Zimont *TsAGI, Uchenye Zapiski*, vol 8, no 1, 1977, p 79-85 In Russian

In the present analysis, time to failure is expressed as the sum of the time to crack nucleation and the time of crack development to the critical dimension Inspections are broken down into periodic inspections, inspections with identical failure probability between inspections, and inspection optimal with respect to the number of inspections The optimality conditions derived from the analysis indicate that the optimal inspection interval depends only on the two preceding intervals A numerical solution algorithm is proposed and is illustrated by examples V P

A79-12137 # **Thermal stability of ribbed sheet systems (Termoustoichivost' plastinchato-sterzhnevykh sistem)** G N Zamula *TsAGI, Uchenye Zapiski*, vol 8, no 1, 1977, p 98-104 In Russian

Zamula (1974) has proposed a method, based on orthogonal difference factorization, for solving stability problems for nonuniformly heated and loaded sheet structures In the present paper, this method is extended to (nonuniformly heated and loaded) systems consisting of plates discretely strengthened by ribs V P

A79-12138 # **Numerical solution of a linear integral equation of the first kind in the inverse problem of symmetric flow past a wing (Chislennoe reshenie lineinogo integral'nogo uravneniia pervogo roda v obratnoi zadache simmetrichnogo obtekaniia kryla)** S G Ignat'ev and L F Lobodina *TsAGI, Uchenye Zapiski*, vol 8, no 1, 1977, p 108-114 6 refs In Russian

Two methods are examined of obtaining regular solutions of a Fredholm integral equation of the first kind with a nonsingular kernel by approximating the equation by a system of linear algebraic equations One method makes use of the properties of the kernel, it leads to a special selection of the mutual position of panels and control points The other method consists of a overdetermination of a system of linear equations by selecting a large number of control points (greater than the number of unknowns) and solving the system of equations by the method of least squares The effectiveness of both approaches is demonstrated by examples V P

A79-12144 # **Application of gradient methods to the optimal design of components of load-bearing structures (Primenenie gradientnykh metodov k optimal'nomu proektirovaniiu elementov silovykh konstruktsii)** V A Belous *TsAGI, Uchenye Zapiski,* vol 8, no 1, 1977, p 143-147 In Russian

The application of the gradient projection method and the gradient method to the minimum-weight design of aircraft load-bearing components is studied An application of the methods to a three times statically indeterminate frame subjected to uniformly distributed load shows that the computational labor is practically equal for both methods V P

A79-12145 # **Decreasing stress concentrations in structures made of high-strength materials (K voprosu o snizhenii kontsentratsii napriazhenii v konstruktsiiakh iz vysokoprochnykh materialov)** N S Galkina and V I Grishin *TsAGI, Uchenye Zapiski,* vol 8, no 1, 1977, p 148 151 6 refs In Russian

A method of designing for minimal local stresses in a main frame prepared from high-strength aluminum (or steel) alloys is proposed Stresses are determined by the finite element method, within the framework of small elastoplastic deformation theory The relations used for writing a program for computing the stress-strain state of a structure in the case of elastic and inelastic behavior of the material are examined V P

A79-12148 # **Some types of separated flow past slotted wings (Nekotorye tipy otryvnogo obtekaniia razreznykh kryl'ev)** A V Petrov *TsAGI, Uchenye Zapiski, vol 8, no 2, 1977, p 16-25* 7 refs In Russian

In the present paper, the results of theoretical and experimental studies concerning the lift characteristics and flow spectra are summarized for angles of attack ranging from -10 to +40 degrees and maximum camber between 0 1 and 0 35 The existence of a reverse flow region just above the laminar boundary layer is demonstrated The configuration of the separated region is studied as a function of the angle of attack, the slotted-flap angle, the maximum camber, and the Reynolds number V P

A79-12151 # **Investigation of the profile drag and the mean and pulsation velocities in the wake of wings by means of a laser Doppler anemometer (Issledovanie srednikh i pul'satsionnykh skorostei v slede i profil'nogo soprotivleniia kryl'ev s pomoshch'iu lazernogo Dopplerovskogo izmeritelia skorosti)** O P Brysov, G L Grodzovskii, Iu E Kuznetsov, A S Mozol'kov, A N Petunin, and V G Shumilkin *TsAGI, Uchenye Zapiski,* vol 8, no 2, 1977, p 44 51 14 refs In Russian

In the study described, a laser Doppler anemometer was used to measure the mean and pulsation velocities in the wake of wing models in a wind tunnel at Reynolds numbers ranging from 1 5 to 2 5 times 10 to the fifth The profile resistance of the models was calculated by the method of moments V P

A79-12152 # **Quality index for an iterative process of optimizing long range aircraft parameters (O kriterii kachestva dlia iteratsionnogo protsessa optimizatsii parametrov samoletov dal'nego deistviia)** V T Pashintsev *TsAGI, Uchenye Zapiski,* vol 8, no 2, 1977, p 52 60 In Russian

The quality index proposed in the present paper characterizes, at each step of an iteration process, the optimization of aircraft parameters and the level of perfection with respect to minimum takeoff run and maximum flying range Results are analyzed of numerical calculations of the optimal wing planform and the weight-optimal dimensions and modes of operation of the engines V P

A79-12153 # **Method of eliminating static and dynamic errors in the reproduction of motion of TV simulator displays (Metod ustraneniia staticheskikh i dinamicheskikh oshibok vosproizvedeniia dvizheniia v televizionnykh imitatorakh vizual'noi obstanovki)** A N Predtechenskii and V V Rodchenko *TsAGI, Uchenye Zapiski,* vol 8, no 2, 1977, p 61 68 In Russian

The method proposed in the present paper for eliminating errors in the reproduction of aircraft motion is based on an additional transformation of the image in the TV channel Relations are derived and analyzed which describe the operation of the error eliminating system A technique for compensating errors in the reproduction of aircraft roll is discussed and its circuitry is diagrammed V P

A79-12155 # **Time frequency method of solving large problems in the dynamics of elastic structures with local nonlinearities (Chastotno-vremennoi metod resheniia bol'shikh zadach dinamiki uprugikh konstruktsii s lokal'nymi nelineinostiami)** G V Vronskii and V D Il'ichev *TsAGI, Uchenye Zapiski,* vol 8, no 2, 1977, p 80-89 6 refs In Russian

A method is proposed for solving systems of ordinary differential equations describing the dynamics of large systems containing nonlinear elements The method is based on splitting the equations into linear and nonlinear parts, with subsequent algebraic solution of the linear part in the frequency domain The nonlinear part is solved by a mixed time-integration technique, termed the time-frequency method of the Lax-Wendroff type, based on the use of fast Fourier transforms For illustration, the method is applied to the calculation of the endurance of an aircraft performing random vibrations V P

A79-12162 # **Investigation of the electrification of an aircraft model by a humid airstream in a wind tunnel (Issledovanie elektrizatsii modeli samoleta potokom uvlazhnennogo vozdukha v aerodinamicheskikh trubakh)** V R Bertyn', A V Podmazov, and A S Frolov *TsAGI, Uchenye Zapiski,* vol 8, no 2, 1977, p 123, 124 In Russian

The experiments described were carried out to study the electrification of aircraft models by dry and humid airstreams at Mach numbers ranging from 0 5 to 1 4 At an angle of attack of 10 degrees, the static charge imparted to the model by a dry airstream was a small fraction of a volt In the case of humid air, the maximal charge at M = 1 4 was 2700 V With increasing Mach number, the charge increased according to a cubic law V P

A79-12163 # **A method of solving multicriterial optimization problems for load-bearing structures (Ob odnom sposobe resheniia mnogokriterial'nykh zadach optimizatsii silovykh konstruktsii)** T G Zuraev and V M Frolov *TsAGI, Uchenye Zapiski,* vol 8, no 2, 1977, p 125-130 In Russian

The problem of applying several criteria to the optimization of a load bearing structure is examined It is proposed to use for this purpose a generalized criterion in the form of a product of special criteria For illustration, the generalized criterion is applied to the problem of minimizing the potential strain and tip-deflection energy for a large-aspect ratio wing in the presence of constraints on the volume of the load-carrying material and the aerodynamic loads V P

A79-12164 # **Summation of defects in the case of nonisothermal programmed loads (Summirovanie povrezhdenii pri neizotermicheskom programmnom nagruzhenii)** S I Ol'kin *TsAGI, Uchenye Zapiski,* vol 8, no 2, 1977, p 131-136 8 refs In Russian

An engineering method is proposed for calculating the endurance in alternating creep and fatigue for loads and temperatures characteristic of a supersonic transport aircraft The method is developed on the basis of an experimental study of the summation of damage in a structural tension element operating under such conditions V P

A79-12168 # ***Lift and longitudinal moment of a small-aspect-ratio wing in the proximity of a body of revolution* (Pod'emnaia sila i prodol'nyi moment kryla malogo udlineniia s raspolozhennym vblizi nego telom vrashcheniia)** V V Keldysh *TsAGI, Uchenye Zapiski,* vol 8, no 3, 1977, p 19 31 9 refs In Russian

In the present paper, slender wing theory is applied to the calculation of the lift and pitching moment of a small aspect-ratio wing in the case where a body of revolution is mounted on the wing or is situated in its proximity The influence of the geometrical parameters on the aerodynamic behavior of the system composed of the wing and body is analyzed V P

A79-12176 # Method of determining the stability and controllability characteristics of an aircraft from the transient processes (Metod opredeleniia kharakteristik ustoichivosti i upravliaemosti samoleta po perekhodnym protsessam) Iu A Vinogradov and M M Medvedev *TsAGI, Uchenye Zapiski,* vol 8, no 3, 1977, p 99 107 6 refs In Russian

The method of identifying stability and controllability charac teristics, proposed in the present paper, is based on repeated averaging of the aircraft's phase coordinates The accuracy of estimates obtained by this method is assessed as a function of the control and phase coordinate errors and the disturbances caused by atmospheric turbulence Good agreement with a solution obtained by the method of least squares is established V P

A79-12182 # Calculation of the transient aerodynamic characteristics of a supersonic flight vehicle (Raschet nestatsionarnykh aerodinamicheskikh kharakteristik sverkhzvukovogo letatel'nogo apparata) S A Popytalov and V V Samsonov *TsAGI Uchenye Zapiski,* vol 8, no 3, 1977, p 143 148 7 refs In Russian

In the present paper, a method proposed by Belotserkovskii and Popytalov (1970) for calculating the aerodynamic characteristics of wings of complex planform within the framework of Krasil'shchikov's (1952) mathematical theory of a wing of finite span in compressible flow is extended to aircraft all of whose load-bearing elements are situated in a common plane The aerodynamic characteristics associated with longitudinal motion are determined, in linear formulation, from the analysis of the flow past a slightly curved surface having the same shape as the aircraft's planform V P

A79-12188 # Regimes of supersonic flow past thin wings (O rezhimakh sverkhzvukovogo obtekaniia tonkikh kryl'ev) A N Minailos *TsAGI, Uchenye Zapiski,* vol 8, no 4, 1977, p 10-17 13 refs In Russian

A numerical approach is taken to supersonic conical flow past thin trapezoidal and delta wings Consideration is given to shock wave behavior in flows with and without separation from sharp edges of the wings Conditions under which developed separation may exist are examined Flow profiles are considered for different Mach numbers B J

A79-12194 # Numerical solution of the direct problem of ideal gas flow in three-dimensional turbine cascades (Chislennoe reshenie priamoi zadachi o techenii ideal'nogo gaza v prostranstvennykh turbinnykh reshetkakh) A B Bogod and M Ia Ivanov *TsAGI, Uchenye Zapiski,* vol 8, no 4, 1977, p 62-69 14 refs In Russian

A three-dimensional variant of the Godunov finite difference method is used to solve the problem of the flow of an inviscid nonthermally conducting gas in an axiradial turbine cascade The method is used to integrate the unsteady three-dimensional equations of gas dynamics describing the cascade flow Some numerical results are presented and attention is given to their accuracy and to the effects of three-dimensionality on the solutions B J

A79-12195 # Numerical-analytical solution of the problem of the constrained torsion of a cantilever wing (O chislenno-analiticheskom reshenii zadachi stesnennogo krucheniia konsol'nogo kryla) Ia M Parkhomovskii *TsAGI, Uchenye Zapiski,* vol 8, no 4, 1977, p 70 80 5 refs In Russian

A method is presented for solving the boundary value problem of the constrained torsion of a wing An asymptotic solution is obtained for the case of moderate constraint on the torsion, characteristic of wings of large and medium aspect ratios In addition, formulas are obtained for the direct calculation of the effect of constraints on the frequency and mode of torsional vibrations of the wing B J

A79-12196 # Investigation of an ejector thrust augmentor with a perforated nozzle for the ejected gas (Issledovanie ezhektornogo uvelichitelia tiagi s perforirovannym soplom ezhektiruiushchego gaza) Iu G Zhulev and Iu F Potapov *TsAGI, Uchenye Zapiski,* vol 8, no 4, 1977, p 81-85 5 refs In Russian

It is shown that conical nozzle attachments perforated with longitudinal slots can be used to increase the efficiency of ejector thrust augmentors Experiments devised to study the effect of geometrical parameters of the nozzle attachment on thrust augmentation characteristics are described It is found that such attachments are quite effective for the case of subcritical pressure drops at the ejector nozzle B J

A79-12198 # Approximate calculation of the velocity field and the motion of vortices in the wake of a low-flying biplane (Priblizhennyi raschet polia skorostei i dvizheniia vikhrei za nizkoletiashchim biplanom) Iu E Kuznetsov and Ia Sh Flaksman *TsAGI, Uchenye Zapiski,* vol 8, no 4, 1977, p 92 96 9 refs In Russian

The paper describes a method for calculating the velocity field some distance behind a low flying biplane The vortex wake is modeled as a system of four infinite free vortices, and the screening effect of the earth surface is taken into account by the introduction of four additional specularly reflected vortices The motion of the vortices is studied as a function of flight altitude B J

A79-12199 # Vortex system at the nose part of a fuselage model at supercritical angles of attack and different Reynolds numbers (Vikhrevaia sistema nosovoi chasti modeli fiuzeliazha samoleta na zakriticheskikh uglakh ataki pri razlichnykh chislakh Reinol'dsa) G I Golovatiuk and Ia I Teteriukov *TsAGI, Uchenye Zapiski,* vol 8, no 4, 1977, p 97 103 In Russian

The vortex system formed at the nosecone of a fuselage model at supercritical angles of attack (20 70 deg) for the Reynolds number range 100,000 700,000 was studied in a hydraulic test tunnel Conditions of symmetry and asymmetry for the vortex system were investigated Flow visualization results are presented B J

A79-12200 # Longitudinal distribution of hydrodynamic load on a gliding flat bottomed plate with keel (Prodol'noe raspredelenie gidrodinamicheskoi nagruzki na glissiruiushchei ploskokilevatoi plastine) L D Kovrizhnykh *TsAGI, Uchenye Zapiski,* vol 8, no 4, 1977, p 104 109 In Russian

Experiments were conducted in a water tunnel to determine hydrodynamic load distribution on a flat bottomed plate with keel gliding on the water surface without wetting its chines The transverse roll angle of the plate was 30 deg The results are interpreted in light of a wing analogy which ascribes to the cross section of the gliding plate half the lift force of a flat delta wing, with correction for roll Wing analogy calculations agree well with experimental results B J

A79-12205 # Effect of viscosity on nonseparated transonic flow past a profile (Vliianie viazkosti na bezotryvnoe okolozvukovoe obtekanie profilia) M A Brutian and V I Savitskii *TsAGI, Uchenye Zapiski,* vol 8, no 5, 1977, p 24 29 8 refs In Russian

The effect of viscosity on the nonseparated flow past a wing profile at transonic velocities is studied within the framework of boundary layer theory A method is developed for calculating the pressure distribution along the profile while taking into account the boundary layer displacement thickness and the vortex wake The method permits calculating the aerodynamic characteristics of wing profiles with allowance for the effects of Reynolds number and Mach number in transonic flow Close agreement was obtained between calculated and experimental results P T H

A79-12213 # **Iterative method of aircraft wing strength calculation taking into account the effect of deformations on distribution of aerodynamic forces (Iteratsionnyi metod rascheta na prochnost' kryla samoleta s uchetom vliianiia deformatsii na raspredelenie aerodinamicheskikh sil)** V V Mazur and G I Turchannikov *TsAGI, Uchenye Zapiski,* vol 8, no 5, 1977, p 80-89 In Russian

An iterative method for solving static aeroelasticity problems is proposed The problem consists of determining the state of stress of a wing when the aerodynamic loads are redistributed on account of wing deformation The algorithm and block diagram of the computer programs set up for the problem are presented Numerical results obtained for a wing of low aspect ratio are discussed P T H

A79-12216 # **Moments on the hub of a lifting propeller with hinge-mounted blades (Momenty na vtulke nesushchego vinta s sharnirnym krepleniem lopastei)** A N Volobuev *TsAGI, Uchenye Zapiski,* vol 8, no 5, 1977, p 101 104 In Russian

Formulas are derived for the longitudinal and transverse components of the moment on the hub of a hinge mounted lifting propeller The formulas take into account the forces in the thrust plane and the plane of rotation Only the case of steady horizontal flight is considered It is assumed that the hinge moment has no influence on the total moment and that the blade is absolutely rigid to bending and torsion P T H

A79-12224 # **Problems in the method of discrete vortices for solving linear wing theory problems (Nekotorye voprosy metoda 'diskretnykh vikhrei' resheniia lineinykh zadach teorii kryla)** I Ia Timofeev *TsAGI, Uchenye Zapiski,* vol 8, no 6, 1977, p 1-8 7 refs In Russian

The method of replacing the continuous vortex layer on a lifting surface by a system of discrete vortices in wing theory is considered It is proved that as the number of discrete vortices increases without bound, the discrete vortices induce at the interior points of the lifting surface the same value for the velocity component normal to the wing surface as in the case of a continuous vortex layer P T H

A79-12226 # **Theory of large-aspect ratio wings in transonic gas flow (K teorii kryla bol'shogo udlineniia v transzvukovom potoke gaza)** Iu B Lifshits *TsAGI, Uchenye Zapiski,* vol 8, no 6, 1977, p 18 21 8 refs In Russian

The asymptotic results of Diesperov and Lifshits (1976) on the influence of conditions at large distances from a profile on the flow in front of and behind the shock are applied to the analysis of the transonic flow past a wing of large aspect ratio The starting point is the equation of transonic small perturbation theory The behavior of the aerodynamic characteristics of the wing as the parameter K (partial derivative of the perturbation potential with respect to x) tends to zero and as the product of the aspect ratio and the 1/3 power of the thickness ratio tends to infinity is determined The analysis shows that the shock is located closer to the leading edge on the wing than on the profile, so that the drag coefficient of the wing is less than that of the profile by a quantity of order of the product of the -1/5 power of the aspect ratio and the 6/5 power of the thickness ratio P T H

A79-12227 # **Calculation of flow past conical bodies with supersonic leading edges (Raschet obtekaniia konicheskikh tel so sverkhzvukovymi perednimi kromkami)** Iu I Lobanovskii *TsAGI, Uchenye Zapiski,* vol 8, no 6, 1977, p 22 30 6 refs In Russian

The paper analyzes the flow of an inviscid perfect gas past delta wings with supersonic leading edges, past planar infinitely thin wings, and past conical wings in isolation and with a half cone placed on the lower or upper wing surface Numerical solution is based on the use of the principle of flow establishment in terms of a hyperbolic variable MacCormack's finite difference scheme is used, which enables computing the whole flow field without first isolating singularities Necessary stability conditions on the nonlinearized system of equations of gas dynamics are estimated P T H

A79-12228 # **Numerical study of the induction of porous walls of the working section of a low velocity wind tunnel (Chislennoe issledovanie induktsii pronitsaemykh stenok rabochei chasti aerodinamicheskoi truby malykh skorostei)** A P Byrkin and I I Mezhirov *TsAGI, Uchenye Zapiski,* vol 8, no 6, 1977, p 31 40 9 refs In Russian

Numerical calculations of two dimensional and three-dimensional flows in low velocity wind tunnels with porous walls were performed It is shown that when the pressure in the chamber surrounding the working section is equal to the pressure of the undisturbed flow, the use of porous walls does not lead to a reduction in the wall induction in the case of two dimensional flow For three-dimensional flows with free vortices propagating with the stream, the use of porous walls with longitudinal slots can lead to a significant reduction in wall induction P T H

A79-12233 # **Qualitative analysis of the effect of jet aircraft acoustic characteristics on the optimal take-off program (Kachestvennyi analiz vliianiia akusticheskikh kharakteristik samoleta s TRD na optimal'nuiu programmu vzleta)** A V Shustov *TsAGI, Uchenye Zapiski,* vol 8, no 6, 1977, p 81 92 10 refs In Russian

An algorithm is given for determining optimal aircraft engine thrust control laws for the climb segment of flight, where optimality is understood in the sense of minimal effective noise level The principal noise components considered are the gas jet noise and the aerodynamic noise Optimal take-off trajectories are numerically calculated P T H

A79-12234 # **Approximate solution of some boundary value problems on aircraft structural integrity (O priblizhennom reshenii nekotorykh kraevykh zadach prochnosti samoleta)** Ia M Parkhomovski *TsAGI, Uchenye Zapiski,* vol 8, no 6, 1977, p 93-106 In Russian

A method is set forth for approximate determination of the eigenvalues and eigenfunctions of several self adjoint boundary value problems As an example, the frequencies and shapes of the natural bending and torsional vibrations of wings not bearing concentrated loads are calculated P T H

A79-12236 # **Features of flow past slotted wings (O nekotorykh osobennostiakh obtekaniia razreznykh kryl'ev)** A V Petrov *TsAGI, Uchenye Zapiski,* vol 8, no 6, 1977, p 119 124 In Russian

The structure of the flow past the upper surface of a slotted wing was investigated for a wide range of variation of the maximal relative curvature of the slot profile (0 1 0 3), angle of attack (0 40 deg), and Reynolds number (0 5 million to 1 55 million) The characteristics of the development of viscous wakes behind elements of the slotted wing were obtained in wind tunnel studies The existence of local regions of backflow both on the wing surface and outside it was observed The change in configuration of backflow regions as a function of angle of attack, angle of deflection of a two slotted flap, and Reynolds number was followed P T H

A79 12240 # **Calculation of effect of viscosity on non-separated subsonic flow past a wing with flap (Uchet vliianiia viazkosti na bezotryvnoe dozvukovoe obtekanie profilia s zakrylkom)** M A Brutian and O L Shchennikova *Nuclear Fusion,* vol 18, Nov 1978, p 143-147 8 refs In Russian

Prandtl's boundary layer method is applied to the case of nonseparated flow past a slotted wing profile at small subsonic velocities A method was developed for calculating the pressure distribution along a mechanized profile that takes into account the boundary layer displacement thickness and the vortex wake The method permits calculation of the aerodynamic characteristics of an arbitrary profile with hinged flaps at small velocities, where the effect of Reynolds number is taken into account for a given position of the transition point Good agreement with experimental data is obtained PTH

A79-12287 **Design of a multivariable controller for a high-order turbofan engine model by Zakian's method of inequalities** O Taiwo (University of Manchester Institute of Science and Technology, Manchester, England) *IEEE Transactions on Automatic Control*, vol AC-23, Oct 1978, p 926 928 11 refs

The method of inequalities is used to design a simple multivariable controller for the regulation of the net thrust level, total airflow and inlet temperature of a 24th-order plant which consists of an F100 turbofan engine and actuators These results reveal some of the inherent difficulties associated with the control of the plant (Author)

A79-12290 **Desensitizing constant gain feedback linear regulators** P J Fleming (North Wales, University College, Bangor, Wales) *IEEE Transactions on Automatic Control*, vol AC-23, Oct 1978, p 933 936 8 refs

A two-stage process is proposed for the design of low sensitivity constant gain feedback linear regulators In the first stage nominal parameter values are assumed and a model response is obtained Plant parameter variations are taken into account in the second stage, and a sensitivity reduction algorithm is described in which a performance index which includes a model following term is to be minimized The computer solution of the feedback matrix is obtained using a gradient search method, and a fourth-order aircraft flight control example illustrates the design's capabilities (Author)

A79-12302 **F-16 Avionics Intermediate Shop self test** B Mertes (General Dynamics Corp, Electronics Div, San Diego, Calif) and L J Isely (ATE Associates, Inc, Northridge, Calif) In AUTOTESTCON '77, Symposium, Hyannis, Mass, November 2-4, 1977, Record New York, Institute of Electrical and Electronics Engineers, Inc, 1977, p 19-23

The F 16 Avionics Intermediate Shop (AIS) family of automatic test equipment fully demonstrates the overall level of sophistication attainable with third-generation ATE Successful ATE projects must produce automatic test stations which are maintainable as well as capable of powerful automatic testing This paper describes F-16 AIS self-test design and gives attention to implementation details The modular ATLAS software approach is shown to be the solution to a large and complex test requirement BJ

A79-12305 **Support systems for advanced military electronics** J W Kenney (General Dynamics Corp, Fort Worth, Tex) In AUTOTESTCON '77, Symposium, Hyannis, Mass, November 2 4, 1977, Record New York, Institute of Electrical and Electronics Engineers, Inc, 1977, p 64-71

The paper examines some of the ways in which support systems are likely to change to keep in step with new avionics approaches It is found that those factors which will probably have the greatest influence on ATE support systems are improved reliability, total digital designs, standardization of processors, software and systems operation monitoring, and on station SRU (Shop Replaceable Unit) operations Of lesser importance are concepts such as dynamic reconfiguration and redundancy BJ

A79-12306 **Advanced technology impact upon ATE self test** W Young (Bendix Corp, Test Systems Div, Teterboro, N J) In AUTOTESTCON '77, Symposium, Hyannis, Mass, November 2-4, 1977, Record New York, Institute of Electrical and Electronics Engineers, Inc, 1977, p 72-77

The paper examines the opportunities afforded to ATE self test by the use of microprocessors and LSI Current self-test concepts are briefly examined in terms of inherent ambiguities, testability, and the need for accessory test equipment The concept of using intelligent instruments along with compact diagnostic module testers within the framework of a large ATE system is treated as a viable cost-effective approach to current ATE self test problems BJ

A79-12309 **Testing of avionics display systems** J W Dickerson (General Dynamics Corp, Fort Worth, Tex) In AUTOTESTCON '77, Symposium, Hyannis, Mass, November 2 4, 1977, Record New York, Institute of Electrical and Electronics Engineers, Inc, 1977, p 135 149

Automatic test guidelines are outlined for sophisticated avionics display systems Testing procedures for symbol generators and display units are discussed separately A projection of future display testing requirements is included BJ

A79-12319 **Management of test program development for S 3A** J M Colebank, V J Peterson, and D A Farr (Lockheed California Co, Burbank, Calif) In AUTOTESTCON '77 Symposium, Hyannis, Mass, November 2 4, 1977, Record New York, Institute of Electrical and Electronics Engineers, Inc, 1977, p 246 253 5 refs

The S 3A Viking antisubmarine warfare aircraft is described in terms of the avionics system, maintainability, and automatic test equipment The management program is considered with reference to the planning, design, programming, debugging, and design acceptance phases The organizational aspects of management are also assessed including test programming, systems engineering, hardware, engineering services, quality testing, and customer relations SCS

A79-12320 **Commercial test software development practices for military applications** R W Milkie (Douglas Aircraft Co, Long Beach, Calif) In AUTOTESTCON 77, Symposium Hyannis, Mass, November 2 4 1977, Record New York, Institute of Electrical and Electronics Engineers, Inc, 1977, p 254 260

A method of implementing the best of commercial test software practices as related to automatic support equipment for military aircraft avionics hardware is described The similarities and differences between commercial and military test software functions are discussed Commercial configuration management and control practices, plus the documentation offered in the development and utilization of support equipment test software for commercial avionics, is highlighted with respect to potential application for military aircraft systems (Author)

A79-12321 **F-16 LRU test programs A systems approach** P D O'Connor (USAF, F 16 System Program Office, Wright Patterson AFB, Ohio) In AUTOTESTCON '77, Symposium, Hyannis, Mass, November 2 4, 1977, Record New York, Institute of Electrical and Electronics Engineers, Inc, 1977, p 270-278

The paper outlines the management approach planned and initiated by the F 16 System Program Office to address the problems associated with system test specifications and line replaceable unit test program source documentation in the early development phases of the F 16 avionics intermediate shop program The approach is based on innovative contractual concepts early in depth planning, and meticulous execution of a detailed game plan Initial results are presented, and suggested changes to acquisition strategy are discussed SD

A79 12366 * **Unsteady subsonic and supersonic potential aerodynamics for complex configurations** L Morino and K Tseng (Boston University, Boston, Mass) In International Symposium on Innovative Numerical Analysis in Applied Engineering Science, Versailles, France, May 23 27, 1977, Proceedings

Senlis, Oise, France, Centre Technique des Industries Mecaniques, 1977, p 4 27 to 4 30 13 refs Grant No NGR-22 004-030

A recently developed general theory for unsteady compressible potential fluid dynamics for complex configuration aircraft is reviewed The method is based on a combination of the following techniques Green's function method (to transform the differential equation into an integral differential-delay equation), finite element method (to transform the equation into a set of differential-delay equations in time), and the Laplace transform method (to transform the differential-delay equations into algebraic equations) P T H

A79-12371 **High efficiency fluid film thrust bearings for turbomachinery** B S Herbage (Centritech Corp, Houston, Tex) In Turbomachinery Symposium, 6th, Houston, Tex, December 6-8, 1977, Proceedings College Station, Tex, Texas A & M University, 1977, p 33 38 5 refs

Fluid film thrust bearings in use on high speed high capacity turbomachinery absorb a great amount of energy in performing their task of positioning rotors A review of thurst bearing fundamentals along with the latest design concepts briefly outline how thrust bearing performance can be substantially improved The major improvements come from selection of materials and methods of lubrication (Author)

A79-12373 **A discussion of turbine and compressor sealing devices and systems** R J Schmal (Stein Seal Co, Philadelphia, Pa) In Turbomachinery Symposium, 6th, Houston, Tex, December 6-8, 1977, Proceedings College Station, Tex, Texas A & M University, 1977, p 153 168 7 refs

A review of sealing devices and systems used in turbines and compressors is presented Labyrinth seals are described noting that they are used when a small loss in efficiency may be tolerated for both static and dynamic applications, straight, staggered, and stepped labyrinth forms are discussed The windback, similar in structure to the labyrinth, is noted Restrictive ring gas seals are outlined with reference to the floating type (segmented or rigid) and the fixed type Consideration is given to fluid film seals which may be designed with either fixed or floating sleeves Various types of liquid contact seal systems are reviewed along with dry gas seal rings with grooved face designs Attention is given to the circumferential contact seal, which is a bore rubbing instrument, and to film riding face seals Several seal systems are reported including the buffered educated restrictive ring seal system S C S

A79-12376 **National Conference on Energy Conservation in General Aviation, 1st, Kalamazoo, Mich, October 10, 11, 1977, Proceedings** Conference sponsored by the Western Michigan University Edited by H D Behm (Western Michigan University, Kalamazoo, Mich) Kalamazoo, Mich, Western Michigan University, 1977 154 p $10 00

The papers in this volume present technological and operational approaches to the problem of increasing fuel economy in general aviation Topics discussed include the controversy of regulation versus technological improvements, alternative aviation turbine fuels, automotive engines for aircraft, energy conservation in general aviation piston powered aircraft, economy in flight operations, and efficiency through angle of attack monitoring P T H

A79-12377 # **Aircraft piston oils Past - present - future** R P Foster (Gulf Research and Development Co, Pittsburgh, Pa) In National Conference on Energy Conservation in General Aviation, 1st, Kalamazoo, Mich, October 10, 11, 1977, Proceedings Kalamazoo, Mich, Western Michigan University, 1977, p 37 39

For many years dating back to World War II and before, aircraft piston engines were lubricated with specially manufactured high quality straight mineral oils It became, however, apparent in the period after World War II that continued engine development was being hindered by the lubricant In many cases, engine overhaul life could not be extended because of excessive deposits or because oil and oil filter change periods and propeller desludge periods became restrictive Introduction of an entirely new group of ashless additives in the middle 50's led to the development of today's ashless dispersant aircraft piston oil During the past five to ten years, a veritable explosion has taken place in the chemical industry such that a myriad of new organic materials are now available to the oil manufacturer The technical climate is, therefore, favorable for the development of improved aircraft piston oils G R

A79-12378 * # **Alternative aviation turbine fuels** J Grobman (NASA, Lewis Research Center, Advanced Technology Section, Cleveland, Ohio) In National Conference on Energy Conservation in General Aviation, 1st, Kalamazoo, Mich, October 10, 11, 1977 Proceedings Kalamazoo, Mich, Western Michigan University, 1977, p 40 59 11 refs

The efficient utilization of fossil fuels by future jet aircraft may necessitate the broadening of current aviation turbine fuel specifications The most significant changes in specifications would be an increased aromatics content and a higher final boiling point in order to minimize refinery energy consumption and costs These changes would increase the freezing point and might lower the thermal stability of the fuel and could cause increased pollutant emissions, increased smoke and carbon formation, increased combustor liner temperatures, and poorer ignition characteristics This paper discusses the effects that broadened specification fuels may have on present-day jet aircraft and engine components and the technology required to use fuels with broadened specifications (Author)

A79-12380 # **Turbine engines in light aircraft** E Lays (Williams Research Corp, Walled Lake, Mich) In National Conference on Energy Conservation in General Aviation, 1st, Kalamazoo, Mich, October 10, 11, 1977, Proceedings Kalamazoo, Mich, Western Michigan University, 1977, p 83 91

Some of the aircraft used by company executives have as many as 19 seats which are rarely used because it's seldom that 19 businessmen are going to the same place, at the same time Much of the fuel consumed by business jets could, therefore, be saved by using smaller aircraft with smaller engines Suitable engines and aircraft models which would satisfy company transportation objectives more economically are discussed Attention is also given to the use of one man crews for business aircraft, the advantages of high-altitude flying capabilities, the desirability to design a small business jet from the outset to be compatible in approach speed with an airliner to reduce the fuel consumption of the airliner by eliminating the need for special maneuvering operations, and fuel savings possible by the use of the general aviation airport G R

A79-12381 # **Energy conservation in general aviation and operation and maintenance of Avco Lycoming piston engines** J A Diblin (Avco Corp, Avco Lycoming Williamsport Div, Williamsport, Pa) In National Conference on Energy Conservation in General Aviation, 1st, Kalamazoo, Mich, October 10, 11, 1977, Proceedings Kalamazoo, Mich, Western Michigan University, 1977, p 92, 93

The author emphasizes certain points on more fuel-efficient flying with general aviation piston engines It is mentioned that proper leaning at cruise makes the engines smooth, protects engine mounts and accessories from vibration and possible failure Leaning at cruise extends the range It is pointed out that switching to automotive fuel is not recommended P T H

A79-12382 # **Energy conservation in general aviation piston powered aircraft** F Monts (Teledyne Continental Motors, Mobile, Ala) In National Conference on Energy Conservation in General Aviation, 1st, Kalamazoo, Mich, October 10, 11, 1977, Proceedings Kalamazoo, Mich, Western Michigan University, 1977, p 94 104

Several charts illustrating the parametric relations governing the performance of general aviation piston engines are presented and discussed The first chart is a generalized mixture strength characteristics plot, depicting the relation of power, specific fuel consumption, and exhaust gas temperature as a function of fuel air ratio The second chart plots mixture strength limits over the power range Some leaning test data are presented A new engine control system under development is mentioned which is designed to provide essentially maximum economy operation automatically throughout the cruise range P T H

A79-12383 # **Economy in flight operations** G A McKinzie (United Air Lines, Inc, Chicago, Ill) In National Conference on Energy Conservation in General Aviation, 1st, Kalamazoo, Mich, October 10, 11, 1977, Proceedings Kalamazoo, Mich, Western Michigan University 1977, p 128 133

A strategy for fuel conservation in general aviation is outlined, the main points of which are (1) reduction of burnout rate, (2) reduction of excess weight, and (3) general measures such as schedule adjustments and improved flight planning The author suggests fuel burnout monitoring, loading for minimum drag, elimination of unnecessary 'tankering', and careful monitoring of the fueling operations P T H

A79-12384 # **Flying angle of attack** D E Lange (Teledyne Avionics, Charlottesville, Va) In National Conference on Energy Conservation in General Aviation, 1st, Kalamazoo, Mich, October 10, 11, 1977, Proceedings Kalamazoo, Mich, Western Michigan University, 1977, p 134-143

The possibilities for angle of attack reference in economic operation of turbojet aircraft are discussed A chart is given showing the relationship between basic angle of attack, Mach number, calibrated airspeed, and true airspeed for different pressure altitudes and different gross weights for the Falcon 10 aircraft Angle of attack cruise schedules for this airplane are given An angle of attack sensor and indicator system is briefly described, the proper use of which, it is claimed, will result in approximate maximum fuel economy P T H

A79-12394 **Theory of lifting surface in fluids of high electrical conductivity** D Homenteovschi (Bucuresti, Institutul Politechnic, Bucharest, Rumania) *Acta Mechanica,* vol 30, no 3-4, 1978, p 283 291 6 refs

This paper examines the motion of an inviscid and perfectly conducting fluid past an airfoil in the presence of a magnetic field orthogonal to the motion direction The integral equation of the theory of lifting surface is deduced and the limit case of the lifting line is also studied For the latter case a simple relation is given which permits the calculation of the lift in the case of a conducting fluid as a function of the lift of an equivalent airfoil placed in a non-conducting fluid (Author)

A79-12395 # **Helicopter noise - State-of-the-art** A R George (Cornell University, Ithaca, N Y) *(American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 4th, Atlanta, Ga, Oct 3 5, 1977, Paper 77-1337) Journal of Aircraft,* vol 15, Nov 1978, p 707-715 94 refs Grant No DAHC04-75-6-0120

The paper examines the state of present understanding and prediction capabilities for helicopter main and tail rotor noise The use of the Lighthill equation in modeling rotor noise generation is described Typical helicopter noise time histories and spectra are examined Current understanding of noise generated by forces of the following kinds is summarized steady forces, periodic blade loading, blade-vortex interactions, radiation due to vortex streets, self-generated turbulent loading, turbulent inflow Quadrupole effects due to turbulence are discussed Finally, a brief look at prediction methods and noise reduction techniques is taken P T H

A79-12396 * # **Passenger ride quality in transport aircraft** I D Jacobson, A R Kuhlthau, L G Richards (Virginia, University, Charlottesville, Va), and D W Conner (NASA, Langley Research Center, Aeronautical Systems Div, Hampton, Va) *Journal of Aircraft,* vol 15, Nov 1978, p 724 730 21 refs

Quantitative relationships are presented which can be used to account for passenger ride quality in transport aircraft These relations can be used to predict passenger comfort and satisfaction under a variety of flight conditions Several applications are detailed, including evaluation of use of spoilers to attenuate trailing vortices, identifying key elements in a complex maneuver which leads to discomfort, determining noise/motion tradeoffs, evaluating changes in wing loading, and others Variables included in the models presented are motion, noise, temperature, pressure, and seating (Author)

A79-12404 # **Application of optimization techniques in engineering design** G N Vanderplaats (U S Naval Postgraduate School, Monterey, Calif) In Symposium on Applications of Computer Methods in Engineering, Los Angeles, Calif, August 23 26, 1977, Proceedings Volume 1 Los Angeles, University of Southern California, 1978, p 33 45 37 refs

Numerical optimization techniques are reviewed with emphasis on the elaboration of guidelines for writing computer codes Several broad areas where numerical optimization can be applied to engineering design are discussed, including structural optimization, conceptual aircraft design, and airfoil shape optimization Future trends of numerical-optimization applications are briefly considered B J

A79 12436 # **Application of an interactive graphics system for the design and optimization of aircraft lifting surfaces** B Dror, S Emil, J Burns, and H Kalman (Israel Aircraft Industries, Ltd, Lod, Israel) In Symposium on Applications of Computer Methods in Engineering, Los Angeles, Calif, August 23-26 1977, Proceedings Volume 2 Los Angeles, University of Southern California, 1978, p 787-797 9 refs

Application of a computerized procedure for the design and optimization of aircraft lifting surface structures employing inter active graphics is described The procedure represents a subsystem of the multidisciplinary Interactive Structural Sizing and Analysis System (ISSAS), currently being used at IAI The paper describes the modules that deal with (1) the design of the primary structural layout, (2) the finite element modeling, (3) the analysis and optimization and (4) the reduction of analysis results The procedure described herein represents a sizable saving in elapsed time and manhours per design iteration relative to conventional methods, and provides for the design of a superior quality structure in a shorter period of time and at lower cost (Author)

A79-12459 # **Gas turbine analysis and design using interactive computer graphics** K C Weston (Tulsa, University, Tulsa, Okla) In Symposium on Applications of Computer Methods in Engineering, Los Angeles, Calif, August 23 26, 1977, Proceedings Volume 2 Los Angeles, University of Southern California, 1978, p 1239 1247

An interactive computer graphics program for gas turbine system design point computation and display is described The program is capable in principle of dealing with systems involving arbitrary numbers of intercooler-compressor and reheater turbine combinations The user may readily generate plots for parametric studies or a comprehensive parameter tabulation for a specific gas turbine system Examples of several types of display photographed directly from a graphics terminal are shown A lattice search routine is incorporated to define an optimal design point based on a given objective function A discussion of aspects of gas turbine design employing these displays demonstrates the program's use (Author)

A79-12460 # **Program REV - A wing structural optimization computer program for preliminary design of fighter aircraft** Y T Phoa and R C Skinner (Northrop Corp, Hawthorne, Calif) In Symposium on Applications of Computer Methods in Engineering, Los Angeles, Calif, August 23 26, 1977, Proceedings Volume 2 Los Angeles, University of Southern California, 1978, p 1281-1289

The described REV (from rapid evaluation) system, a cost effective computer program used as an aid for the preliminary sizing of wings for fighter aircraft, contains stress, aeroelastic, and flutter analysis modules as well as an optimization capacity The input data are confined to the basic wing parameters combined with data associated with aeroelastic criteria, while the output consists of a single number the total weight of the wing structure The system is designed to ensure that all candidate configurations are given equal treatment M L

A79-12473 # **'Strategic' time-based ATC** R L Erwin, Jr (Boeing Commercial Airplane Co, Renton, Wash) *Astronautics and Aeronautics,* vol 16, Nov 1978, p 56-61 18 refs

Consideration is given to the strategic time based air traffic control (ATC) concept which, when used in conjunction with four dimensional navigation and guidance instrumentation, will reduce controller workload and increase runway capacity The system consists of (1) determining flight sequences, (2) assigning landing times reflecting other traffic, and (3) computing the four-dimensional path from aircraft to runway A method of time-based metering of arrivals is also discussed along with the automated en route ATC and a time based system which controls arrivals by path stretching S C S

A79-12525 **The Omega navigation system - An overview** J F Kasper (Analytic Sciences Corp, Reading, Mass) and C E Hutchinson (Massachusetts, University, Amherst, Mass) *Ortung und Navigation,* no 2, 1978, p 228 257 19 refs

The Omega worldwide VLF radio navigation system is discussed Following a brief historical perspective, the current and projected system configurations are described with emphasis on the operational characteristics of transmitting station equipment The Omega position fixing process is examined and the available user equipment is reviewed The characteristics of VLF radio wave propagation, which have a significant impact on Omega navigation accuracy, are discussed Finally, the various elements of the Omega user community are described along with the likely nature of future increased applications of the Omega navigation system (Author)

A79-12526 **Radio navigation and antenna technology, an area of study of many years' standing at the Institute for Communications Engineering of Braunschweig Technical University (Funknavigation and Antennentechnik, ein langjahriges Arbeitsgebiet des Instituts fur Nachrichtentechnik der TU Braunschweig)** H Fricke (Braunschweig, Technische Universtat, Braunschweig, West Germany) *Ortung und Navigation,* no 2, 1978, p 274 284 In German

The article examines the close link between advances in antenna technology and advances in radio navigation The principles of several modern types of radio navigation equipment are considered, including the VHF omnidirectional radio range, the compensator antenna for radar beam swinging, the quotient measuring method, radar camouflage, and logarithmic periodic dipole antennas P T H

A79-12527 **From Transit to Navstar - Development trends of satellite navigation (Von Transit zu Navstar - Entwicklungstendenzen der Satellitennavigation)** F Sender (Prakla Seimos GmbH, Hanover, West Germany) *Ortung und Navigation,* no 2, 1978, p 318-338 In German

The paper describes the basic principles of the Transit and Navstar satellite system for navigation The procedure used by a ship connected with the Transit system to determine its position is briefly outlined Emphasis is on the larger services to be provided by the Navstar/GPS (Navigation System with Time And Ranging/Global Positioning System), now under development The various phases of this program envisage enlarging the satellite system from six satellites to 9-11 satellites and finally 24 satellites, to provide accurate three-dimensional position and direction finding Signal structure, coding, processor requirements, and receiver characteristics are described P T H

A79-12528 # **Choice of the main parameters in the design of aircraft engines (Volba hlavnich parametru nove navrhovanych leteckych motoru)** J Rada *Zpravodaj VZLU,* no 3, 1978, p 117-122 In Czech

Consideration is given to the possibility of calculating, given the current standards of computational technique, the basic parameters and elements of present-day aircraft engines A number of problems which cannot be handled computationally at the present time is presented for a series of engines, ranked according to bypass ratio It is concluded that only a portion of engine-design parameters can be mathematically optimized B J

A79-12529 # **Current problems in the development and production of small gas turbine engines (Aktualni otazky vyvoje a vyroby malych turbinovych motoru)** A Malek *Zpravodaj VZLU,* no 3, 1978, p 123 127 5 refs In Czech

A multifaceted approach is taken to the problem of developing small gas turbine engines Consideration is given to the utilization of experimental flight data in the preliminary design stage, and to the necessity for improved fabrication technology, construction materials, and structural designs It is noted that fuel consumption of small gas turbines will, in the future, remain the most essential economic parameter B J

A79-12530 # **Control system requirements for aircraft gas turbine engines (Pozadavky na regulacni systemy leteckych turbinovych pohonnych jednotek)** B Riha *Zpravodaj VZLU,* no 3, 1978, p 129-133 In Czech

The paper presents a brief review of control system requirements for gas turbine engines from the point of view of development specifications The main obstacles associated with satisfying such requirements are discussed Attention is also given to the possibility of objective quality evaluations of such control systems on the basis of combined engineering and cost criteria B J

A79-12531 # **Control systems and problems of their development from the viewpoint of technological and operational requirements (Regulacni systemy a problemy jejich vyvoje se zamerenim na technologicke a provozni pozadavky)** J Silhanek *Zpravodaj VZLU,* no 3, 1978, p 135 138 In Czech

Consideration is given to the development of control systems for aircraft gas turbine engines The present-generation M 601 system is discussed with reference to its electronic and hydraulic design Some possible future directions for the development of engine control systems are briefly considered B J

A79-12532 # **Certain problems which had to be solved between the prototype stage and mass production stage in the development of an engine (Nektere problemy, ktere bylo nutno vyresit v obdobi mezi stavem prototypovym a stavem hromadne vyroby motoru)** J Soucek and F Vachata *Zpravodaj VZLU,* no 3, 1978, p 139 144 6 refs In Czech

Several problems had to be solved in the development of the M 601 turboprop engine This paper examines three of these problems (1) engine vibrations associated with the core, (2) intense loading of the stator due to nonuniform air flow in the test cell, and (3) assurance of flight safety in case the torsion shaft connecting the disk and shaft of the free turbine is broken B J

A79-12533 # **New construction materials for gas turbine engines and technology for processing these materials (Nove materialy ve stavbe pohonnych turbinovych jednotek a technologie jejich zpracovani)** P Schier *Zpravodaj VZLU,* no 3, 1978, p 145-151 5 refs In Czech

The paper reviews current trends in the development of metallic materials for use in gas turbine engines Consideration is given to the utilization of steels, titanium alloys, magnesium alloys, aluminum alloys, and reinforced materials New technologies for the working, welding, and soldering of such materials are also briefly described B J

A79-12534 # **Active control (Aktivni rizeni)** J Kudrna *Zpravodaj VZLU,* no 4, 1978, p 169 176 11 refs In Czech

The paper considers the possibilities of active control systems for aircraft, in which the deflections of the organs changing the control moments and forces are given by signals from the deflections of the control stick and further signals characterizing, for example, the motion and configuration of the aircraft These signals are then processed by electronic circuits in such a manner that they actively influence the aircraft characteristics in the desired way Such concepts as CCV, fly by wire and relaxed stability are then discussed in this connection P T H

A79-12535 # **Processing a random loading process by computer to obtain life information (Vyhodnocovani nahodneho procesu napeti pocitacem s ohledem na zivotnost)** O Kropac *Zpravodaj VZLU*, no 4, 1978, p 177 193 7 refs In Czech

The article describes the measurement and evaluation of a continuous record of the stress at critical locations of an aircraft wing structure during typical flight phases Current techniques of measuring the stress with a plotting recorder and their manual or semiautomatic evaluation are first described The use of magnetic tape opens the possibility of computer processing and enables one to compute a suitable shape of the stress spectrum for calculations of fatigue damage and residual life Four main methods from the literature and some experiments of the author are compiled and their algorithms described Computer output is a two parameter decomposition of the amplitudes and mean stress components To test the individual methods, they were used to process three random processes through the use of two S N curves with different fatigue limits P T H

A79-12560 # **The F-16 environmental control system** W J Peters and R G Jones (General Dynamics Corp , Fort Worth, Tex) *American Society of Mechanical Engineers, Intersociety Conference on Environmental Systems, San Diego, Calif , July 10 13, 1978, Paper 78-ENAs-11* 8 p Members, $1 50, nonmembers, $3 00

The discussion of the F 16 environmental control system focuses on the bootstrap air cycle system which, containing a regenerative heat exchanger and water separator, conditions air from the engine 7th and 13th stage bleed ports Topics considered include the bleed air ducting, bleed airflow, the refrigeration package, the regenerative heat exchanger, and the hot air modulating valves Overtemperature protection, anti icing, cockpit temperature and pressure control, and the use of a cooling airflow are examined M L

A79-12567 # **The application of foil air bearing turbomachinery in aircraft environmental control systems** T P Emerson (AiResearch Manufacturing Company of California, Torrance, Calif) *American Society of Mechanical Engineers, Intersociety Conference on Environmental Systems, San Diego, Calif , July 10-13, 1978, Paper 780-ENAs-18* 8 p Members, $1 50, nonmembers, $3 00

Cooling turbine design requirements and the characteristics of ball bearing cooling turbines are discussed Design features and advantages of foil bearing units are examined, and service performance of these bearings is described Advantages include zero maintenance, insensitivity to contaminants, bearing life, temperature limits, shock tolerance, tolerance of abnormal conditions, and wearout and failure characteristics Performance is discussed with attention to high speed characteristics and limitations as well as the life and reliability Application in various aircraft and in cryogenic, space, and Rankine systems is considered M L

A79-12570 # **Advanced environmental cooling concepts for supersonic aircraft** V K Rajpaul and J N Runnels (Boeing Aerospace Co , Seattle, Wash) *American Society of Mechanical Engineers, Intersociety Conference on Environmental Systems, San Diego, Calif , July 10-13, 1978, Paper 78 ENAs-21* 6 p Members, $1 50, nonmembers, $3 00

A study was conducted to compare the operating penalty of advanced closed-loop and regenerative open loop air cycle concepts using fuel heat sinks with current technology bootstrap air cycle systems utilizing ram air heat sinks The results indicate substantial reductions in fuel operating penalty can be attained with associated lower aircraft design gross weight (Author)

A79-12572 # **F-18 air conditioning system** J E Strang (AiResearch Manufacturing Company of California, Torrance, Calif) *American Society of Mechanical Engineers, Intersociety Conference on Environmental Systems, San Diego, Calif , July 10 13, 1978, Paper 78-ENAs-23* 8 p Members, $1 50, nonmembers, $3 00

The F-18 Air Conditioning System is a bootstrap configuration with high pressure water separation that supplies dry air for avionics and cabin cooling By supplying this dry air at a lower temperature than can be achieved in conventional water separation systems, improved avionics reliability can be achieved Other advantages of the system result from the elimination of the normal water separater coalescer bag that requires scheduled replacement, and the use of foil bearings in the air cycle machine These bearings eliminate the normal running contact that produces bearing wear by supporting the rotational shaft on a cushion of air (Author)

A79-12599 * # **Supersonic unstalled flutter** J J Adamczyk, M E Goldstein, and M J Hartmann (NASA Lewis Research Center, Cleveland, Ohio) *NATO, AGARD, Meeting of the Propulsion and Energetics Panel, 52nd, Cleveland, Ohio, Oct 23 27, 1978, Paper 23* p 8 refs

Recently two flutter analyses have been developed at NASA Lewis Research Center to predict the onset of supersonic unstalled flutter of a cascade of two dimensional airfoils The first of these analyzes the onset of supersonic flutter at low levels of aerodynamic loading (i e , backpressure), while the second examines the occurrence of supersonic flutter at moderate levels of aerodynamic loading Both of these analyses are based on the linearized unsteady inviscid equations of gas dynamics to model the flow field surrounding the cascade The details of the development of the solution to each of these models have been published The objective of the present paper is to utilize these analyses in a parametric study to show the effects of cascade geometry, inlet Mach number, and backpressure on the onset of single and multi degree of freedom unstalled supersonic flutter Several of the results from this study are correlated against experimental qualitative observation to validate the models (Author)

A79-12610 # **Performance analysis of a particularly simple Kalman filter** P S Maybeck (USAF, Institute of Technology, Wright Patterson AFB, Ohio) *Journal of Guidance and Control*, vol 1, Nov Dec 1978, p 391 396 13 refs

Because of stringent storage restrictions, a very simple Kalman filter has been proposed for optimally aiding a strapdown inertial navigation system (INS) with data from a radiometric area correlator (RAC) onboard a weapon system currently under development However, the adequacy of two decoupled three state filters to meet performance specifications was subject to serious question A set of covariance analyses has been conducted to determine estimation capabilities in a realistic environment generated by accurate 'truth models' of the error characteristics of two competing inertial systems (one using laser gyros and the other, conventional dry gyros) and the RAC system Despite the simple form, the filters performed well enough to meet system specifications on navigation errors Because of its extreme precision at low altitudes, the RAC was the dominant factor in attaining this accuracy, with the laser gyro INS providing somewhat better performance than the dry gyro system Sensitivity analyses revealed that better RAC hardware or RAC error models in the filters would provide the most effective performance enhancement (Author)

A79 12755 **Synthesis and analysis of systems for active control and suppression of flutter of flying craft** S M Belotserkovskii, B O Kachanov, and V V Novitskii *(Akademiia Nauk SSSR, Izvestiia, Mekhanika Tverdogo Tela*, Jan Feb 1978, p 45-56) *Mechanics of Solids*, vol 13, no 1, 1978, p 43 53 7 refs Translation

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

A79-12784 **Three-dimensional radiative heat-transfer problem with shading** V F Kravchenko and V M Iudin (Tsentral'nyi Aerogidrodinamicheskii Institut, Moscow, USSR) *(Inzhenerno-Fizicheskii Zhurnal,* vol 34, Jan 1978, p 27 33) *Journal of Engineering Physics,* vol 34, no 1 July 1978, p 15 19 Translation

A method is proposed for calculating radiant transfer between grey diffuse convex surfaces of rectangular planform, simulating the walls of closed aircraft compartments The conditions for points of mutual visibility at such a surface are formulated A system of integral Fredholm equations of radiant transfer, written in terms of the incident flux density, is reduced to a system of algebraic equations which is solved by an iteration technique V P

A79-12824 **The utilization of data relating to fin geometry and manufacturing processes of ceramic matrix systems to the design of ceramic heat exchangers** C A Fucinari (Ford Motor Co, Dearborn, Mich) In Ceramics for high performance applications - II, Proceedings of the Fifth Army Materials Technology Conference, Newport, R I, March 21-25, 1977 Chestnut Hill, Mass, Brook Hill Publishing Co, 1978, p 349-368 5 refs ARPA Army-ERDA-supported research

A description is presented of the relationship between significant matrix thermal and physical properties which control the thermal stress capacity A simplified analysis is discussed for estimating the effect of alterations in matrix fin shape on the performance of the regenerator To obtain the heat transfer and pressure drop data for the matrices evaluated, a transient shuttle rig technique was utilized Attention is given to regenerator performance with respect to package size and fin parameters for constant flow conditions, the regenerator performance zones, and the maximization of overall matrix surface efficiency The manufacturing processes currently available in the industry for fabricating a variety of ceramic cellular structures for rotary heat exchanger applications are related to corrugating, embossing, and extrusion techniques The engineering factors related to the manufacturing processes are evaluated and a matrix comparison study is conducted G R

A79-12949 # **Skirt components of the aerodynamic characteristics of an air cushion vehicle using the oncoming flow to generate lift (Ekrannye sostavliaiushchie aerodinamicheskikh kharakteristik ustroistva na vozdushnoi podushke s podduvom nabegaiushchim potokom)** M A Gur'ianov *Aviatsionnaia Tekhnika,* vol 21, no 2, 1978, p 17 29 8 refs In Russian

In the present paper, the general laws of gasdynamics (laws of total pressure, flow rate, and momentum conservation in the gas stream) are used as a basis to derive formulas which relate the skirt components of the aerodynamic characteristics to the parameters defining the geometry and position of the skirts The interaction force of the oncoming flow is taken into consideration only at the inner surface of the skirts The latter are configured as a pi shaped half tunnel It is shown that this geometry is characterized by a high L/D ratio and high stability with respect to pitch V P

A79-12950 # **Statistical diagnostics of aircraft engines (Statisticheskaia diagnostika aviatsionnykh dvigatelei)** Iu V Kozhevnikov *Aviatsionnaia Tekhnika,* vol 21, no 2, 1978, p 30 35 5 refs In Russian

The present paper deals with the linear statistical problem of aircraft engine parametric diagnostics for a given set of stable modes of operation Some diagnostics problems with respect to one or more parameters are analyzed and solved V P

A79-12951 # **Optimal designing of gas-turbine engine thermogasdynamics on the basis of prototype elements I (Optimal'noe termogazodinamicheskoe proektirovanie GTD po prototipam elementov I)** Iu V Kozhevnikov, V O Borovik, V S Ivanov, V A Talyzin, I N Agliullin, and Iu V Meluzov *Aviatsionnaia Tekhnika* vol 21, no 2, 1978, p 36 43 In Russian

The problem of optimal thermogasdynamic designing on the basis of a mathematical model of a gas-turbine engine, containing the characteristics of prototype engine elements in similarity parameters is analyzed Optimality criteria are derived for a two-spool bypass turbojet engine, making allowance for the engines modes of operation V P

A79-12953 # **Determination of the geometrical parameters and position of the nose flap at the root section of a swept wing on the basis of wind tunnel data I (K vyboru geometricheskikh parametrov i polozheniia nosovogo shchitka na kornevom profile strelovidnogo kryla po dannym trubnykh ispytanii I)** A I Matiazh, V A Sterlin, V A Popov, V V Isaev, and G A Cheremukhin *Aviatsionnaia Tekhnika,* vol 21, no 2, 1978, p 49 54 5 refs In Russian

A79-12955 # **The smooth approximation method and its application to the mathematical description of the aerodynamic characteristics of a wing (O metode gladkoi approksimatsii i ego primenenii k matematicheskomu opisaniiu aerodinamicheskikh kharakteristik kryla)** V A Ovchinnikov, V D Osorgin V G Pavlov, and E Ia Fedorov *Aviatsionnaia Tekhnika,* vol 21, no 2, 1978, p 62 65 In Russian

A79-12956 # **Solution of the inverse problem of aerodynamics by a random search technique (Reshenie obratnoi zadachi aerodinamiki metodom sluchainogo poiska)** G D Peshatov and Iu N Novoselov *Aviatsionnaia Tekhnika,* vol 21, no 2, 1978, p 68 73 7 refs In Russian

A computer-aided method is proposed for designing subsonic and supersonic wing profiles for a given pressure distribution An optimization procedure for designing a simply connected contour from the constraints on its shape is outlined, and its block diagram is discussed V P

A79-12963 # **Harmonic vibrations of an annular wing in the steady flow of an ideal fluid (Garmonicheskie kolebaniia kol'tsevogo kryla v statsionarnom potoke ideal'noi zhidkosti)** Z N Shesternina *Aviatsionnaia Tekhnika,* vol 21, no 2, 1978, p 115-121 7 refs In Russian

Existing methods of solving problems concerning the harmonic vibrations of wings in translational flow are based on the substitution of a system of attached ring vortices for the wing The methods reduce to the solution of a system of Fredholm integral equations of the first kind In the method proposed in the present paper, use is made of the same substitution, however, by using the properties of the single layer potential and a somewhat modified impermeability condition, the problem is reduced to a system of Fredholm integral equations of the second kind with respect to the density of the attached vortices The detailed formalism of these equations made it possible to prove the uniqueness of the solution, to satisfy the Chaplygin-Joukowski condition, and to determine the influence of the wing profile configuration on the convergence of the iterations V P

A79-12966 # **Overall aerodynamic characteristics of conical and delta wings at supersonic speeds (Summarnye aerodinamicheskie kharakteristiki V-obraznykh i del'tavidnykh kryl'ev pri sverkhzvukovykh skorostiakh)** Iu P Gun'ko and I I Mazhul' *Aviatsionnaia Tekhnika,* vol 21, no 2, 1978, p 129 132 6 refs In Russian

A79-12968 # **Choice of a fuselage for passenger aircraft (K vyboru fiuzeliazha passazhirskogo samoleta)** Iu N Egorov *Aviatsionnaia Tekhnika,* vol 21, no 2, 1978, p 135-138 In Russian

Weight and drag criteria are presented for the fuselages of passenger aircraft, with consideration of the space required for passenger accomodations An expression is obtained relating the surface area, diameter and length of a fuselage for purposes of weight- and drag-optimal design Relationships between weight and aspect ratio are also examined B J

A79-12970 # Inverse mixed problem for a profile with a prescribed velocity distribution on one of its sides and a known thickness distribution (Obratnaia smeshannaia zadacha dlia profilia s zadannym raspredeleniem skorostei na odnoi iz ego storon i izvestnym zakonom tolshchiny) S D Kostornoi and A A Litvinenko *Aviatsionnaia Tekhnika* vol 21, no 2, 1978 p 142 144 In Russian

A79-12971 # Free periodic oscillations of a parachute system in the longitudinal plane (O svobodnykh periodicheskikh kolebaniiakh parashiutnoi sistemy v prodol'noi ploskosti) V M Churkin and N A Kosarchuk *Aviatsionnaia Tekhnika*, vol 21, no 2, 1978, p 144 146 In Russian

The harmonic linearization method is used to investigate the self-oscillations of a simple parachute system for the case of unperturbed vertical descent with zero glide angle and at constant velocity Conditions for the existence of stable periodic oscillations of the system in the longitudinal plane are determined It is also found that these self-oscillations will be the only possible mode of oscillation when the unperturbed descent under consideration corresponds to a certain isolated singular point of the equations of motion B J

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STAR ENTRIES

N79-10001# Army Aviation Research and Development Command, St Louis Mo
AIRCRAFT RAM (MMH/FH) DATA COMPARATIVE ANALYSIS Final Report
Israel Mussbaum May 1978 20 p refs
(AD-A056893 USAAVRADCOM-TR-78-30) Avail NTIS HC A02/MF A01 CSCL 01/3

This report consists of a comparative analysis of reported Maintenance Manhours per Flight Hour (MMH/FH) for a group of five (5) developmental Army helicopter systems expected to be operational in the mid-1980s time period The study was initiated as a result of the wide disparity found among the various aircraft programs in how MMH/FH data is obtained as well as how it is processed and displayed There is a need for uniformity consistency and validity in the aircraft MMH/FH projections, which form the primary basis for development of aircraft field unit TOEs Author (GRA)

N79-10002# Advisory Group for Aerospace Research and Development Paris (France)
ICING TESTING FOR AIRCRAFT ENGINES
Aug 1978 206 p refs In ENGLISH and FRENCH Presented at the 51st Propulsion and Energetics Panel (A) Spec Meeting, London, 3-4 Apr 1978
(AGARD-CP-236 ISBN-92-835-0217-5) Avail NTIS HC A10/MF A01

Meteorological icing conditions the microphysical structure of icing clouds and the measurement of snow concentration were discussed Icing test facilities and their instrumentation current used in the US UK and France were reported Measurement systems icing of aircraft engines either installed in aircraft and helicopters or when taken into test facilities were also considered

N79-10005# Luftfahrt-Bundesamt Brunswick (West Germany)
METEOROLOGICAL ICING CONDITIONS
K A Vath *In* AGARD Icing Testing for Aircraft Eng Aug 1978 22 p refs
Avail NTIS HC A10/MF A01

The meteorological influences leading to ice formation on aircraft and engines their causes and effects as well as the meteorological icing parameters specified in the airworthiness requirements for public transport airplanes in Europe the USA and the USSR are presented J A M

N79-10006# National Gas Turbine Establishment Pyestock (England)
ICING TEST FACILITIES AT THE NATIONAL GAS TURBINE ESTABLISHMENT
R D Swift *In* AGARD Icing Testing for Aircraft Eng Aug 1978 22 p refs
Avail NTIS HC A10/MF A01

The extensive capacity of the NGTE Engine Test Facility enabled a close representation of the conditions encountered during flight in icing conditions achieved on a scale such that tests can be made on complete propulsion units (intake engine and propelling nozzle) or on full scale aircraft components such as a helicopter fuselage complete with its engines and air intakes The compressor/exhauster machinery the test cells the water spray equipment and the associated instrumentation and calibration gear are described Illustrations of its use for icing tests on Pegasus and RB211 engines and on the Sea King and Lynx helicopters are given J A M

N79-10007# Centre d Essais de Propulseurs Saclay (France)
INSTALLATION OF ICING TESTS [INSTALLATIONS D'ESSAIS DE GIVRAGE]
Jacques Bongrand *In* AGARD Icing Testing for Aircraft Eng Aug 1978 9 p refs In FRENCH

Avail NTIS HC A10/MF A01

Flow velocity and freezing conditions as well as a means for control are described with emphasis placed on measuring procedures for liquid water concentration and droplet size Various types of tests currently utilized were reviewed Two test installations utilized in France for ice testing are briefly described Transl by B B

N79-10008# ARO Inc Arnold Air Force Station Tenn
ENGINE ICING MEASUREMENT CAPABILITIES AT THE AEDC
Jay D Hunt *In* AGARD Icing Testing for Aircraft Eng Aug 1978 15 p refs Sponsored in part by AEDC

Avail NTIS HC A10/MF A01

Measurement and control of the principal factors that govern the mechanics and thermodynamics of icing namely water droplet size and size distribution liquid water content cloud temperature pressure and airflow are discussed A research program in icing measurements is described and current results are presented J A M

N79-10010# National Research Council of Canada, Ottawa (Ontario) Div of Mechanical Engineering
THE DYNAMIC ICE DETECTOR FOR HELICOPTERS
T R Ringer and J R Stallabrass *In* AGARD Icing Testing for Aircraft Eng Aug 1978 8 p refs

Avail NTIS HC A10/MF A01

The development of an icing detector is described using a dynamic principle that results in ice being detected equally well whether the helicopter is hovering or at flight cruise speed The response was rapid allowing the pilots of unprotected helicopters sufficient time to evade further icing within the time limitations In addition to detecting ice the instrument output can be presented in the form of an icing severity indication or a cloud liquid water content measurement Integration of the instrument output allowed accurate control of a helicopter electrothermal deicing systems J A M

N79-10011# Pratt and Whitney Aircraft, East Hartford Conn Commercial Products Div
AIRCRAFT ENGINE ICING, TECHNICAL SUMMARY
Gordon D Pfeifer *In* AGARD Icing Testing for Aircraft Eng Aug 1978 17 p refs

(Contract DOT-FA76WA-3840)
Avail NTIS HC A10/MF A01

Aircraft engines ingest supercooled water droplets in concentrations roughly fifty percent greater than cloud concentrations and the first few stages of the engine compressor are subject to icing Engine icing can be prevented, or at least kept within tolerable limits by engine design procedures which utilize the tendency of the fan to create warmer temperatures by compression effects the tendency of the rotor to shed ice by centrifugal effects before it get too thick and various designs of active anti-icing systems Appropriate background information equations and design charts are summarized such that a design approach to engine ice prevention can be established Experimental icing simulation procedures are also presented J A M

N79-10012# Centre d Essais de Propulseurs Saclay (France)
EXPERIMENTAL AND THEORETICAL STUDY OF THE INFLUENCE OF VARIOUS PARAMETERS ON AN ICING SECTION [ETUDE THEORIQUE ET EXPERIMENTALE DE L'INFLUENCE DE DIVERS PARAMETERS SUR LE GIVRAGE D'UN PROFIL]
Jacques Bongrand *In* AGARD Icing Testing for Aircraft Eng Aug 1978 13 p refs In FRENCH

Avail NTIS HC A10/MF A01

A theoretical and experimental study to investigate the influence of various parameters on ice formation as an obstacle is presented The effect of altitude was studied in detail utilizing ground simulation laws Equally considered were (1) speed (2) temperature and (3) water concentration and water drop size The accumulation of ice deposit under high altitude conditions was observed and interpreted on two test sections (conical and cylindrical cowlings) Results show that under certain conditions it appears possible to simulate the phenomena by increasing the diameter of the water drops Transl by B B

N79-10013# National Gas Turbine Establishment Pyestock (England) Engine Test Dept
ICING TESTS ON TURBOJET AND TURBOFAN ENGINES USING THE NGTE ENGINE TEST FACILITY
R G J Ball and A G Prince *In* AGARD Icing Testing for Aircraft Eng Aug 1978 15 p ref

Avail NTIS HC A10/MF A01

Tests were made at conditions representing wet icing that was with the air supply containing a fine dispersion of supercooled water droplets (volumetric mean diameter nominally 20 microns) but facilities also existed for injecting solid ice particles into the airstream thereby enabling a mixed icing environment to be simulated Wet icing tests were made on the Olympus 593 powerplant (engine intake combination) and on the RB211 high by pass turbofan J A M

N79-10014# Messerschmitt-Boelkow-Blohm G m b H Munich (West Germany) Helicopter Div
TESTS UNDER SNOW AND ICING CONDITIONS WITH THE BO 105 ENGINE INSTALLATION
Dieter Bender *In* AGARD Icing Testing for Aircraft Eng Aug 1978 12 p refs
Avail NTIS HC A10/MF A01

Corresponding preliminary tests had shown that a snowshield ahead of the main rotor gearbox in conjunction with the production standard compressor bleed air de-icing was the most effective form of protection This snowshield caused the engines to draw their air from a plenum chamber an arrangement which has resulted in faultless behavior even in extremely heavy snowfall Proof of operational safety under icing conditions was obtained in a number of steps beginning with tests in the icing tunnel Then the helicopter hovered for a total of more than 30 hours under conditions that were considerably more severe than FAA and CAA requirements The snowshield and plenum configuration proved itself again in flight trials under natural icing conditions partly under rather severe conditions In addition the measurement of atmospheric conditions such as liquid water content droplet diameter temperature and icing severity are briefly discussed J A M

N79-10015# National Research Council of Canada Ottawa (Ontario)
ICING TESTS OF A SMALL GAS TURBINE WITH INERTIAL SEPARATION ANTI-ICING SYSTEM
W Grabe and D Tedstone (Pratt and Whitney Aircraft of Can Ltd Longueuil Quebec) *In* AGARD Icing Testing for Aircraft Eng Aug 1978 20 p refs

Avail NTIS HC A10/MF A01

Two sea-level icing programs were carried out on Pratt & Whitney Aircraft of Canada PT6 aero engines protected by inertial separation anti-icing systems An air ejector located downstream of the engine induced air flows in the test section of up to 210 MPH (340 km/h) in icing conditions to simulate aircraft forward speed The anti-icing protected the compressor inlet against supercooled water droplets of various diameters as well as against natural snow Ice formation in the cowl inlet and bypass sections never rendered the inertial separator inoperative Inlet total pressure losses increased with ice buildups on inlet surfaces but generally did not exceed acceptable limits J A M

N79-10016 Engineering Sciences Data Unit London (England)
AERODYNAMIC CENTER OF WING-FUSELAGE-NACELLE COMBINATIONS EFFECT OF REAR-FUSELAGE PYLON MOUNTED NACELLES
Jun 1978 13 p
(ESDU-78013 ISBN-0-85679-214-4) For information on availability of series sub-series and other individual data items write NTIS Attn ESDU Springfield Va 22161 HC $434 50

This item calculates the shift at subsonic speeds in aerodynamic centre position caused by mounting nacelles on short pylons on the rear fuselage of wing-fuselage combinations The shift is calculated by treating the nacelles as annular aerofoils located in the wing downwash field and subject to nacelle-fuselage interference effects The shift is then subtracted from the wing-fuselage aerodynamic centre position to provide the overall aerodynamic centre position of the wing-fuselage-nacelle combination Rear-mounted nacelles cause a rearward shift in the aerodynamic centre position ESDU

N79-10017 Texas A&M Univ College Station
A LIFTING SURFACE PERFORMANCE ANALYSIS WITH CIRCULATION COUPLED WAKE FOR ADVANCED CONFIGURATION HOVERING ROTORS Ph D Thesis
James David Kocurek 1978 221 p
Avail Univ Microfilms Order No 781791

Techniques are developed to combine the lifting surface method with a conventional strip analysis to introduce airfoil section characteristics into the problem Also a Gothert type similarity transformation is developed for the hovering rotor This transformation provides a refined treatment of the important influence of compressibility These analytical procedures are supported by the development of an improved prescribed wake model derived from schlieren flow visualization studies of model rotor wakes Numerical experimentation using the lifting surface analysis with the experimentally prescribed wake demonstrates that wake settling rates can be coupled to calculated tip vortex circulation strength such that these parameters are no longer explicitly influenced by rotor blade geometry characteristics These studies also indicate however that wake contraction rate is governed by the overall inflow distribution Dissert Abstr

N79-10018 Air Force Inst of Tech Wright-Patterson AFB Ohio
A NUMERICAL SOLUTION OF SUPERSONIC AND HYPERSONIC VISCOUS FLOW FIELDS AROUND THIN PLANAR DELTA WINGS Ph D Thesis
Guion Stewart Bluford Jr 1978 235 p
Avail Univ Microfilms Order No 7819267

A numerical technique was used to compute the supersonic and hypersonic viscous flow fields around thin planar delta wings These solutions were obtained by solving the Navier-Stokes equations subject to a conical approximation The integration technique used was the second-order accurate finite difference scheme This numerical integration was performed on a constant step size array generated by a conical coordinate transformation Solutions were obtained for the upper-only lower-only and total flow fields around delta wings with supersonic leading edges Numerical oscillations due to shock capturing were reduced by applying normal stress damping and a fourth-order density damping term to the finite difference equations A stability criteria was developed and used which accounted for both the viscous and inviscid flow regions The shock-induced vortex within the viscous region and the hypersonic viscous bubble on top of the boundary layer were computed Dissert Abstr

N79-10019 California Inst of Tech Pasadena
FLYING HOT-WIRE STUDY OF TWO-DIMENSIONAL TURBULENT SEPARATION ON AN NACA 4412 AIRFOIL AT MAXIMUM LIFT Ph D Thesis
Alan James Wadcock 1978 148 p
Avail Univ Microfilms Order No 7818203

Hot-wire measurements were made in the boundary layer the separated region and the near wake for flow past an NACA 4412 airfoil at maximum lift The Reynolds number based on chord was about 1 500 000 Special care was taken to achieve a two-dimensional mean flow The main instrumentation was a hot-wire probe mounted on the end of a rotation arm A digital computer was used to control synchronized sampling and storage of hot-wire data at closely spaced points along the probe arc Data obtained at several thousand locations in the flow field include intermittency two components of mean velocity and mean values for three double four triple and five quadruple products of two velocity fluctuations No information was obtained about the spanwise velocity component The data are available on punched cards in raw form and also in processed form Dissert Abstr

N79-10020*# National Aeronautics and Space Administration Hugh L Dryden Flight Research Center Edwards Calif
UTILIZATION OF THE WING-BODY AERODYNAMIC ANALYSIS PROGRAM
Robert E Curry Oct 1978 29 p refs
(NASA-TM-72856 H-1071) Avail NTIS HC A03/MF A01 CSCL 01A

The analysis program was used to investigate several aircraft characteristics The studies performed included vehicle stability analysis determination of upwash angle identification of nonpotential flow launch dynamics and wake vortex upset loads The techniques and are discussed When possible, computed results are compared with experimental data G G

N79-10021*# Wichita State Univ Kans
WIND TUNNEL TESTS OF THE GA(W)-2 AIRFOIL WITH 20% AILERON, 25% SLOTTED FLAP, 30% FOWLER FLAP AND 10% SLOT-LIP SPOILER
W H Wentz Jr Jan 1977 75 p refs
(Grant NsG-1165)
(NASA-CR-145139 AR-76-2) Avail NTIS HC A04/MF A01 CSCL 01A

Two dimensional wind tunnel tests were conducted for the GA(W)-2 airfoil section with 20% aileron 25% slotted flap 30% Fowler flap and 10% slot-lip spoiler All tests were conducted at a Reynolds number of 2 200 000 and a Mach Number of 0 13 In addition to force measurements tuft studies were conducted for the slotted and Fowler flap configurations Aileron and spoiler hinge moments were obtained by integration of surface pressure measurements Tests results show that a value of 3 82 was obtained with 30% Fowler flap Aileron control effectiveness and hinge moments were similar to other airfoils The slot-lip spoiler provided powerful positive roll control at all flap settings J A M

N79-10022*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
AERODYNAMIC PERFORMANCE OF A 1 35-PRESSURE-RATIO AXIAL-FLOW FAN STAGE
Walter M Osborn Royce D Moore and Ronald J Steinke Oct 1978 108 p refs
(NASA-TP-1299 E-9025) Avail NTIS HC A06/MF A01 CSCL 01A

The overall blade element performances and the aerodynamic design parameters are presented for a 1 35-pressure-ratio fan stage The fan stage was designed for a weight flow of 32 7 kilograms per second and a tip speed of 302 8 meters per second At design speed the stage peak efficiency of 0 879 occurred at a pressure ratio of 1 329 and design flow Stage stall margin was approximately 14 percent At design flow rotor efficiency was 0 94 and the pressure ratio was 1 360 B B

N79-10023*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
A COMPUTER PROGRAM FOR THE CALCULATION OF THE FLOW FIELD IN SUPERSONIC MIXED-COMPRESSION INLETS AT ANGLE OF ATTACK USING THE THREE-DIMENSIONAL METHOD OF CHARACTERISTICS WITH DISCRETE SHOCK WAVE FITTING
Joseph Vadyak (Purdue Univ West Lafayette Ind) Joe D Hoffman (Purdue Univ West Lafayette, Ind) and Allan R Bishop Jun 1978 173 p refs
(Grant NGR-15-005-191)
(NASA-TM-78947 E-9694) Avail NTIS HC A08/MF A01 CSCL 01A

The calculation procedure is based on the method of characteristics for steady three-dimensional flow The bow shock wave and the internal shock wave system were computed using a discrete shock wave fitting procedure The general structure of the computer program is discussed and a brief description of each subroutine is given All program input parameters are defined and a brief discussion on interpretation of the output is provided A number of sample cases complete with data deck listings are presented G G

N79-10024*# Northrop Corp Hawthorne Calif Aircraft Group
STUDY OF AERODYNAMIC TECHNOLOGY FOR VSTOL FIGHTER/ATTACK AIRCRAFT HORIZONTAL ATTITUDE CONCEPT Final Report
S H Brown May 1978 242 p refs Sponsored in part by the David Taylor Naval Ship Research and Development Center Bethesda Md
(Contract NAS2-9771)
(NASA-CR-152130 NOR78-54) Avail NTIS HC A11/MF A01 CSCL 01A

A horizontal attitude VSTOL (HAVSTOL) supersonic fighter attack aircraft powered by RALS turbofan propulsion system is analyzed Reaction control for subaerodynamic flight is obtained in pitch and yaw from the RALS and roll from wingtip jets powered by bleed air from the RALS duct Emphasis is placed on the development of aerodynamic characteristics and the identification of aerodynamic uncertainties A wind tunnel program is shown to resolve some of the uncertainties Aerodynamic data developed are static characteristics about all axes control effectiveness drag propulsion induced effects and reaction control characteristics G Y

N79-10025*# General Dynamics/Fort Worth Tex
STUDY OF AERODYNAMIC TECHNOLOGY FOR VSTOL FIGHTER/ATTACK AIRCRAFT, VOLUME 1 Final Report, 1 Nov 1977 - 31 May 1978
J R Lummus May 1978 264 p refs Sponsored in part by the David Taylor Naval Ship Research and Development Center Bethesda Md
(Contract NAS2-9769)
(NASA-CR-152128) Avail NTIS HC A12/MF A01 CSCL 01A

An assessment was made of the aerodynamic uncertainties associated with the design of a cold-deck-environment Navy VSTOL fighter/attack aircraft utilizing jet-diffuser ejectors for vertical lift and vectored-engine-over-wing blowing for supercirculation benefits The critical aerodynamic uncertainties were determined as those associated with the constraints which size the aircraft to a specified set of requirements A wind tunnel model and test programs are recommended for resolving these uncertainties G G

N79-10026*# Northrop Corp Hawthorne Calif
STUDY OF AERODYNAMIC TECHNOLOGY FOR VSTOL FIGHTER/ATTACK AIRCRAFT VERTICAL ATTITUDE CONCEPT Final Report, 1 Nov 1977 - 31 May 1978
H A Gerhardt and W S Chen May 1978 253 p refs Sponsored in part by the David Taylor Naval Ship Research and Development Center, Bethesda Md

(Contract NAS2-9771)
(NASA-CR-152131) Avail NTIS HC A12/MF A01 CSCL 01A

The aerodynamic technology for a vertical attitude VSTOL (VATOL) supersonic fighter/attack aircraft was studied The selected configuration features a tailless clipped delta wing with leading-edge extension (LEX) maneuvering flaps top-side inlet twin dry engines and vectoring nozzles A relaxed static stability is employed in conjunction with the maneuvering flaps to optimize transonic performance and minimize supersonic trim drag Control for subaerodynamic flight is obtained by gimballing the nozzles in combination with wing tip jets Emphasis is placed on the development of aerodynamic characteristics and the identification of aerodynamic uncertainties A wind tunnel test program is proposed to resolve these uncertainties and ascertain the feasibility of the conceptual design Ship interface flight control integration, crew station concepts, advanced weapons avionics and materials are discussed G Y

N79-10027*# Grumman Aerospace Corp Bethpage N Y
STUDY OF AERODYNAMIC TECHNOLOGY FOR VSTOL FIGHTER ATTACK AIRCRAFT Final Report, 1 Nov 1977 - 23 May, 1978
W Burhans Jr Vincent J Crafta Jr, N Dannenhoffer, Frank A Dellamura, and Robert E Krepski 23 May 1978 196 p refs Sponsored in part by David Taylor Naval Ship Research and Development Center Bethesda Md
(Contract NAS2-9770)
(NASA-CR-152129 PDR-623-24) Avail NTIS HC A09/MF A01 CSCL 01A

Vertical short takeoff aircraft capability supersonic dash capability and transonic agility were investigated for the development of Fighter/attack aircraft to be accommodated on ships smaller than present aircraft carriers Topics covered include (1) description of viable V/STOL fighter/attack configuration (a high wing close-coupled canard twin-engine control configured aircraft) which meets or exceeds specified levels of vehicle performance (2) estimates of vehicle aerodynamic characteristics and the methodology utilized to generate them (3) description of propulsion system characteristics and vehicle mass properties (4) identification of areas of aerodynamic uncertainty and (5) a test program to investigate the areas of aerodynamic uncertainty in the conventional flight mode A R H

N79-10028*# Vought Corp Dallas Tex
STUDY OF AERODYNAMIC TECHNOLOGY FOR VSTOL FIGHTER/ATTACK AIRCRAFT, PHASE 1 Final Report, Nov 1977 - May 1978
Herbert H Driggers May 1978 182 p refs Sponsored in part by David Taylor Naval Ship Research and Development Center Bethesda Md
(Contract NAS2-9772)
(NASA-CR-152132 Rept-2-31200/8CR-79) Avail NTIS HC A09/MF A01 CSCL 01A

A conceptual design study was performed of a vertical attitude takeoff and landing (VATOL) fighter/attack aircraft The configuration has a close-coupled canard-delta wing side two-dimensional ramp inlets and two augmented turbofan engines with thrust vectoring capability Performance and sensitivities to objective requirements were calculated Aerodynamic characteristics were estimated based on contractor and NASA wind tunnel data Computer simulations of VATOL transitions were performed Successful transitions can be made even with series post-stall instabilities if reaction controls are properly phased Principal aerodynamic uncertainties identified were post-stall aerodynamics transonic aerodynamics with thrust vectoring and inlet performance in VATOL transition A wind tunnel research program was recommended to resolve the aerodynamic uncertainties Author

N79-10029# Army Research and Technology Labs Moffett Field Calif
VELOCITY MEASUREMENT ABOUT A NACA 0012 AIRFOIL WITH A LASER VELOCIMETER
Danny R Hoad Warren H Young Jr and James F Meyers Jun 1978 15 p refs
(AD-A056447) Avail NTIS HC A02/MF A01 CSCL 20/4

A laser velocimeter measured the velocity field about a wing with a NACA 0012 airfoil section These measurements were compared at two low angles of attack (0 deg 4 15 deg) with a two-dimensional viscous-flow prediction program At 0 deg the comparison provided confidence in the effectiveness and accuracy of the laser velocimeter At 4 15 deg the data indicated that a small laminar separation bubble with oscillating shear layer probably existed The unique capability of the laser velocimeter in measuring absolute flow magnitude and direction without prior knowledge of general flow direction was demonstrated in the complex separated reverse flows over the wing at an angle of attack of 19 4 deg GRA

N79-10030# Nielsen Engineering and Research Inc Mountain View Calif
IMPROVED TRANSONIC NOSE DRAG ESTIMATES FOR THE NSWC MISSILE AERODYNAMIC COMPUTER PROGRAM Technical Report, 4 Mar - 4 Oct 1977
Denny S Chaussee Apr 1978 71 p refs
(Contract N60921-77-C-A085)
(AD-A056795 NEAR-TR-153 NSWC/DL-TR-3830) Avail NTIS HC A04/MF A01 CSCL 20/4

An axisymmetric implicit unsteady Euler equation solver has been applied to the transonic flow past sphere-ogive-cylinder bodies This paper documents this method and shows results that were obtained for the full range of transonic Mach numbers 0 7 < or = M free stream < or = 1 2 A rather extensive parametric study of sphere-ogive-cylinders was performed over the transonic Mach number range Nose pressure drag values were calculated and are presented for varying nose radii 0 to 1 0 varying nose length 1 0 to 10 0 and varying Mach numbers 0 7 to 1 2 where all geometric quantities are normalized with respect to the maximum body radius These results have been included in the NSWC Missile Aerodynamic Computer program to improve transonic nose drag estimates Author (GRA)

N79-10034# Purdue Univ Lafayette Ind
AXIAL FLOW IN TRAILING LINE VORTICES
Mahinder S Uberoi Bhimsen K Shivamoggi and Sin-Sung Chen Jun 1978 17 p refs Sponsored by Colorado Univ Boulder
(Contract N00014-75-C-1143 Proj SQUID)
(AD-A057075 SQUID-UC-2-PU) Avail NTIS HC A02/MF A01 CSCL 20/4

Axial flow in the core of laminar steady trailing vortex from the tip of a semi-infinite lifting wing is analyzed assuming that the pressure gradient is determined by the swirl velocities of an ideal infinite line vortex The axial and lateral variations of the axial velocity depend on the strength of the vortex and initial axial velocity distribution which must be specified at some station behind the wing Author (GRA)

N79-10036# New York Univ N Y Courant Inst of Mathematical Sciences
NUMERICAL CALCULATION OF TRANSONIC FLOW PAST A SWEPT WING BY A FINITE VOLUME METHOD
A Jameson 1977 25 p refs
(Contract EY-76-C-02-3077)
(CONF-771204-3) Avail NTIS HC A02/MF A01

The finite volume method for the numerical calculation of transonic flow past a swept wing was developed and its use for calculating the pressure distribution on the upper surface of a Onera m6 wing in Mach No 0 84 flow and of a Douglas DC10 wing in M = 0 85 flow was illustrated Calculated results were compared with experimental data It appears that it can be used to treat configurations of more or less arbitrary complexity subject to limits set by the power of the available computers The extension to configurations is primarily a matter of devising mesh generating schemes since the internal computations are essentially independent of the configuration apart from the identification of which elements are the boundary elements Author (DOE)

N79-10037# BioTechnology Inc Falls Church Va
AN EVALUATION OF A NEW FORMAT FOR EJECTION INFORMATION IN A NATOPS MANUAL Final Report
Theodore J Post and Robert L Kershner 15 May 1978 59 p refs
(Contract N00014-77-C-0321 NR Proj 207-068)
(AD-A056910) Avail NTIS HC A04/MF A01 CSCL 01/3

Naval Aviation Training and Operating Procedures Standardization (NATOPS) Manuals include procedures for operating equipment under normal and emergency conditions Invariably emergency conditions require an immediate and accurate response demanding that the performer knows precisely what to do and when and how to do it Since the performer is not free to refer to the NATOPS under these conditions NATOPS coverage of emergency procedures should but frequently does not employ formats which emphasize clarity learning and recall This project used the ejection procedures section of the T-2 aircraft NATOPS manual to study this topic Specific objectives were to Reformat the ejection section of the T-2 NATOPS manual to conform to state-of-the-art information presentation techniques Compare the difference in performance between subjects using the current NATOPS manual and those using the reformatted materials and Recommend to the Naval Air Systems Command a course of action based on the results of the evaluation The results of the evaluation revealed that the groups using the reformatted NATOPS materials outscored the groups using the current NATOPS materials in all the content areas Moreover in envelope assessment the students who studied the new materials convincingly outscored the students given the old presentation This research indicates that the documentation used in this evaluation is an effective means of fostering the learning of ejection information Author (GRA)

N79-10038*# Analytical Mechanics Associates Inc Mountain View Calif
IMPLEMENTATION OF AN OPTIMUM PROFILE GUIDANCE SYSTEM ON STOLAND
Paul F Flanagan Sep 1978 49 p refs
(Contract NAS2-9460)
(NASA-CR-152187) Avail NTIS HC A03/MF A01 CSCL 17G

The implementation on the STOLAND airborne digital computer of an optimum profile guidance system for the augmentor wing jet STOL research aircraft is described Major tasks were to implement the guidance and control logic to airborne computer software and to integrate the module with the existing STOLAND navigation display and autopilot routines The optimum profile guidance system comprises an algorithm for synthesizing mimimum fuel trajectories for a wide range of starting positions in the terminal area and a control law for flying the aircraft automatically along the trajectory The avionics software developed is described along with a FORTRAN program that was constructed to reflect the modular nature and algorithms implemented in the avionics software J M S

N79-10043# National Technical Information Service Springfield Va
AIR TRAFFIC CONTROL SIMULATION MODELS, VOLUME 1 A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, 1964 - 1975
Guy E Habercom Jr Aug 1978 224 p
(NTIS/PS-78/0787/8) Avail NTIS HC $28 00/MF $28 00 CSCL 17G

En-route and terminal air traffic control facilities are investigated by use of mathematical models and computerized simulators Ground based and satellite navigational aids are modeled for present and predicted air traffic requirements Worldwide networks for traffic scheduling are simulated This updated bibliography contains 217 abstracts none of which are new entries to the previous edition GRA

N79-10044# National Technical Information Service Springfield Va
AIR TRAFFIC CONTROL SIMULATION MODELS, VOLUME 2 A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, 1976 - Jun 1978
Guy E Habercom Jr Aug 1978 132 p Supersedes NTIS/PS-77/0702 NTIS/PS-76/0610 NTIS/PS-75/521
(NTIS/PS-78/0788/6 NTIS/PS-77/0702 NTIS/PS-76-0610 NTIS/PS-75/521) Avail NTIS HC $28 00/MF $28 00 CSCL 17G

En-route and terminal air traffic control facilities are investigated by use of mathematical models and computerized simulations Ground based and satellite navigational aids are modeled for present and predicted air traffic requirements Worldwide networks for traffic scheduling are simulated (This updated bibliography contains 125 abstracts 41 of which are new entries to the previous edition) GRA

N79-10045*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
DIRECT NUMERICAL SOLUTION OF THE TRANSONIC PERTURBATION INTEGRAL EQUATION FOR LIFTING AND NONLIFTING AIRFOILS
David Nixon Sep 1978 27 p refs
(NASA-TM-78518 A-7591) Avail NTIS HC A03/MF A01 CSCL 01A

The linear transonic perturbation integral equation previously derived for nonlifting airfoils is formulated for lifting cases In order to treat shock wave motions a strained coordinate system is used in which the shock location is invariant The tangency boundary conditions are either formulated using the thin airfoil approximation or by using the analytic continuation concept A direct numerical solution to this equation is derived in contrast to the iterative scheme initially used and results of both lifting and nonlifting examples indicate that the method is satisfactory Author

N79-10047*# Northrop Corp Hawthorne Calif Aircraft Group
NORTHROP F-5F SHARK NOSE DEVELOPMENT
O R Edwards Oct 1978 235 p refs
(Contract NAS1-15159)
(NASA-CR-158936) Avail NTIS HC A11/MF A01 CSCL 01C

During spin susceptibility testing of the Northrop F-5F airplane two erect spin entries were obtained from purely longitudinal control inputs at low speed Post flight analysis of the data showed that the initial yaw departure occurred at zero sideslip and review of wind tunnel data showed significant yawing moments present at angles of attack well above stall Further analysis of this wind tunnel data indicated that the yawing moments were being generated by the long slender nose of the airplane Redesign of the nose was accomplished resulting in a nose configuration which completely alleviated the asymmetric yawing moments J A M

N79-10048*# Boeing Co Wichita Kans
LOAD AND DYNAMIC ASSESSMENT OF B-52B-008 CARRIER AIRCRAFT FOR FINNED CONFIGURATION 1 SPACE SHUTTLE SOLID ROCKET BOOSTER DECELERATOR SUBSYSTEM DROP TEST VEHICLE VOLUME 1 SUMMARY
Delmar A Quade 9 Jun 1978 68 p refs 4 Vol
(Contract NAS8-31805)
(NASA-CR-150833 D3-11220-2-Vol-1) Avail NTIS HC A04/MF A01 CSCL 01C

The B-52B airplane was identified for use in solid rocket booster (RSB) parachute drop flight testing The purpose of this study was to determine by theoretical analysis methods the compatability and structural capability of B-52B drop test vehicle configuration (with fins) to accomplish the drop test mission This document consist of four volumes This volume presents a summary of airplane flutter and load strength evaluation analysis results and a comparative study of the pylon loading resulting from drop test vehicle inertia and aerodynamic considerations G Y

N79-10049*# Boeing Co Wichita Kans
LOAD AND DYNAMIC ASSESSMENT OF B-52B-008 CARRIER AIRCRAFT FOR FINNED CONFIGURATION 1 SPACE SHUTTLE SOLID ROCKET BOOSTER DECELERATOR SUBSYSTEM DROP TEST VEHICLE VOLUME 2 AIRPLANE FLUTTER AND LOAD ANALYSIS RESULTS
Delmar A Quade 9 Jun 1978 72 p refs 4 Vol
(Contract NAS8-31805)
(NASA-CR-150834 D3-11220-2-Vol-2) Avail NTIS HC A04/MF A01 CSCL 01C

The airplane flutter and maneuver-gust load analysis results obtained during B-52B drop test vehicle configuration (with fins) evaluation are presented These data are presented as supplementary data to that given in Volume 1 of this document A brief mathematical description of airspeed notation and gust load factor criteria are provided as a help to the user References are defined which provide mathematical description of the airplane flutter and load analysis techniques Air-speed-load factor diagrams are provided for the airplane weight configurations reanalyzed for finned drop test vehicle configuration G Y

N79-10050*# Boeing Co Wichita Kans
LOAD AND DYNAMIC ASSESSMENT OF B-52B-008 CARRIER AIRCRAFT FOR FINNED CONFIGURATION 1 SPACE SHUTTLE SOLID ROCKET BOOSTER DECELERATOR SUBSYSTEM DROP TEST VEHICLE VOLUME 3 PYLON LOAD DATA METHOD 1
Delmar A Quade 9 Jun 1978 135 p refs 4 Vol
(Contract NAS8-31805)
(NASA-CR-150835 D3-11220-2-Vol-3) Avail NTIS HC A07/MF A01 CSCL 01C

The pylon loading at the drop test vehicle and wing interface attach points is presented The loads shown are determined using a stiffness method which assumes the side stiffness of the foreward hook guide to be one-fourth of the fore and aft stiffness of each drag pin The net effect of this assumption is that the forward hook guide reacts approximately 85% of the drop test vehicle yawing moment For a comparison of these loads to previous X-15 analysis design loadings see Volume 1 of this document G Y

N79-10051*# Boeing Co Wichita Kans
LOAD AND DYNAMIC ASSESSMENT OF B-52B-008 CARRIER AIRCRAFT FOR FINNED CONFIGURATION 1 SPACE SHUTTLE SOLID ROCKET BOOSTER DECELERATION SUBSYSTEM DROP TEST VEHICLE VOLUME 4 PYLON LOAD DATA
Delmar A Quade 9 Jun 1978 135 p refs 4 Vol
(Contract NAS8-31805)
(NASA-CR-150836 D3-11220-2-Vol-4) Avail NTIS HC A07/MF A01 CSCL 01C

The pylon loading at the drop test vehicle and wing interface attack points is presented The loads shown are determined using a stiffness method which assumes the side stiffness of the forward hook guide and the fore and aft stiffness of each drag pin to be equal The net effect of this assumption is that the forward hook guide reacts approximately 96% of the drop test vehicle yawing moment For a comparison of these loads to previous X-15 analysis design loadings see Volume 1 of this document G Y

N79-10052# Ballistic Research Labs Aberdeen Proving Ground Md
HIGHLY SURVIVABLE TRUSS TYPE TAIL BOOM
Thomas F Erline Jun 1978 15 p refs
(AD-A056430) Avail NTIS HC A02/MF A01 CSCL 01/3

Successful completion of Army helicopter missions in future battle scenarios may well depend upon survival of the structure after battle damage Survivability of a helicopter will depend significantly upon the structure s ability to retain structural integrity The principle purpose of this study is to develop a structural concept which assures a high degree of confidence in the integrity of a structure that has received combat damage This study has been pursued because the Army needs to meet and provide a solution to the ever escalating high explosive anti-aircraft threat to the helicopter tail boom GRA

N79-10053# Army Aviation Research and Development Command St Louis Mo
DOPPLER HOVER SYSTEM (DHS) FLIGHT TEST REPORT
Christos M Tsoubanos Apr 1978 44 p refs
(AD-A056777 USAAVRADCOM-TR-78-10) Avail NTIS HC A03/MF A01 CSCL 01/2

This report presents the flight test evaluation of a self-contained hover system concept design for the AAH and ASH helicopters The configured system includes the Lightweight Doppler Navigation System (LDNS) a simulated Pilot Night Vision System (PNVS) utilizing a closed circuit daylight TV system and analog symbol generator The emphasis of the flight test was to determine hover performance and the potential of the LDNS to provide adequate velocity information near zero This velocity and other quantitative parameters were symbolically displayed with imagery on a panel-mounted CRT such that the pilot was able to manipulate them to maintain an accurate manual hover GRA

N79-10054*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
FLIGHT EXPERIENCE WITH ADVANCED CONTROLS AND DISPLAYS DURING PILOTED CURVED DECELERATING APPROACHES IN A POWERED-LIFT STOL AIRCRAFT
W S Hindson (Natl Aeron Estab Ottawa) and G H Hardy Sep 1978 14 p refs
(NASA-TM-78527 A-7625) Avail NTIS HC A02/MF A01 CSCL 01D

The control display and procedural features are described for a flight experiment conducted to assess the feasibility of piloted STOL approaches along predefined steep curved and decelerating approach profiles It was found to be particularly important to assist the pilot through use of the flight director computing capability with the lower frequency control-related tasks such as those associated with monitoring and adjusting configuration trim as influenced by atmospheric effects and preventing the system from exceeding powerplant and SAS authority limitations Many of the technical and pilot related issues identified in the course of this flight investigation are representative of similarly demanding operational tasks that are thought to be possible only through the use of sophisticated control and display systems A R H

N79-10055# Air Force Inst of Tech Wright-Patterson AFB Ohio School of Engineering
SPARE MEMORY AND TIMING PARAMETERS IN AVIONICS COMPUTER SYSTEM REQUIREMENTS M S Thesis
Gary B Wigle Dec 1977 90 p refs
(AD-A056521 AFIT-GSM/SM/77D-30) Avail NTIS HC A05/MF A01 CSCL 01/3

Avionics computers require continuous software maintenance support during the life cycle of the airborne system Spare memory and timing capability should be provided with the initial acquisition of the system Too often additional capability must be acquired at a later date and at a high cost Current recommendations for spare capacity vary between 20 and 100 percent An analysis has been made on 25 computers in 14 Air Force airborne systems to determine the growth of software and hardware size to date The results of this analysis indicate that 100-300 percent spare memory should be provided in avionics computers that process data for navigation weapons control radar electronic warfare or any other function that has changing mission requirements Also only 25 percent spare memory is needed in avionics computers associated with missiles status monitoring fault isolation or similar functions Not enough data is available to reach any sound conclusions concerning the timing in avionics computers Author (GRA)

N79-10056# Army Avionics Research and Development Activity Fort Monmouth N J

INTEGRATED AVIONICS CONTROL SYSTEM (IACS)

Charles A Pleckaitis Carl J Balanti Anthony S Santanelli and George Stech Jun 1978 14 p

(AD-A056476) Avail NTIS HC A02/MF A01 CSCL 01/3

The concept of an Integrated Avionics Control Systems (IACS) in military aircraft has evolved from a significant increase in the number of electronic systems available for use on Army aircraft today A system such as IACS is needed for Army aviation because it reduces the crew workload reduces demands on already crowded cockpits and makes new installation less difficult and less expensive Recently considerable emphasis has been placed on reducing the cost of new avionics systems thus the IACS program is being pursued under the design-to-cost concept This paper discusses the Army approach to an integrated avionics control system The background of the program is outlined followed by a description of the overall IACS and its operation GRA

N79-10057* National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio

APPARATUS AND METHOD FOR REDUCING THERMAL STRESS IN A TURBINE ROTOR Patent

Jack A Heller inventor (to NASA) Issued 3 Oct 1978 6 p Filed 4 Mar 1977 Supersedes N77-18160 (15 - 09 p 1135)

(NASA-Case-LEW-12232-1 US-Patent-4 117 669 US-Patent-Appl-SN-776029 US-Patent-Class-60-39 14 US-Patent-Class-415-115 US-Patent-Class-415-116) Avail US Patent Office CSCL 21E

A gas turbine is described wherein the thermal stresses in the turbine rotor are reduced The rotor includes a central disc with a peripheral rim and a plurality of blades extending radially outward from the rim To reduce thermal stresses a duct arrangement is provided which selectively directs hot gases from the turbine combustor to the rim during the turbine start up The hot gases from the combustor serve to heat the rim and decrease the start up period necessary to bring the temperature profile of the rotor into the operating temperature range After the start up period the duct arrangement is then used to direct cool gases from the turbine compressor to the rim of the rotor in order to maintain a lower rotor equilibrium temperature Official Gazette of the U S Patent Office

N79-10058*# Pratt and Whitney Aircraft Group West Palm Beach Fla Government Products Div

EVALUATION OF THE CYCLIC BEHAVIOR OF AIRCRAFT TURBINE DISK ALLOYS Final Report

B A Cowles D L Sims and J R Warren Oct 1978 152 p refs

(Contract NAS3-20367)

(NASA-CR-159409 PWA-FR-10299) Avail NTIS HC A08/MF A01 CSCL 21E

Five aircraft turbine disk alloys representing various strength and processing histories were evaluated at 650 C to determine if recent strength advances in powder metallurgy have resulted in corresponding increases in low cycle fatigue (LCF) capability Controlled strain LCF tests and controlled load crack propagation tests were performed Results were used for direct material comparisons and in the analysis of an advanced aircraft turbine disk having a fixed design and operating cycle Crack initiation lives were found to increase with increasing tensile yield strength while resistance to fatigue crack propagation generally decreased with increasing strength Author

N79-10059# Pratt and Whitney Aircraft Group East Hartford Conn

INTERNAL MIXER INVESTIGATION FOR JT8D ENGINE JET NOISE REDUCTION VOLUME 1 RESULTS Final Report, May 1976 - Jul 1977

A B Packman and D C Eiler Dec 1977 111 p refs 2 Vol

(Contract DOT-FA76WA-3809)

(AD-A057309 PWA-5582-Vol-1 FAA-RD-77-132-1-Vol-1) Avail NTIS HC A06/MF A01 CSCL 20/1

A scale model experimental program was conducted to determine the noise reduction and the impact on propulsive performance that would result from installing a multilobed internal mixer on the JT8D engine Long and short mixer designs were investigated One-seventh scale mixer models designed to permit lobe geometry variations were fabricated and tested along with a model of the JT8D reference exhaust system The test results indicated that in general the long and short mixers produced 3-4 PNdB reduction in peak percaived noise level relative to the reference exhaust system Exhaust system performance in terms of improvement in cruise thrust specific fuel consumption and impact on takeoff thrust was somewhat better for the long mixer than for the short mixer configurations However the short mixers offer significant advantages in terms of weight savings and minimized the hardware changes required for installation in the current JT8D engines Based on the noise and performance test results in conjunction with the installation considerations a short mixer design was recommended for evaluation in a full scale engine test Author

N79-10060*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio

PERFORMANCE OF SINGLE-STAGE AXIAL-FLOW TRANSONIC COMPRESSOR WITH ROTOR AND STATOR ASPECT RATIOS OF 1 19 AND 1 26, RESPECTIVELY, AND WITH DESIGN PRESSURE RATIO OF 1 82

Lonnie Reid and Royce D Moore Nov 1978 103 p refs

(NASA-TP-1338 E-9461) Avail NTIS HC A06/MF A01 CSCL 21E

The overall and blade-element performance of a low-aspect-ratio transonic compressor stage is presented over the stable operating flow range at 70 90 and 100 percent design speeds At design speed the rotor and stage achieved peak efficiencies of 0 872 and 0 845 at pressure ratios of 1 875 and 1 842 respectively The stage stall margin at design speed was 21 8 percent Author

N79-10061*# Mechanical Technology Inc Latham N Y

STUDY OF T53 ENGINE VIBRATION Final Report

Thomas J Walter Nov 1978 60 p refs

(Contract NAS3-20609)

(NASA-CR-135449 MTI-78TR66) Avail NTIS HC A04/MF A01 CSCL 21E

Vibration characteristics for overhauled T53 engines including rejection rate principal sources of vibration and normal procedures taken by the overhaul center to reduce engine vibration are summarized Analytical and experimental data were compared to determine the engine s dynamic response to unbalance forces with results showing that the engine operates through bending critical speeds Present rigid rotor balancing techniques are incapable of compensating for the flexible rotor unbalance A comparison of typical test cell and aircraft vibration levels disclosed significant differences in the engine s dynamic response A probable spline shift phenomenon was uncovered and investigated Action items to control costs and reduce vibration levels were identified from analytical and experimental studies B B

N79-10062# Borst (Henry V) and Associates Wayne Pa

AERODYNAMIC DESIGN AND ANALYSIS OF PROPELLERS FOR MINI-REMOTELY PILOTED AIR VEHICLES VOLUME 2 DUCTED PROPELLERS Final Report, Jun 1976 - Mar 1978

Henry V Borst May 1978 77 p

(Contract DAAJ02-76-C-0031 DA Proj 1F2-62209-AH-76)

(AD-A056948 USAAMRDL-TR-77-45B-Vol-2) Avail NTIS HC A05/MF A01 CSCL 01/3

This report presents the design and analysis of two open propellers and two ducted propellers for use on advanced Remotely Piloted Vehicles RPVs One of the two open propellers was designed for use on a direct-drive engine with a maximum rpm of 8000 The other open propeller was designed for a geared engine of the same power output but with a maximum rpm of 5860 Two ducted propellers were designed for the same engines The open and ducted propellers were designed based on a procedure that was established for determining the lowest power and rpm to meet the performance requirements at any operating condition The geometric characteristics of the four propellers designed based on this procedure are presented so that the blades of these propellers can be fabricated GRA

N79-10063# Air Force Flight Dynamics Lab Wright-Patterson AFB Ohio
DESIGN AND TEST OF AN ANNULAR STING SUPPORT CONCEPT FOR AFTBODY NOZZLE WIND TUNNEL TESTING Final Report, 1 Jan 1976 - 1 Sep 1977
Douglas L Bowers Apr 1978 73 p refs Presented at 13th AIAA/SAE Propulsion Conf 1 Jan 1976 - 1 Sep 1977
(AD-A056945 AFFDL-TR-78-26) Avail NTIS HC A04/MF A01 CSCL 21/5

The annular sting support concept for aftbody nozzle testing supports the model through the exhaust nozzles provides high pressure air to simulate the exhaust plume to enter the model and provides a path for instrumentation lines to be routed out of the model The support concept experimental model and supporting analytical studies are described Experimental data for the aftbody nozzle contours are compared for a free jet test and the annular sting support test Also the results of an analytical prediction of the nozzle boattail pressure distribution and wind tunnel wall effects are described Test results and experimental data comparisons indicate that the annular sting support concept offers an alternate testing technique for aftbody nozzles Author (GRA)

N79-10064# Hughes Helicopters Culver City Calif
ENGINE/AIRFRAME/DRIVE TRAIN DYNAMIC INTERFACE DOCUMENTATION Final Report, Jul 1977 - Jan 1978
James F Needham and Debashis Banerjee May 1978 61 p refs
(Contract DAAJ02-77-C-0035)
(AD-A056956 HH-78-31 USARTL-TR-78-12) Avail NTIS HC A04/MF A01 CSCL 01/3

This report pertains to engine/airframe/drive train dynamic interface problems experienced by helicopters and the methodology used to avoid dynamic interface problems The problem of low torsional frequency of the engine/airframe/drive train dynamic system that results from the design philosophy of using a stationary main rotor mast enclosing a separate floating torque drive shaft is addressed The use of supercritical shafts and vibration isolators are described and mobility methods to preclude engine/airframe vibration problems are discussed GRA

N79-10065# Pratt and Whitney Aircraft Group, East Hartford Conn
INTERNAL MIXER INVESTIGATION FOR JT8D ENGINE JET NOISE REDUCTION VOLUME 2 APPENDICES A, B, C, AND D Final Report, May 1976 - Jul 1977
A B Packman and D C Eiler Dec 1977 186 p 2 Vol
(Contract DOT-FA76WA-3809)
(AD-A057310/5 FAA-RD-77-132-Vol-2 PWA-5582-Vol-2) Avail NTIS HC A09/MF A01 CSCL 20/1

The operating condition for each test point of the configurations tested is listed B B

N79-10066*# National Aeronautics and Space Administration Washington D C
PIVOTING OUTPUT UNIT CONTROL SYSTEMS ACTIVATED BY JACKS
Pierre Belliere Oct 1978 13 p Transl into ENGLISH of French Patent no 76-06636 9 Mar 1976 12 p Transl by Kanner (Leo) Associates Redwood City Calif
(Contract NASw-3199)
(NASA-TM-75581) Avail NTIS HC A02/MF A01 CSCL 01C

An invention to be used for controlling aircraft flaps is described It is applicable to control systems with two coaxial output units which pivot simultaneously with respect to two fixed units and which are activated by two opposed straight coaxial jacks J M S

N79-10068*# National Aeronautics and Space Administration Hugh L Dryden Flight Research Center Edwards Calif
FLIGHT-DETERMINED STABILITY AND CONTROL DERIVATIVES FOR THE F-111 TACT RESEARCH AIRCRAFT
Alex G Sim and Robert E Curry Oct 1978 78 p refs
(NASA-TP-1350 H-1004) Avail NTIS HC A05/MF A01 CSCL 01C

A flight investigation was conducted to provide a stability and control derivative data base for the F-111 transonic aircraft technology research aircraft Longitudinal and lateral-directional data were obtained as functions of Mach number angle of attack and wing sweep For selected derivatives the flight results were correlated with derivatives calculated based on vehicle geometry The validity of the angle of attack measurement was independently verified at a Mach number of 0 70 for angles of attack between 3 and 10 degrees Author

N79-10069*# National Aeronautics and Space Administration ,Hugh L Dryden Flight Research Center Edwards Calif
TOW BAR FOR AIRCRAFT Patent Application
Paul Baldridge inventor (to NASA) Filed 9 Aug 1978 11 p
(NASA-Case-FRC-11022-1 US-Patent-Appl-SN-932108) Avail NTIS HC A02/MF A01 CSCL 13I

The tow bar of the instant invention includes a rigid elongated beam having a hitch located at each of its opposite ends for accommodating a coupling of the tow bar between a gear truck and a towing vehicle Interposed between the center mass of the tow bar and the end thereof to be connected with a gear truck there is provided a wheel transport assembly including wheels which serve as a fulcrum for the tow bar as one end is elevated for facilitating a coupling of the tow bar to a gear truck and a manually operable hydraulic jack for elevating the opposite end of the beam sufficiently for facilitating a hook-up with a towing vehicle as well as to clear the transport wheels from engagement with the supporting surface of the aircraft By employing the tow bar of the instant invention it was found that one man can effect a coupling of the tow bar with a given aircraft in even less time than four to six men NASA

N79-10070# National Technical Information Service Springfield Va
AIRFIELD PAVEMENT EVALUATION, VOLUME 4 A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, Jul 1976 - Jun 1978
Guy E Habercom Jr Jul 1978 190 p Supersedes NTIS/PS-77/0662 NTIS/PS-76/0581
(NTIS/PS-78/0685/4 NTIS/PS-77/0662 NTIS/PS-76/0581) Avail NTIS HC $28 00/MF $28 00 CSCL 01E

The bibliography contains abstracts of government-sponsored research reports relative to airfield pavement structures Durability wear resistance skid resistance and surface qualities are analyzed and evaluated This updated bibliography contains 184 abstracts 16 of which are new entries to the previous edition GRA

N79-10071# Inglewood City Dept of Planning and Development Calif
LAX AIRPORT/LAND USE PLANNING STUDY PHASE 1 REPORT SHORT TERM NOISE ABATEMENT Final Report
P Patrick Mann Mar 1978 44 p

(PB-281622/1 ING-101) Avail NTIS HC A03/MF A01 CSCL 13B

Short-term aircraft noise abatement strategies involving minimal capital investment were investigated for application to Los Angeles International Airport The FAA integrated noise model was used to generate a grid map of noise levels Noise levels were compared with existing land uses in a city-developed grid mapping program GRA

N79-10072# Aerotherm Acurex Corp Mountain View Calif
JET ENGINE TEST CELLS EMISSIONS AND CONTROL MEASURES, PHASE 2 Final Report
John Kelly and Edward Chu Apr 1978 158 p refs
(Contract EPA-68-01-4142)
(PB-282412/6 ACUREX/TR-78/102 EPA-340/1-78-001B) Avail NTIS HC A08/MF A01 CSCL 13B

Background information is provided on the environmental aspects of uncontrolled and controlled military jet engine test cell operations The environmental impact of these operations is considered on both a source and an air quality basis Wet-packed scrubber jet engine clean combustor and ferrocene fuel-additive test cell emissions control strategies are described Clean combustor technology and its associated cost of implementation are discussed in detail It is estimated that for some jet engine tests applying clean combustors can cause NOx emissions to rise above local stationary source regulations The air quality impact of controlled jet engine test cell emissions is small GRA

N79-10423*# Avco Lycoming Div Stratford, Conn
TRANSMISSION SEAL DEVELOPMENT Final Report, 1 Jul 1976 - 30 Apr 1977
Michael Brien Oct 1977 41 p refs Sponsored in part by USAAMRDC
(Contract NAS3-20045)
(NASA-CR-135372 LYC-77-65) Avail NTIS HC A03/MF A01 CSCL 11A

An experimental evaluation was performed on a high-speed (72 9 m/s 14 349 ft/min) transmission seal of the synergistic type During testing of the seal oil leakage occurred at positive bearing cavity pressures Modifications were made in an attempt to eliminate the leakage but none were completely successful Leakage appears to be the result of questionable positioning of the sealing elements resulting in inadequate shaft contact by the oil side sealing element This condition may be related to the nonsymmetrical shape of the elastomeric retainer and to dimensional changes caused by swelling of the elastomeric retainer from exposure to the sealed fluid Indications of a speed dependent leakage characteristic were also observed Author

N79-10439# Hartman (William F) Knoxville Tenn
POTENTIAL APPLICATIONS OF ACOUSTIC EMISSION TECHNOLOGY AS A NONDESTRUCTIVE EVALUATION METHOD FOR NAVAL AVIATION GROUND SUPPORT Final Report, 13 Jul 1977 - 16 Mar. 1978
William F Hartman 5 Jul 1978 21 p refs
(Contract N68335-77-M-5735)
(AD-A056650 NAEC-92-127) Avail NTIS HC A02/MF A01 CSCL 01/5

This report presents the results of a survey of the potential use of acoustic emission monitoring for specific inspection and maintenance tasks in performance of ground support of Naval aircraft One potential application detecting corrosion in composites is identified as worthy of an implementation study since the U S Air Force has already proven feasibility Feasibility studies are recommended for AE detection of defects in landing gear cockpit canopies fuel tanks helicopter rotor blades retreaded tires and fan blades Research and development programs are suggested for bearing noise analysis weld inspection and damage assessment in composites Author (GRA)

N79-10440# Army Tropic Test Center APO New York 09827
INTENSIVE TROPIC FUNCTION TESTING
Eldon M Cady Jun 1978 13 p
(AD-A056416) Avail NTIS HC A02/MF A01 CSCL 15/5

Tropic testing of US Army materiel includes a storage phase designed to surface the adverse effects of the humid tropics Failures are sometimes catastrophic but are usually time dependent Regulations such as AR 1000-1 require that efforts be made to reduce Development Test time Project Managers and DARCOM commodity commands have curtailed or foregone Development Tests because of excessive time/cost considerations It was hypothesized that reducing test calendar time while increasing test functioning time, i e increasing the ratio of operational hours to calendar days may yield quicker and still valid test results for some categories of equipment Large quantities of Reliability Availability and Maintainability (RAM) data could be generated quickly for immediate analysis using standard RAM data analysis A methodology investigation was conducted at the US Army Tropic Test Center to validate the intensified testing concept and reassess storage testing GRA

N79-10445 Aeronautical Research Labs, Melbourne (Australia)
RESIDUAL STRENGTH OF A CRACKED LUG
R J Callinan Oct 1977 37 p refs
(ARL-Struc-Note-442 AR-000-1101) Copyright Avail Issuing Activity

The finite element method and fracture mechanics concepts were used to calculate the residual strength of a pin-loaded lug containing a through-the-thickness crack The results are compared with some previously published experimental results for lugs containing quadrant cracks although there are difficulties in establishing a proper basis for this comparison A R H

N79-10450*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
NUMERICAL AERODYNAMIC SIMULATION FACILITY
F R Bailey and A W Hathaway *In* NASA Langley Res Center Res in Computerized Structural Analysis and Syn, Oct 1978 p 15-30 refs

Avail NTIS HC A10/MF A01 CSCL 20K

Critical to the advancement of computational aerodynamics capability is the ability to simulate flows about three-dimensional configurations that contain both compressible and viscous effects, including turbulence and flow separation at high Reynolds numbers Analyses were conducted of two solution techniques for solving the Reynolds averaged Navier-Stokes equations describing the mean motion of a turbulent flow with certain terms involving the transport of turbulent momentum and energy modeled by auxiliary equations The first solution technique is an implicit approximate factorization finite-difference scheme applied to three-dimensional flows that avoids the restrictive stability conditions when small grid spacing is used The approximate factorization reduces the solution process to a sequence of three one-dimensional problems with easily inverted matrices The second technique is a hybrid explicit/implicit finite-difference scheme which is also factored and applied to three-dimensional flows Both methods are applicable to problems with highly distorted grids and a variety of boundary conditions and turbulence models G G

N79-10453*# Sikorsky Aircraft Stratford Conn
FINITE ELEMENT ANALYSIS OF HELICOPTER STRUCTURES
Melvin J Rich *In* NASA Langley Res Center Res in Computerized Structural Analysis and Syn Oct 1978 p 51-61 refs
Avail NTIS HC A10/MF A01 CSCL 01C

Application of the finite element analysis is now being expanded to three dimensional analysis of mechanical components Examples are presented for airframe mechanical components and composite structure calculations Data are detailed on the increase of model size computer usage and the effect on reducing stress analysis costs Future applications for use of finite element analysis for helicopter structures are projected G G

N79-10454*# National Aeronautics and Space Administration Langley Research Center Hampton Va
SYNTHESIS OF AIRCRAFT STRUCTURES USING INTEGRATED DESIGN AND ANALYSIS METHODS Status Report
Jaroslaw Sobieszczanski-Sobieski and Robert C Goetz *In its* Res in Computerized Structural Analysis and Syn Oct 1978 p 63-76 refs
Avail NTIS HC A10/MF A01 CSCL 01C
A systematic research is reported to develop and validate methods for structural sizing of an airframe designed with the use of composite materials and active controls This research program includes procedures for computing aeroelastic loads static and dynamic aeroelasticity analysis and synthesis of active controls, and optimization techniques Development of the methods is concerned with the most effective ways of integrating and sequencing the procedures in order to generate structural sizing and the associated active control system which is optimal with respect to a given merit function constrained by strength and aeroelasticity requirements G G

N79-10843*# National Aeronautics and Space Administration Langley Research Center Hampton Va
HELICOPTER ACOUSTICS, PART 2
Aug 1978 438 p refs Presented at the Intern Specialists Symp Hampton Va 22-24 May 1978 sponsored by the Am Helicopter Soc and AROD
(NASA-CP-2052-Pt-2 L-12339-Pt-2) Avail NTIS HC A19/MF A01 CSCL 20A
Exterior and interior helicopter noise problems are addressed from the physics and engineering as well as the human factors point of view Noise regulation concepts human factors and criteria rotor noise generation and control design operations and testing for noise control helicopter noise prediction and research tools and measurements are covered

N79-10844*# Bolt Beranek and Newman Inc Cambridge Mass
SUBJECTIVE EVALUATION OF HELICOPTER BLADE SLAP NOISE
William J Galloway *In* NASA Langley Res Center Helicopter Acoustics Pt 2 Aug 1978 p 403-418 refs

Avail NTIS HC A19/MF A01 CSCL 20A
Several methods for adjusting EPNL to account for its underestimate of judged annoyance are applied to eight helicopter flyover noise signatures having various degrees of blade slap A proposal for an impulsive noise correlation procedure based on a digital analysis of the flyover signal is investigated When all data are combined the proposal is little better than simply adding an arbitrary fixed adjustment of 3 decibels to EPNL J M S

N79-10845*# Westland Helicopters Ltd Yeovil (England)
RATING HELICOPTER NOISE
John W Leverton B J Southwood and A C Pike *In* NASA Langley Res Center Helicopter Acoustics Pt 2 Aug 1978 p 419-438 refs
Avail NTIS HC A19/MF A01 CSCL 20A
The effectiveness of the EPNL procedure in quantifying helicopter blade slap and tail rotor noise heard on approach some distance from the flyover position is addressed Alternative methods of rating helicopter noise are reviewed including correction procedures to the EPNL concept which account for blade slap and tail rotor noise The impact of the use of such corrections is examined J M S

N79-10850*# Army Aeromedical Research Lab Fort Rucker Ala Bioacoustics Div
THE EFFECTIVE ACOUSTIC ENVIRONMENT OF HELICOPTER CREWMEN
Robert T Camp Jr and Ben T Mozo *In* NASA Langley Res Center Helicopter Acoustics, Pt 2 Aug 1978 p 513-517

Avail NTIS HC A19/MF A01 CSCL 20A
Methods of measuring the composite acoustic environment of helicopters in order to quantify the effective acoustic environment of the crewmen and to assess the real acoustic hazards of the personnel are examined It is indicated that the attenuation characteristics of the helmets and hearing protectors and the variables of the physiology of the human ear be accounted for in determining the effective acoustic environment of Army helicopter crewmen as well as the acoustic hazards of voice communications systems noise J M S

N79-10851*# National Aeronautics and Space Administration Langley Research Center Hampton Va
THE EFFECT OF OPERATIONS ON THE GROUND NOISE FOOTPRINTS ASSOCIATED WITH A LARGE MULTIBLADED, NONBANGING HELICOPTER
David A Hilton Herbert R Henderson Domenic J Maglieri and William B Bigler II (Virginia Univ) *In its* Helicopter Acoustics Pt 2 Aug 1978 p 519-533 refs

Avail NTIS HC A19/MF A01 CSCL 20A
In order to expand the data base of helicopter external noise characteristics a flyover noise measurement program was conducted utilizing the NASA Civil Helicopter Research Aircraft The remotely operated multiple array acoustics range (ROMAAR) and a 2560-m linear microphone array were utilized for the purpose of documenting the noise characteristics of the test helicopter during flyby and landing operations By utilizing both ROMAAR concept and the linear array the data necessary to plot the ground noise footprints and noise radiation patterns were obtained Examples of the measured noise signature of the test helicopter the ground noise footprint or contours and the directivity patterns measured during level flyby and landing operations of a large multibladed nonbanging helicopter the CH-53 are presented J M S

N79-10852*# Army Armament Research and Development Command Aberdeen Proving Ground Md
A STATIC ACOUSTIC SIGNATURE SYSTEM FOR THE ANALYSIS OF DYNAMIC FLIGHT INFORMATION
Daniel J Ramer *In* NASA Langley Res Center Helicopter Acoustics Pt 2 Aug 1978 p 535-544

Avail NTIS HC A19/MF A01 CSCL 20A
The Army family of helicopters was analyzed to measure the polar octave band acoustic signature in various modes of flight A static array of calibrated microphones was used to simultaneously acquire the signature and differential times required to mathematically position the aircraft in space The signature was then reconstructed mathematically normalized to a fixed radius around the aircraft J M S

N79-10853*# Southampton Univ (England) Wolfson Unit for Noise and Vibration Control ISVR
AN ACTIVE NOISE REDUCTION SYSTEM FOR AIRCREW HELMETS
Peter D Wheeler David Rawlinson Stephen F Pelc and Tony P Dorey *In* NASA Langley Res Center Helicopter Acoustics Pt 2 Aug 1978 p 545-550 refs

Avail NTIS HC A19/MF A01 CSCL 20A
An active noise reduction system was developed for use in aircrew flying helmets in which the acoustic noise field inside the ear defender is detected using a miniature microphone and an antiphase signal is fed back to a communications telephone within the ear defender Performance of the active noise reduction system in a laboratory trial simulating flight conditions is shown to be satisfactory J M S

N79-10854*# Boeing Vertol Co Philadelphia Pa
DESIGN OF HELICOPTER ROTORS TO NOISE CONSTRAINTS
Edward G Schaeffer and Harry Sternfeld Jr *In* NASA Langley Res Center Helicopter Acoustics Pt 2 Aug 1978 p 551-561 refs
(Contract NAS1-15226)
Avail NTIS HC A19/MF A01 CSCL 20A

Results of the initial phase of a research project to study the design constraints on helicopter noise are presented These include the calculation of nonimpulsive rotor harmonic and broadband hover noise spectra over a wide range of rotor design variables and the sensitivity of perceived noise level (PNL) to changes in rotor design parameters The prediction methodology used correlated well with measured whirl tower data Application of the predictions to variations in rotor design showed tip speed and thrust as having the most effect on changing PNL J M S

N79-10855*# Kaman Aerospace Corp Bloomfield Conn
THE COST OF APPLYING CURRENT HELICOPTER EXTERNAL NOISE REDUCTION METHODS WHILE MAINTAINING REALISTIC VEHICLE PERFORMANCE
Michael A Bowes *In* NASA Langley Res Center Helicopter Acoustics Pt 2 Aug 1978 p 563-582 refs

(Contract DOT-FA76WA-3791)
Avail NTIS HC A19/MF A01 CSCL 20A

Analytical methods were developed and/or adopted for calculating helicopter component noise and these methods were incorporated into a unified total vehicle noise calculation model Analytical methods were also developed for calculating the effects of noise reduction methodology on helicopter design performance and cost These methods were used to calculate changes in noise design performance and cost due to the incorporation of engine and main rotor noise reduction methods All noise reduction techniques were evaluated in the context of an established mission performance criterion which included consideration of hovering ceiling forward flight range/speed/payload and rotor stall margin The results indicate that small but meaningful reductions in helicopter noise can be obtained by treating the turbine engine exhaust duct Furthermore these reductions do not result in excessive life cycle cost penalties Currently available main rotor noise reduction methodology however is shown to be inadequate and excessively costly J M S

N79-10856*# Bolt Beranek and Newman Inc Cambridge Mass
HELICOPTER CABIN NOISE METHODS OF SOURCE AND PATH IDENTIFICATION AND CHARACTERIZATION
Bruce S Murray and John F Wilby *In* NASA Langley Res Center Helicopter Acoustics Pt 2 Aug 1978 p 583-594 ref
Avail NTIS HC A19/MF A01 CSCL 20A

Internal noise sources in a helicopter are considered These include propulsion machinery comprising engine and transmission and turbulent boundary layer effects It is shown that by using relatively simple concepts together with careful experimental work it is possible to generate reliable data on which to base the design of high performance noise control treatments J M S

N79-10857*# Sikorsky Aircraft Stratford Conn
A PRACTICAL APPROACH TO HELICOPTER INTERNAL NOISE PREDICTION
Larry S Levine and Jon J DeFelice *In* NASA Langley Res Center Helicopter Acoustics Pt 2 Aug 1978 p 595-638 refs
Avail NTIS HC A19/MF A01 CSCL 20A

A practical and well correlated procedure for predicting helicopter internal noise is presented It accounts for the propagation of noise along multiple paths on an octave by octave basis The method is sufficiently general to be applicable to conventional helicopters as well as other aircraft types when the appropriate structural geometry noise source strengths, and material acoustic properties are defined A guide is provided for the prediction of various helicopter noise sources over a wide range of horsepower for use when measured data are not available The method is applied to the prediction of the interior levels of the Civil Helicopter Research Aircraft (CHRA) both with and without soundproofing installed Results include good correlation with measured levels and prediction of the speech interference level within 1 5 db at all conditions A sample problem is also shown illustrating the use of the procedure This example calculates the engine casing noise observed in the passenger cabin of the CHRA J M S

N79-10858*# Textron Bell Helicopter Ft Worth Tex
HELICOPTER INTERNAL NOISE CONTROL THREE CASE HISTORIES
Bryan D Edwards and Charlie R Cox *In* NASA Langley Res Center Helicopter Acoustics, Pt 2 Aug 1978 p 639-656

Avail NTIS HC A19/MF A01 CSCL 20A

Case histories are described in which measurable improvements in the cabin noise environments of the Bell 214B 206B and 222 were realized These case histories trace the noise control efforts followed in each vehicle Among the design approaches considered the addition of a fluid pulsation damper in a hydraulic system and the installation of elastomeric engine mounts are highlighted It is concluded that substantial weight savings result when the major interior noise sources are controlled by design both in altering the noise producing mechanism and interrupting the sound transmission paths J M S

N79-10859*# Kaman Aerospace Corp Bloomfield Conn
AN ANALYTICAL METHOD FOR DESIGNING LOW NOISE HELICOPTER TRANSMISSIONS
Robert B Bossler Jr Michael A Bowes and Allen C Royal (Army Res and Technol Labs) *In* NASA Langley Res Center Helicopter Acoustics Pt 2 Aug 1978 p 657-677 refs

(Contract DAAJ02-74-C-0039)
Avail NTIS HC A19/MF A01 CSCL 20A

The development and experimental validation of a method for analytically modeling the noise mechanism in the helicopter geared power transmission systems is described This method can be used within the design process to predict interior noise levels and to investigate the noise reducing potential of alternative transmission design details Examples are discussed J M S

N79-10860*# Westland Helicopters Ltd Yeovil (England)
THE INFLUENCE OF THE NOISE ENVIRONMENT ON CREW COMMUNICATIONS
John W Leverton *In* NASA Langley Res Center Helicopter Acoustics Pt 2 Aug 1978 p 679-693 refs

Avail NTIS HC A19/MF A01 CSCL 20A

The noise environment and how it affects crew communications in helicopters is considered The signal to noise (S/N) ratio at the microphone and the effect of the attenuation provided by the helmet is discussed This shows that the most important aspect is the S/N ratio at the microphone particularly when helmets with improved attenuation characteristics are considered Evidence is presented which shows that in high noise environments the system S/N ratio is well below that required and hence there is an urgent need to reduce the cabin noise levels and improve the microphone rejection properties Emphasis is placed on environmental/acoustic considerations J M S

N79-10861*# Societe Nationale Industrielle Aerospatiale Paris (France)
HELICOPTER INTERNAL NOISE REDUCTION RESEARCH AND DEVELOPMENT APPLICATION TO THE SA 360 AND SA 365 DAUPHIN
H J Marze and F Dambra *In* NASA Langley Res Center Helicopter Acoustics Pt 2 Aug 1978 p 695-722

Avail NTIS HC A19/MF A01 CSCL 20A

Noise sources inside helicopter cabins are considered with emphasis on the mechanisms of vibration generation inside the main gear box and mechanisms of transmission between source and cabin The dynamic behavior of the main gear box components is examined in relation to the transfer of vibration energy to the structure It is indicated that although improvements can be made in noise reduction at the source a soundproofing treatment isolating the passenger from the noise source is necessary Soundproofing treatments installed and optimized include (1) an acoustic screen using the weight effect to isolate the passenger from the noise source (2) a damping treatment to limit the conversion of the vibratory energy into acoustic energy and (3) an absorbing treatment achieved either through HELMHOLTZ resonators or through a glass wool blanket to limit the propagation of acoustic waves and the wave reflection effects in the cabin The application of treatments at the source and the optimization of the sound barriers improved the noise level by about 30 db J M S

N79-10862*# Systems Research Labs Inc Dayton Ohio RASA Div
THE STATUS OF ROTOR NOISE TECHNOLOGY ONE MAN'S OPINION
Richard P White Jr *In* NASA Langley Res Center Helicopter Acoustics, Pt 2 Aug 1978 p 723-780 refs

Avail NTIS HC A19/MF A01 CSCL 20A
The problem of establishing the state of the technology is approached by first identifying the various characteristics of rotor noise and then assessing the state of technology in understanding and predicting the most important of these rotor noise characteristics in a real-world environment J M S

N79-10863*# National Aeronautics and Space Administration Langley Research Center Hampton Va
TRENDS IN LANGLEY HELICOPTER NOISE RESEARCH
Harvey H Hubbard Domenic J Maglieri and David G Stephens *In its* Helicopter Acoustics Pt 2 Aug 1978 p 781-796 refs

Avail NTIS HC A19/MF A01 CSCL 20A
A broad perspective of needs in helicopter exterior and interior control is presented Emphasis is given to those items which support noise certification of civil helicopters and which result in reduced environmental noise impact to community residents as well as to helicopter passengers The activities described are related to the Langley responsibilities for helicopter acoustics as defined by NASA roles and missions J M S

N79-10864*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
AEROACOUSTIC RESEARCH AN ARMY PERSPECTIVE
H Andrew Morse and Fredric H Schmitz *In* NASA Langley Res Center Helicopter Acoustics Pt 2 Aug 1978 p 797-817 refs Prepared in cooperation with Army Res and Technol Labs, Fort Eustis Va
Avail NTIS HC A19/MF A01 CSCL 20A
A short perspective of the Army aeroacoustic research program is presented that emphasizes rotary wing aerodynamically generated noise Exciting breakthroughs in experimental techniques and facilities are reviewed which are helping build a detailed understanding of helicopter external noise Army and joint Army/NASA supported research programs in acoustics which promise to reduce the noise of future helicopters without severe performance penalties are included J M S

N79-10942*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
PLANNING FOR AIRPORT ACCESS AN ANALYSIS OF THE SAN FRANCISCO BAY AREA
Jarir S Dajani, ed (Stanford Univ Calif) James V Jucker, ed, and J Lloyd Jones (Stanford Univ) May 1978 300 p refs Stanford-NASA-ASEE Summer Faculty Fellowship Program on Eng System Design held at Moffett Field Calif, 1977
(Grant NGR-05-020-409)
(NASA-CP-2044 A-7347) Avail NTIS HC A13/MF A01 CSCL 13F
A description of the airport area its current transportation capabilities, and recommendations for future access planning are presented

N79-10943*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
PLANNING FOR AIRPORT ACCESS AN ANALYSIS OF THE SAN FRANCISCO BAY AREA INTRODUCTION AND CONCLUSIONS
In its Planning for Airport Access May 1978 p 1-14

Avail NTIS HC A13/MF A01 CSCL 13F
The problems of airport access are examined and recommendations are made based on current transportation availability public costs and future transportation demand Major conclusions presented include (1) access must be considered in the contex of the overall urban transportation system (2) expensive and inflexible travel modes designed primarily for airport access are not justifiable, (3) VTOL and STOL are presently too expensive for large-scale commercial use and (4) the automobile will continue to be the predominant access mode in the future S B S

N79-10944*# *National Aeronautics and Space Administration* Ames Research Center, Moffett Field Calif
PLANNING FOR AIRPORT ACCESS AN ANALYSIS OF THE SAN FRANCISCO BAY AREA THE SETTING
In its Planning for Airport Access May 1978 p 15-50 refs

Avail NTIS HC A13/MF A01 CSCL 13F
The regional setting for the three San Franscisco Bay area airports is described The general role of the airports in the national air transportation system, the demand for air transportation and the relationship of airport location to the demand for air transportation are examined The problem of airport access is also considered Various access modes their destination frequency and cost are presented S B S

N79-10945*# National Aeronautics and Space Administration Ames Research Center, Moffett Field Calif
COMPONENTS OF THE AIRPORT ACCESS SYSTEM
In its Planning for Airport Access May 1978 p 51-126 refs

Avail NTIS HC A13/MF A01 CSCL 13F
The organizations and agencies which make up or influence the airport access system are examined These include the airport the airline industry the public and private transit agencies which provide ground access to the airport, and the regulatory agencies which affect all of these organizations and their actions Each component with the exception of the regulatory agencies is described in terms of its legal status its sources of funds and the nature of its relationship with the other components Conclusions regarding the system components effects on airport access and recommendations for changes which appear practical are presented S B S

N79-10946*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
PLANNING FOR AIRPORT ACCESS AN ANALYSIS OF THE SAN FRANCISCO BAY AREA EXISTING STUDIES
In its Planning for Airport Access May 1978 p 127-154 refs

Avail NTIS HC A13/MF A01 CSCL 13F
The transportation systems studies completed, which have a bearing on the area s airport access system, are surveyed A brief description of some of the selected studies a framework for their evaluation and an assessment of their proposals are provided Areas of concentration presented include (1) San Francisco International Airport (2) Metropolitan Oakland International Airport, (3) San Jose Municipal Airport and (4) Regional and Local transportation systems S E S

N79-10947*# National Aeronautics and Space Administration Ames Research Center, Moffett Field Calif
PLANNING FOR AIRPORT ACCESS AN ANALYSIS OF THE SAN FRANCISCO BAY AREA TECHNOLOGICAL OPTIONS

In its Planning for Airport Access May 1978 p 115-188 refs

Avail NTIS HC A13/MF A01 CSCL 13F

Current transportation technology and expected technological trends are reviewed These technologies are assessed within the framework of the airport access system in the San Francisco Bay area Four types of technological options are considered (1) automotive systems (2) commuter air systems (3) automated guideways and (4) water systems SES

N79-10948*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif

PLANNING FOR AIRPORT ACCESS AN ANALYSIS OF THE SAN FRANCISCO BAY AREA THREE SUBSYSTEM DESIGNS

In its Planning for Airport Access May 1978 p 189-250 refs

Avail NTIS HC A13/MF A01 CSCL 22B

The outcomes of three analytical studies are presented Areas of concentration presented include (1) Zonal Airport Transit System designed to address the problem of airport access options, (2) the issues and problems of airport parking and circulation and (3) the problems of effectively providing airport access information SES

N79-10998*# Lockheed-Georgia Co Marietta

IMPROVED SONIC-BOX COMPUTER PROGRAM FOR CALCULATING TRANSONIC AERODYNAMIC LOADS ON OSCILLATING WINGS WITH THICKNESS

S Y Ruo Sep 1978 128 p refs

(Contract NAS1 13613)

(NASA-CR-158906 LG78ER0225) Avail NTIS HC A07/MF A01 CSCL 01A

A computer program was developed to account approximately for the effects of finite wing thickness in transonic potential flow over an oscillation wing of finite span The program is based on the original sonic box computer program for planar wing which was extended to account for the effect of wing thickness Computational efficiency and accuracy were improved and swept trailing edges were accounted for Account for the nonuniform flow caused by finite thickness was made by application of the local linearization concept with appropriate coordinate transformation A brief description of each computer routine and the applications of cubic spline and spline surface data fitting techniques used in the program are given and the method of input was shown in detail Sample calculations as well as a complete listing of the computer program listing are presented BB

N79-10999*# Lockheed-Georgia Co Marietta

SONIC-BOX METHOD EMPLOYING LOCAL MACH NUMBER FOR OSCILLATING WINGS WITH THICKNESS Final Report

S Y Ruo Sep 1978 73 p refs

(Contract NAS1-13613)

(NASA-CR-158907 LG78ER0226) Avail NTIS HC A04/MF A01 CSCL 01A

A computer program was developed to account approximately for the effects of finite wing thickness in the transonic potential flow over an oscillating wing of finite span The program is based on the original sonic-box program for planar wing which was previously extended to include the effects of the swept trailing edge and the thickness of the wing Account for the nonuniform flow caused by finite thickness is made by application of the local linearization concept The thickness effect, expressed in terms of the local Mach number is included in the basic solution to replace the coordinate transformation method used in the earlier work Calculations were made for a delta wing and a rectangular wing performing plunge and pitch oscillations and the results were compared with those obtained from other methods An input quide and a complete listing of the computer code are presented Author

N79-11000*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio

SUPERSONIC UNSTALLED FLUTTER

J J Adamczyk M E Goldstein and M J Hartmann 1978 24 p refs Presented at the 52d Meeting of the Propulsion and Energetics Panel Cleveland 23-27 Oct 1978 sponsored by AGARD

(NASA-TM-79001 E-9785) Avail NTIS HC A02/MF A01 CSCL 01A

Flutter analyses were developed to predict the onset of supersonic unstalled flutter of a cascade of two-dimensional airfoils The first of these analyzes the onset of supersonic flutter at low levels of aerodynamic loading (i e backpressure) while the second examines the occurrence of supersonic flutter at moderate levels of aerodynamic loading Both of these analyses are based on the linearized unsteady inviscid equations of gas dynamics to model the flow field surrounding the cascade These analyses are utilized in a parametric study to show the effects of cascade geometry inlet Mach number and backpressure on the onset of single and multi degree of freedom unstalled supersonic flutter Several of the results are correlated against experimental qualitative observation to validate the models JMS

N79-11001*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio

AERODYNAMIC AND ACOUSTIC EFFECTS OF ELIMINATING CORE SWIRL FROM A FULL SCALE 1 6 STAGE PRESSURE RATIO FAN (QF-5A)

Richard P Woodward Loren W Acker and Edward G Stakolich Sep 1978 35 p refs

(NASA-TM-78991 E-9774) Avail NTIS HC A03/MF A01 CSCL 01A

Fan QF-5A was a modification of fan QF-5 which had an additional core stator and adjusted support struts to turn the core exit flow from a 30 deg swirl to the axial direction This modification was necessary to eliminate the impingement of the swirling core flow on the axial support pylon of the NASA Lewis Quiet Fan Facility that caused aerodynamic acoustic and structural problems with the original fan stage at fan speeds greater than 85 percent of design The redesigned fan QF-5A did obtain the design bypass ratio with an increased core airflow suggesting that the flow problem was resolved Acoustically the redesigned stage showed a low frequency broadband noise reduction compared to the results for fan QF-5 at similar operating conditions Author

N79-11002# Notre Dame Univ Ind Dept of Aerospace and Mechanical Engineering

THE INFLUENCE OF AERODYNAMIC INTERFERENCE ON HIGH ANGLE OF ATTACK WIND TUNNEL TESTING Final Report, 1 Apr 1977 - 31 Mar 1978

Robert C Nelson and Thomas N Mouch Jun 1978 38 p refs

(Grant AF-AFOSR 3299-77 AF Proj 2307)

(AD-A056045 AFOSR-78 1079TR) Avail NTIS HC A03/MF A01 CSCL 02/4

Results from an experimental investigation of strut support interference on high angle of attack aerodynamic measurements are presented The influence of the strut support on the leeward wake structure was investigated by means of a two dimensional experiment of a cylinder-splitter plate combination Pressure distributions pressure drag coefficient and wake flow visualization data for various cylinder-splitter plate combinations are presented for high subcritical Reynolds numbers The influence of plate position and size on the pressure drag coefficient were also examined The results show the splitter plate can alter the vortex wake formation significantly and as a consequence reduce the pressure drag coefficient by as much as 30% or more Plate sizes of 0 5 1 1 and 1 5 diameter were tested with the 1 1 diameter plate yielding the largest drag reduction Author (GRA)

N79-11003# Air Force Inst of Tech Wright-Patterson AFB Ohio School of Engineering

A NUMERICAL SOLUTION OF SUPERSONIC AND HYPERSONIC VISCOUS FLOW FIELDS AROUND THIN PLANAR

DELTA WINGS Ph D Thesis
Guion Stewart Bluford Jr Jun 1978 239 p refs
(AF Proj 2404)
(AD-A056513 AFIT/DS/AA/78S-1) Avail NTIS HC A11/MF A01 CSCL 20/4

A numerical technique was used to compute the supersonic and hypersonic viscous flow fields around thin planar delta wings These solutions were obtained by solving the Navier-Stokes equations subject to a conical approximation The integration technique used was the MacCormack finite difference scheme Solutions were obtained for the upper-only lower only and total flow fields around delta wings with supersonic leading edges These solutions span a Mach number range of 2 94 to 10 17 a local Reynolds number range of 334 500 to 5 000 000 and various angles of attack from 15 to -15 deg A stability criteria was developed and used which accounted for both the viscous and inviscid flow regions Good agreement was obtained between the numerical results and experimental flow field data The shock-induced vortex within the viscous region and the hypersonic viscous bubble on top of the boundary layer were computed for the first time A unique examination was made of the vortical singularities in the conical cross flow plane of the delta wing This investigation demonstrated the feasibility of applying the conical approximation to the Navier Stokes equations in order to solve flow fields around thin delta wings GRA

N79-11004# AiResearch Mfg Co Phoenix Ariz
TRANSONIC 3-D FLOW ANALYSIS OF COMPRESSOR CASCADE WITH SPLINTER VANES Final Report, 13 Feb 1976 - 13 Feb 1978
P R Dodge and L S Lieber May 1978 84 p refs
(Contract F33615 76 C-2071 AF Proj 2307)
(AD-A057504 AiResearch 21 2524 3 AFAPL TR 78 23) Avail NTIS HC A05/MF A01 CSCL 20/4

Transonic analysis of compressors is performed with and without splitter vanes This has generally followed five phases of development proceeding from a single bladed cascade to splittered cascades and finally a fully-rotating compressor The sections in this report describe the basic method (description of geometry radial equilibrium and relaxation portions) and comparison data GRA

N79-11005# ARO Inc Arnold Air Force Station Tenn
AERODYNAMIC CHARACTERISTICS OF A 1/24-SCALE F-111 AIRCRAFT WITH VARIOUS EXTERNAL STORES AT MACH NUMBERS FROM 0 5 TO 1 3 Final Report, 23 Dec 1977 - 9 Jan 1978
C F Anderson AEDC Jul 1978 132 p
(AD-A057409 AEDC-TR 78-35 AFATL TR-78 55)
HC A07/MF A01 CSCL 20/4

This report presents and discusses the results of transonic wind tunnel tests conducted to evaluate the effects of external stores on the aerodynamic characteristics of the F 111 aircraft at wing sweep angles of 26 45 and 54 deg The analysis includes evaluation of the incremental changes in the drag static margin and lateral-directional derivatives associated with the various store configurations Wind tunnel coefficient data for a clean baseline configuration are also presented Data are presented with pylons alone GBU-10 GBU-15CCW GBU-15CCW with extended Pave Tack pod AGM-65 Rockeye SUU-30H/B and MK-82SE stores Data are presented for Mach numbers ranging from 0 5 to 1 3 at angles of attack from -2 to 16 deg at zero sideslip angle and for sideslip angles from 10 to 10 deg at angles of attack of 5 10 and 15 deg Author (GRA)

N79-11008*# Old Dominion Univ Norfolk Va
NETWORK DESIGN
In its Air Cargo An Integrated Systems View 1978 Summer Fac Fellowship Program in Eng Systems Design Sep 1978 p 1-102 refs
Avail NTIS HC A15/MF A01 CSCL 01C

A transportation network consists of areas to be served nodal points and connecting lines between nodes Node location is treated from theoretical implications derived from a central place theory The closely associated problems of routing and scheduling are pragmatically treated Network economics is discussed Cargo handling capacities and potential at existing airports by the implications of intermodal transfer upon network design and by the closely allied problems of aircraft payload and fleet-size are also discussed G Y

N79-11013*# National Aeronautics and Space Administration Langley Research Center Hampton Va
SINGLE PILOT IFR OPERATING PROBLEMS DETERMINED FROM ACCIDENTAL DATA ANALYSIS
Donna L Forsyth (Florida Univ Gainsville) and John D Shaughnessy Sep 1978 49 p
(NASA-TM-78773) Avail NTIS HC A03/MF A01 CSCL 05H

The accident reports examined were restricted to instrument rated pilots flying in IFR weather A brief examination was made of accidents which occurred during all phases of flight and which were due to all causes A detailed examination was made of those accidents which involved a single pilot which occurred during the landing phases of flight and were due to pilot error Problem areas found include (1) landing phase operations especially final approach (2) pilot weather briefings (3) night approaches in low IFR weather (4) below minimum approaches (5) aircraft icing (6) imprecise navigation (7) descending below minimum IFR altitudes (8) fuel mismanagement (9) pilot overconfidence and (10) high pilot workload especially in twins Some suggested areas of research included (1) low cost deicing systems (2) standardized navigation displays (3) low cost low-altitude warning systems (4) improved fuel management systems (5) improved ATC communications (6) more effective pilot training and experience acquisition methods and (7) better weather data dissemination techniques L S

N79-11016# National Transportation Safety Board Washington D C Bureau of Technology
LISTING OF ACCIDENTS/INCIDENTS BY AIRCRAFT MAKE AND MODEL, US CIVIL AVIATION, 1976 Accident Report, 1976
13 Apr 1978 197 p
(PB-283000/8 NTSB-AMM-78-1) Avail NTIS HC A09/MF A01 CSCL 01B

A listing of all U S civil aviation accidents/incidents occurring in calendar year 1976 sorted by aircraft make and model are presented Included are the file number aircraft registration number data and location of the accident aircraft make and model and injury index for all 4 331 accidents/incidents occurring in the period GRA

N79-11033# European Space Agency Paris (France)
BETTER PERFORMANCE FOR AIRCRAFT TRACKING AND HOLDING UNDER GUST AND SHEARWIND INFLUENCE BY USE OF DIRECT DIGITAL CONTROL
Hans Gerd Schlueter and Klaus Bender Sep 1978 54 p refs
Transl into ENGLISH of Ein Beitr zur Erhoehung der Bahnfuehrungsgenauigkeit von Flugzeugen gegenueber Windstoerungen mit Hilfe einer direkten digitalen Steuerung DFVLR Brunswick Report DLR-FB-77-48 14 Nov 1977 Original report in GERMAN previously announced as ESA 91009 Original German report available from DFVLR Cologne DM 20 70
(ESA-TT-506 DLR-FB-77 48) Avail NTIS HC A04/MF A01

The application of direct digital control for aircraft control is proposed Using this technique no aerodynamic states are considered for the invariance conditions against wind and gust disturbances Thus high accuracy for path holding and tracking can be achieved A simple iteration-procedure calculates the control input necessary to compensate the influence of wind on the commanded aircraft acceleration The inverse solutions of the nonlinear and coupled equations of forces and moments were determined online by use of an airborne digital computer Sensitivity to parameter changes is reduced by use of additional feedback and adaptation loops Author (ESA)

N79-11036# Air Force Inst of Tech Wright-Patterson AFB Ohio School of Engineering

INVESTIGATION OF THE YF-16 IN HIGH ANGLE OF ATTACK ASYMMETRIC FLIGHT M S Thesis

Eric B House II Mar 1978 165 p refs
(AD-A056511 AFIT/GAE/AA/78M-6) Avail NTIS HC A08/MF A01 CSCL 01/3

A study was made of the theoretical departure modes of the YF-16 due to pitch and yaw perturbations from asymmetrical rectilinear flight An alpha-beta control boundary was developed and within that boundary perturbations of 20 deg/sec and 30 deg/sec were introduced The areas of uncontrolled motions were mapped out and the motions were categorized Three types of motions were identified erect spins inverted spins and rolling departures For yaw perturbations only a simple controller was modelled which had as its inputs alpha beta and yaw rate The controller prevented the aircraft from departing controlled flight Time traces of the various departure modes and the effects of including a departure controller are presented in the appendices Author (GRA)

N79-11037# *Army Aviation Research and Development* Command St Louis Mo

COMPARISON OF THE EFFECT OF STRUCTURAL COUPLING PARAMETERS ON FLAP-LAG FORCED RESPONSE AND STABILITY OF A HELICOPTER ROTOR BLADE IN FORWARD FLIGHT

Daniel P Schrage and David A Peters Jun 1978 15 p refs
(AD-A056485) Avail NTIS HC A02/MF A01 CSCL 01/1

An eigenvalue and modal decoupling method to predict helicopter rotor stability and forced response has been successfully developed The advantages of this method are Stability and forced response are obtained from the same method thus allowing direct comparison of parametric effects Only one rotor revolution of numerical integration for an initial condition of unity imposed on each degree of freedom is necessary to define the Floquet Transition Matrix therefore the ambiguous interpretation of time history response data over many rotor revolutions and the separation of transient and forced response is no longer necessary and Additional degrees of freedom such as hub and airframe motions inflow feedback etc in both the fixed and rotating systems can be included since Floquet theory is applicable to equations with periodic coefficients GRA

N79-11038# Bell Helicopter Co Fort Worth Tex

VIBRATORY ICE PROTECTION FOR HELICOPTER ROTOR BLADES Final Report

H E Lemont and H Upton Jun 1978 170 p refs
(Contract DAAJ02-76-C-0051 DA Proj 1F2-62209 A-H76)
(AD-A057329 USAAMRDL-TR-77-29) Avail NTIS HC A08/MF A01 CSCL 01/3

This report presents the results of a study on vibrational deicing of main and tail rotor blades through higher harmonic shaking of the blades with aerodynamic mechanical and hydraulic shakers Studies were made of various locations for mounting shakers the forces and frequencies to deice types of shakers concept effectiveness energy requirements system reliability system maintainability weights costs aircraft performance penalties impact on countermeasure methods effects on aircraft components and applicability to main and tail rotor blades of both metal and composite construction Ratings of systems to vibrate blades are compared electrical control diagrams for shaker mechanisms are presented and results of a breadboard test are included A bibliography is presented of reports pertinent to vibrational deicing of rotor blades Author (GRA)

N79-11039*# National Aeronautics and Space Administration Langley Research Center Hampton Va

DESCRIPTION AND PRELIMINARY STUDIES OF A COMPUTER DRAWN INSTRUMENT LANDING APPROACH DISPLAY

James J Adams and Frederick J Lallman Nov 1978 44 p refs
(NASA-TM-78771 L-12269) Avail NTIS HC A03/MF A01 CSCL 01D

A computer drawn instrument landing approach display which shows a box located on the desired path aligned with the path and moving along the path at a selected distance ahead of the aircraft was examined Vertical and lateral displacements from the desired path and aircraft altitude information are used as inputs to the computer A preliminary simulation study with pilot subjects has shown that the pilots find the display very easy to use and they achieved better performance scores with the box display than with a cross pointer instrument landing display Author

N79-11043*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio

INFRARED SUPPRESSOR EFFECT ON T63 TURBOSHAFT ENGINE PERFORMANCE

Everett E Bailey Kestutis C Civinskas and Curtis L Walker Sep 1978 14 p ref
(NASA-TM-78970 E-9730 AVRADCOM-TR-78-38(PL)) Avail NTIS HC A02/MF A01 CSCL 21E

Tests were conducted to determine if there are performance penalties associated with the installation of infrared (IR) suppressors on the T63-A-700 turboshaft engine The testing was done in a sea-level static test cell The same engine (A-E402808 B) *was run with the standard OH-58 aircraft exhaust* stacks and with the ejector-type IR suppressors in order to make a valid comparison Repeatability of the test results for the two configurations was verified by rerunning the conditions over a period of days Test results showed no measurable difference in performance between the standard exhaust stacks and the IR suppressors Author

N79-11048# Air Force Inst of Tech Wright-Patterson AFB Ohio School of Engineering

AN EXPERIMENTAL STUDY OF A CATALYTIC COMBUSTOR FOR AN EXPENDABLE TURBOJET ENGINE M S Thesis

Larry E Taylor Mar 1978 43 p refs
(AD-A056512 AFIT/GAE/AA/78M-15) Avail NTIS HC A03/MF A01 CSCL 21/5

A catalytic combustor was designed an existing one modified and both were tested on a small turbojet engine The existing catalytic combustor combustor A used straight through flow and was modified by adding a flame arrestor to the combustor inlet Combustor B was designed to use reverse flow with a preburner and air dilution zones Combustors A and B were designed for an air capacity up to 0 75 lbm/sec and outlet temperatures of 1800 F Combustor B did prove successful Cold flow total pressure loss in combustor B was two percent while the total pressure loss during heat addition was a maximum of seven percent The flame arrestors tested on combustor A *did not prove to be successful Hydrogen was used as fuel for* both combustors Temperatures across the catalyst face varied by 290 F at a turbine inlet temperature of 1070 F 370 F at 1450 F Turbine inlet temperatures varied by 55 F at an average 1045 F 190 F at an average 1475 F The maximum temperature rise across the combustor during testing was 1565 F and the maximum turbine inlet temperature tested was 1855 F GRA

N79-11049# Delta Electronic Control Corp Irvine Calif

DEVELOPMENT OF A 10 KVA POWER CONDITIONER UNIT, AIRCRAFT, 115/200 VOLT, 3-PHASE, 400 Hz Final Report

W G Lawrence Apr 1978 38 p
(Contract N62269-76-C-0076)
(AD-A056119 DECC-61126-001) Avail NTIS HC A03/MF A01 CSCL 10/2

This paper discusses the development of parallelable power conditioning units capable of operating from 200 V line-to-line 3 phase 400 Hz ac or 270 V dc input power to produce a 10 kVA regulated low distortion 115/200 Vac 3 phase 400 Hz *output* *Author (GRA)*

N79-11050# Naval Test Pilot School Patuxent River Md
PRINCIPLES OF JET ENGINE OPERATION
John A Morrison May 1978 148 p Revised
(AD-A056158 USNTPS-T-3) Avail NTIS HC A07/MF A01 CSCL 21/5

This manual is primarily a guide for pilots Naval Flight officers and engineers attending the U S Naval Test Pilot School The purpose of this manual is to present the concepts underlying the gas turbine engine to develop the component characteristics and to combine the components into an operating engine The configurations considered are the turbojet the by-pass and the turbo-prop engines Author (GRA)

N79-11051# Flight Dynamics Research Corp Van Nuys Calif
END WALL AND CORNER FLOW IMPROVEMENTS OF THE RECTANGULAR ALPERIN JET-DIFFUSER EJECTOR Final Report, May 1977 - May 1978
Morton Alperin and Tiunn-Jenq Wu May 1978 77 p refs
(Contract N62269-77-C-0232)
(AD-A057663 NADC-77050-30) Avail NTIS HC A05/MF A01 CSCL 21/5

A generalized ring vortex system was utilized to determine the pressure distributions and streamline shapes within a three-dimensional jet-diffuser ejector Experiments verified the utility of the method and resulted in a measured performance exceeding that of the original STAMP (Small Tactical Aerial Mobility Platform) Ejector while avoiding the use of the large protruding end plates required by that ejector Ground effect tests on the new design showed improved performance compared to similar tests on the STAMP Ejector over the entire range of ground clearances Author (GRA)

N79-11052# ARO Inc Arnold Air Force Station Tenn
EXHAUST PLUME THERMODYNAMIC EFFECTS ON NONAXISYMMETRIC NOZZLE AFTERBODY PERFORMANCE IN TRANSONIC FLOW Final Report, 24 Nov - 4 Dec 1976
C E Robinson AEDC Aug 1978 98 p refs
(AD-A057363 AEDC-TR-78-24) Avail NTIS HC A05/MF A01 CSCL 20/4

An experimental investigation was conducted to determine the effect of exhaust plume thermodynamic properties on a nonaxisymmetric nozzle afterbody The model consisted of a strut-mounted cone-cylinder with an isolated nozzle afterbody The shape of the nozzle afterbody was generally based on the early configurations of the ADEN design An ethylene/air combustor was used to vary the thermodynamic properties by varying fuel-to-air ratio Data were obtained at four fuel-to-air ratios representing exhaust plume temperatures of approximately 500 F (cold flow fuel-to-air = 0) 1 200 1 500 and 1 900 R Pressure measurements of the nozzle afterbody surface were obtained from which drag coefficients along the rows of pressure orifices were calculated The investigation was conducted over a range of Mach numbers from 0 6 to 1 4 at a Reynolds number per foot of 2 5 million Generally the nozzle afterbody drag decreased with increasing exhaust plume temperature over the entire Mach number range GRA

N79-11054# Naval Ship Research and Development Center Bethesda Md Dept of Aviation and Surface Effects
AN INVESTIGATION OF THE PERFORMANCE OF A J52-P-8A ENGINE OPERATING UNDER THE INFLUENCE OF HIGH BLEED FLOW EXTRACTION RATES
Rodney A Hemmerly Aug 1977 99 p refs
(ZF41400001)
(AD-A057325 DTNSRDC/ASED-387) Avail NTIS HC A05/MF A01 CSCL 21/5

The uninstalled performance characteristics of a J52-P-8A engine operating under the influence of bleed flow extraction rates in excess of the standard specification limits were experimentally evaluated This investigation was undertaken as part of the Circulation Control Wing Flight Demonstrator Program to assess engine capability of supplying airflow to power the high-lift aerodynamic system incorporated on the Flight Demonstrator and define a data base from which higher confidence level analytical short takeoff and landing performance evaluations could be obtained Results of the investigation indicate that bleed flow extraction rates significantly greater than the standard specification limits are obtainable An endurance evaluation of the engine operating under the influence of the high bleed flow extraction rates indicates that these extraction rates do not adversely affect the J52-P-8A engine The results of the endurance evaluation should serve to qualify the J52-P-8A engine for the proposed Flight Test Program Author (GRA)

N79-11055# General Electric Co Cincinnati Ohio Material and Process Technology Labs
SUPERALLOY KNIFE EDGE SEAL REPAIR Final Report, 1 Mar 1976 - 31 Nov 1977
R E Kutchera and P G Bailey May 1978 116 p refs
(Contract F33615-76-C-5123 AF Proj 7351)
(AD-A057269 AFML TR-78 56) Avail NTIS HC A06/MF A01 CSCL 11/6

A twenty month effort has successfully demonstrated the feasibility of the Continuous Seam Diffusion Bonding (CSDB) process for repairing knife edge seal teeth on superalloy engine components Seal teeth rings from the F101 Rene 95 Compressor Rotor Spool (CRS) stages 4-9 containing five representative seal teeth clusters were used for this investigation The Rene 95 seal teeth were repaired with Inconel 718 tip extension material The developed processes were utilized to repair two seal teeth rings machined from the CRS Isothermal rolling was used successfully to initially widen the seal teeth bond interface to facilitate notch-free diffusion bonds after reprofiling CSDB parameters were established for bonding the Inconel 718 to the Rene 95 seal teeth A closure technique was developed to complete the circumferential bonding of a seal teeth ring GRA

N79-11056# Advisory Group for Aerospace Research and Development Paris (France)
SEAL TECHNOLOGY IN GAS TURBINE ENGINES
Aug 1978 277 p refs Presented at the Propulsion and Energetics Panel s 51st (B) Specialists Meeting London 6-7 April 1978
(AGARD-CP-237 ISBN-92-835-0218-3) Avail NTIS HC A13/MF A01

Both gas and oil path seals are discussed as well as developments in material technology that influences seal design and operation The impact of turbine engine operation on seal performance is examined as well as the effect of seal performance on engine maintenance Laboratory measurements and test facilities for investigating seal behavior are described as well as design methods

N79-11057*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
GAS PATH SEALING IN TURBINE ENGINES
Lawrence P Ludwig *In* AGARD Seal Technol in Gas Turbine Eng Aug 1978 41 p refs

Avail NTIS HC A13/MF A01 CSCL 21E

Gas path seals are discussed with emphasis on sealing clearance effects on engine component efficiency compressor pressure ratio and stall margin Various case rotor relative displacements which affect gas path seal clearances are identified Forces produced by nonuniform sealing clearances and their effect on rotor stability are examined qualitatively and recent work on turbine-blade-tip sealing for high temperatures is described The need for active clearance control and for engine structural analysis is discussed The functions of the internal-flow system and its seals are reviewed A R H

N79-11058# Rolls-Royce Ltd Bristol (England) Mechanical Research Dept
USE OF COATINGS IN TURBOMACHINERY GAS PATH SEALS

J G Ferguson *In* AGARD Seal Technol in Gas Turbine Eng Aug 1978 15 p
Avail NTIS HC A13/MF A01

Abradable coatings found in many seals throughout a gas turbine engine from the fan to the turbine have to cope with a temperature range from a little above ambient to 1 250 K Test methods exist for laboratory and rig evaluation of coatings and these are discussed but improved methods for evaluation of erosion and abradability are required To overcome shortcomings in current abradable coating materials many are at present being tailored specially to meet the conditions in particular seals within an engine This means that there are several different coatings within any given engine each having a limited range of use New coatings are still required which can be used in a wide range of applications throughout an engine There is in particular an urgent need for abradable materials which can be used in turbine seals covering a temperature range from 870 K to 1 250 K A R H

N79-11061# American Airlines Inc Tulsa Okla
AMERICAN AIRLINES' OPERATIONAL AND MAINTENANCE EXPERIENCE WITH AERODYNAMIC SEALS AND OIL SEALS IN TURBOFAN ENGINES
C R Smith *In* AGARD Seal Technol in Gas Turbine Eng Aug 1978 11 p
Avail NTIS HC A13/MF A01

User experience with aerodynamic and oil system seal designs currently used in commercial turbofan engines is reported with emphasis on operational performance seal reliability seal repair techniques and seal maintainability costs Gas path deterioration resulting from sealing problems and the effects of associated hardware problems on seal performance are examined The impact of this deterioration on fuel consumption maintenance requirements (engine management) and airline operations and operating costs is discussed A R H

N79-11062# Rolls-Royce Ltd Derby (England) Technical Design Group
OIL SEALING OF AERO ENGINE BEARING COMPARTMENTS
D C Whitlock *In* AGARD Seal Technol in Gas Turbine Eng Aug 1978 11 p
Avail NTIS HC A13/MF A01

The basic problem of oil sealing of aero engine bearing compartments is to provide a seal between rotating and 'tatic components or between rotating components accommodating axial movements and possible radial excursions (such a shaft whirling) The sealing arrangements must also conform to modular concepts of engine construction Such seals incur penalties on the oil system such as heat generation air leakage and debris generation Means of reducing these penalties and improving sealing integrity by developments of existing techniques are considered A R H

N79-11065# Rolls-Royce Ltd Bristol (England) Advanced Projects Dept
THE CONTRIBUTION OF DYNAMIC X-RAY TO GAS TURBINE AIR SEALED TECHNOLOGY
P A E Stewart and K A Brasnett *In* AGARD Seal Technol in Gas Turbine Eng Aug 1978 13 p refs

Avail NTIS HC A13/MF A01

A radiographic technique is described for studying the behavior of components (particularly seals) during the full range of gas turbine operation Its application to a wide range of engines particularly during transient conditions is discussed A R H

N79-11068*# Detroit Diesel Allison Indianapolis Ind Flow Systems Group
DETERMINING AND IMPROVING LABYRINTH SEAL PERFORMANCE IN CURRENT AND ADVANCED HIGH PERFORMANCE GAS TURBINES
Harold L Stocker *In* AGARD Seal Technol in Gas Turbine Eng Aug 1978 22 p refs
02-07)
(Contracts NAS3 20056 N00140-73-C-005
N00140-74-C-0759)
Avail NTIS HC A13/MF A01 CSCL 21E

Abradable and honeycomb lands were evaluated with a conventional straight-through seal using a static two dimensional (rectangular flowpath) seal rig and a rotating three dimensional seal rig Test results show that some abradable lands leak significantly more than a solid-smooth land However honeycomb lands were found to reduce leakage up to 24 percent Through aerodynamic testing an advanced design labyrinth seal was developed which reduced leakage 54 2 percent compared to a conventional straight-through seal and 26 3 percent compared to a conventional stepped seal A R H

N79-11069# Air Force Aero Propulsion Lab Wright-Patterson AFB Ohio Components Branch
FACTORS ASSOCIATED WITH RUB TOLERANCE OF COMPRESSOR TIP SEALS
Charles W Elrod *In* AGARD Seal Technol in Gas Turbine Eng Aug 1978 12 p refs

Avail NTIS HC A13/MF A01

Air Force facilities for investigating different facets of the problem of ineffective tolerance of compressor blade tip seals to high speed rubs are described and the integration of the test data in the overall rub tolerance program is delineated A compressor rub test facility (CRTF) including a single compressor stage driven by an electric motor drive is used to study rub interaction in a realistic compressor environment The apparatus is unique in its capability to provide a full range of compressor operating conditions and rub interaction rates for a full scale tip seal configuration A laser test facility is used to examine the phenomena of self sustained combustion of titanium in a simulated compressor environment especially the environment involved in the CRTF The burn rate and damage criteria is used to develop proper procedures for safe test operation The pressure temperature and velocity relationships on self sustained combustion of titanium are noted to have significant relevance to many situations outside the CRTF environment A R H

N79-11070*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
SELF-ACTING SHAFT SEALS
Lawrence P Ludwig *In* AGARD Seal Technol in Gas Turbine Eng Aug 1978 29 p refs

Avail NTIS HC A13/MF A01 CSCL 13I

The operating principle and design of the self-acting seal is reviewed Mathematical models for obtaining a seal force balance and the equilibrium operating film thickness are outlined Particular attention is given to primary ring response (seal vibration) to rotating seat face runout This response analysis reveals three different vibration modes with secondary seal friction being an important parameter Leakage flow inlet pressure drop and affects of axisymmetric and nonaxisymmetric sealing face deformations are discussed Experimental data on self-acting face seals operating under simulated gas turbine conditions are given these data show the feasibility of operating the seal at conditions of 345 N sq cm (500 psi) and 152 m/sec (500 ft/sec) sliding speed Also a spiral groove seal design operated to 244 m/sec (800 ft/sec) is described A R H

N79-11071# Pisa Univ (Italy) Istituto di Macchine
SELF ACTIVE PAD SEAL APPLICATION FOR HIGH PRESSURE ENGINES
Dino Dini *In* AGARD Seal Technol in Gas Turbine Eng Aug 1978 10 p refs
Avail NTIS HC A13/MF A01

A more effective and improved engine sealing system is analyzed and discussed for application to an advanced high pressure engine Very high leakage in labyrinth seal applied at high pressure and temperature locations of high performance engines is overcome by a self-acting lift pad seal added to the primary sealing surface enabling a very thin gas film separation of the surfaces during shaft rotation Details of construction and design to operate at a clearance less than 1/10th that associated with labyrinth seals are given Operation was obtained at a rotating speed of 600 ft/sec and a sealed air temperature of 600 F The maximum speed and pressure capability is at present tested for use in high-pressure engine applications A R H

N79-11072# Rolls-Royce Ltd Derby (England) Technical Design Group
GAS TURBINE DISC SEALING SYSTEM DESIGN
D A Campbell *In* AGARD Seal Technol in Gas Turbine Eng Aug 1978 16 p refs

Avail NTIS HC A13/MF A01

The turbine sealing system must seal the disc space against ingress of hot turbine gases and absorb windage and conducted heat with limited air temperature rises Air leakage in the system must be controlled to minimize engine performance losses to avoid loss of blade cooling effectiveness and to maintain the integrity of associated shaft and bearing cooling systems The effect of the required bleed flow on engine performance is considered and found to be fairly small provided that an accurate assessment of this offtake is made at the beginning of the design process Subsequent increases of the air bleed during the development phase can bring substantial penalties in turbine entry temperature The various factors to be considered when determining the sealing and cooling flows are reviewed and the areas where further research would be useful are indicated
Author

N79-11074*# National Aeronautics and Space Administration Langley Research Center Hampton Va
SPINEQ A PROGRAM FOR DETERMINING AIRCRAFT EQUILIBRIUM SPIN CHARACTERISTICS INCLUDING STABILITY
William M Adams Jr Nov 1978 86 p refs
(NASA-TM 78759 L 12328) Avail NTIS HC A05/MF A01 CSCL 01C

A computer program SPINEQ is described which can algebraically solve the nonlinear equations of motion for equilibrium spin conditions Linear characteristics of the airplane about the equilibrium points are also determined The theoretical basis of the program is outlined computational flow is shown the functions of major subroutines are described and key parameters directing the computations are identified Program input and output are described and illustrated by means of a test case The program is available from COSMIC Author

N79-11075# Deutsche Forschungs und Versuchsanstalt fuer Luft- und Raumfahrt Brunswick (West Germany) Inst fuer Flugfuehrung
A CONTRIBUTION TO THE INCREASE OF AIRCRAFT GUIDANCE PRECISION UNDER WIND DISTURBANCE CONDITIONS BY USING DIRECT DIGITAL CONTROL
Hans Gerd Schlueter and Klaus Bender 14 Nov 1977 40 p refs In GERMAN ENGLISH summary Report will also be announced as translation (ESA-TT-506)
(DLR-FB-77-48) Avail NTIS HC A03/MF A01 DFVLR Cologne DM 20 70

The application of direct digital control for aircraft control is proposed Using this technique no aerodynamic states are considered for the invariance conditions against wind and gust disturbances Thus high accuracy for path holding and tracking can be achieved A simple iteration-procedure calculates the control input necessary to compensate the influence of wind on the commanded aircraft acceleration The inverse solutions of the nonlinear and coupled equations of forces and moments were determined on-line using an airborne digital computer The sensitivity to parameter changes was reduced by additional feedback and adaptation loops Author (ESA)

N79-11076# European Space Agency Paris (France)
INVESTIGATIONS FOR THE CALCULATION OF ROBUST CONTROL SYSTEMS
R Steinhauser Jun 1978 30 p refs Transl into ENGLISH of Untersuch zur Berechnung robuster Regelungsysteme DFVLR Oberpfaffenhofen West Ger Report DLR-IB 552-77/41 Nov 1977
(ESA-TT-488 DLR IB-552-77/41) Avail NTIS HC A03/MF A01

Robust control systems i e stabilizing systems which do not lead to instability at the occurrence of a failure without duplication and switching over are discussed Two procedures for the calculation of a robust controller are presented in which the stability criteria of Hurwitz and the Riccati equation are applied respectively With the latter procedure a robust controller for a simple system was calculated Author (ESA)

N79-11088# European Space Agency Paris (France)
ELECTROPHORESIS EXPERIMENT MA-014 IN THE APOLLO SOYUZ TEST PROJECT PART 3 FUTURE APPLICATIONS
Erhard Schoen Guenter Dorl and Hans Juergen Lemke Sep 1978 148 p refs Transl into ENGLISH of Elektrophorese-Expt MA-014 im Apollo-Sojus Test Proj Teil 3 Zukuenftige Verwendungsmoeglichkeiten BMM Munich Report BMFT FB W 77 04 Sep 1977 Original report in GERMAN previously announced as N78-22131 Original German report available from ZLDI Munich DM 25 85
(ESA TT-473 BMFT FB W 77 04) Avail NTIS HC A07/MF A01

In view of future mission objectives the Apollo Soyuz Test Project (ASTP) configuration of the experiment does not appear suited for use in Spacelab Instead an experiment to be flown aboard sounding rockets (TEXUS) is presented which serves to verify the ASTP results and to test components of the Spacelab equipment On the basis of this ASTP configuration and taking into account the necessary modifications and required performance characteristics and electrophoresis equipment suited for use in Spacelab was conceived together with a schedule and cost estimate for the manufacture of the components A configuration to be used on the pallet of the Shuttle (without Spacelab) is considered Such a use is of interest because of the considerably higher number of launches possible and the lower costs of launching Owing to the absence of the Spacelab periphery (atmosphere power supply computer etc) both the cost of production of such equipment and the cost for specimen analysis are substantially higher than the comparable costs related to the Spacelab configuration so that it is recommended to abandon this possibility Author (ESA)

N79-11203# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt Cologne (West Germany) Inst fuer Werkstoff-forschung
INFLUENCE OF THERMOMECHANICAL TREATMENT ON MICROSTRUCTURE AND MECHANICAL PROPERTIES OF HIGH STRENGTH ALUMINUM ALLOYS Ph D Thesis - Ruhr Univ Bochum, West Ger
Karl Welpmann Gerd Luetjering (Ruhr Univ) and Wolfgang Bunk 23 Nov 1977 79 p refs In GERMAN ENGLISH summary Report will also be announced as translation (ESA-TT 507)
(DLR-FB-77-50) Avail NTIS HC A05/MF A01 DFVLR Cologne DM 40 70

Thermomechanical treatment (TMT) tests on AlZnMgCu alloys were made The inhomogeneous slip which occurs during the rolling process produced shear offsets at the grain boundaries and so reduced the effective grain boundary length In a pure alloy without Fe Si and Cr this microstructural modification caused an improvement of various mechanical properties The tensile ductility and the lifetime in the fatigue tests increased The SCC resistance of the alloy was enhanced and the fracture toughness values were raised The fatigue crack propagation behavior in the high crack propagation rate regime was improved At low crack propagation rates the cracks propagated along slip bands and the TMT caused a deterioration of the crack propagation behavior The commercial AlZnMgCu alloys also showed microstructural modifications at the grain boundaries produced by the TMT The influence of the grain boundaries on the deformation crack initiation and crack propagation mechanisms is not a dominant factor and the mechanical properties were found to be only slightly affected by the TMT Author (ESA)

N79-11240# Department of Energy Bartlesville Okla Research Center

AVIATION TURBINE FUELS, 1977

Ella Mae Shelton May 1978 15 p refs
(BERC/PPS-78/2) Avail NTIS HC A02/MF A01

Average values of selected tests of aviation turbine fuels produced during 1977 are compared with data from the 1970-1976 surveys for aviation turbine fuels for grade JP-4 military Jet B commercial grade JP-5 military Jet A commercial and Jet A 1 commercial fuels Data for each of the individual analyses are tabulated DOE

N79-11291# Strategic Air Command Offutt AFB Nebr Aircraft Engineering Div

GIANT IMAGE 2 RELIABILITY AND MAINTAINABILITY B-52D

James H Harrington 10 Jul 1978 27 p
(AD-A057938 SAC/LGME ER-P 313) Avail NTIS HC A03/MF A01 CSCL 17/9

This report provides a subjective assessment of the logistics supportability of the AN/ALR-46(V)-3 (commonly referred to as ALR46A) radar warning receiver during and following the Giant Image 2 Qualification Operational Test and Evaluation in a B-52D GRA

N79-11352*# California Inst of Tech Pasadena Graduate Aeronautical Lab

THE FLYING HOT WIRE AND RELATED INSTRUMENTATION Final Report

Donald Coles Brian Cantnell and Alan Wadcock Nov 1978 62 p refs
(Grant NGL-05-002-229)
(NASA-CR-3066) Avail NTIS HC A04/MF A01 CSCL 14B

A flying hot-wire technique is proposed for studies of separated turbulent flow in wind tunnels The technique avoids the problem of signal rectification in regions of high turbulence level by moving the probe rapidly through the flow on the end of a rotating arm New problems which arise include control of effects of torque variation on rotor speed avoidance of interference from the wake of the moving arms and synchronization of data acquisition with rotation Solutions for these problems are described The self-calibrating feature of the technique is illustrated by a sample X-array calibration Author

N79-11409*# AiResearch Mfg Co Phoenix Ariz

ANALYSIS, DESIGN FABRICATION AND TESTING OF THE MINI-BRAYTON ROTATING UNIT (MINI BRU) VOLUME 2 FIGURES AND DRAWINGS Final Report

F X Dobler Oct 1978 448 p 2 Vol
(Contract NAS3-18517)
(NASA-CR-159441-Vol-2 AiResearch 31 2935-2) Avail NTIS HC A19/MF A01 CSCL 13I

This volume contains the figures and drawings reference in Volume 1 Author

N79-11410# Parks College of St Louis Univ Cahokia

HELICOPTER BEARING FAILURE DETECTION UTILIZING SHOCK PULSE TECHNIQUES Final Report

John A George Timothy C Mayer Harold W Sutphin and J Thomas Harrington 20 Sep 1977 480 p
(Contract DAAJ01 72 A-0027)
(AD-A057308 USAAVRADCOM TR-78 6) Avail NTIS HC A21/MF A01 CSCL 01/3

The Shock Pulse technique works on the principle that a discrete fault such as a pit or a spall will cause repetitive impacts of short duration These impacts will cause shock waves to propagate through the bearing structure causing a pulse displacement input to an accelerometer suitably attached to the bearing structure The output of the accelerometer passes through a high gain amplifier tuned at the resonant frequency of the accelerometer (this amplifier then acts as a sharp band pose filter) After the signal is processed the output is displayed on a counter which provides the frequency of peaks above any desired peak amplitudes GRA

N79-11414# Argonne National Lab Ill

PRELIMINARY EVALUATION OF SEVERAL NONDESTRUCTIVE-EVALUATION TECHNIQUES FOR SILICON NITRIDE GAS-TURBINE ROTORS

D S Kupperman C Sciammarella N P Lapinski A Sather D Yuhas L Kessler and N F Fiore Jan 1978 80 p refs
(Contract W 31-109-eng 38)
(ANL 77-89) Avail NTIS HC A05/MF A01

Several nondestructive-evaluation (NDE) techniques were examined Preliminary results were obtained for holographic interferometry acoustic microscopy dye-enhanced radiography acoustic emission and acoustic-impact testing techniques The relative effectiveness of these techniques in terms of their applicability to the rotor geometry and ability to detect critically sized flaws is discussed Where feasible flaw indications were verified by alternative NDE techniques or destructive examination This study indicates that since the various techniques have different advantages ultimately a reliable interrogation of ceramic rotors may require the application of several NDE methods DOE

N79-11433*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio

THERMAL-STRUCTURAL MISSION ANALYSES OF AIR-COOLED GAS TURBINE BLADES

Albert Kaufman and Raymond E Gaugler 1978 13 p refs
Proposed for presentation at the Intern Gas Turbine Conf San Diego Calif 11-15 Mar 1979
(NASA-TM-78963 E-9720) Avail NTIS HC A02/MF A01 CSCL 21E

Cyclic temperature and stress-strain states in cooled turbine blades were calculated for a simulated mission of an advanced technology aircraft engine TACT1 (three dimensional heat transfer) and MARC (nonlinear structural analysis) computer programs were used to analyze impingement cooled airfoils with and without leading-edge film cooling Creep was the predominant damage mode particularly around film cooling holes Radially angled holes exhibited less creep than holes normal to surface Beam-type analyses of all-impingement cooled airfoils gave fair agreement with MARC results for initial creep Author

N79-11439# RAND Corp Santa Monica Calif

PROBABILITY THAT THE PROPAGATION OF AN UNDETECTED FATIGUE CRACK WILL NOT CAUSE A STRUCTURAL FAILURE Interim Report

J R Gebman and P C Paris Jun 1978 80 p refs
(AD-A057335 RAND/R-2238-RC) Avail NTIS HC A05/MF A01 CSCL 01/3

The undetected propagation of a fatigue crack constitutes a significant cause of aircraft and other structural failures To raise the structural failure load to a relatively high level the manufacturer can divide the structure into many small elements which significantly increases the ability of a structure to tolerate an element failure This report presents a procedure for calculating the probability that the element has not failed as a function of the crack propagation time and hence the crack s length The procedure s form is so simple that computations with a desk calculator can yield reasonably accurate results To illustrate this the report uses data that an aircraft manufacturer developed for the structural components/elements that currently limit the service life of an existing transport aircraft Author (GRA)

N79-11542# Department of Energy Washington D C Div of Consumption Data Studies
FEDERAL ENERGY DATA SYSTEM (FEDS) TECHNICAL DOCUMENTATION
Raymond F Fuller Jun 1978 117 p refs
(PB-281815/1 DOE/EIA-0031/1 CRN-780301-00087) Avail NTIS HC A06/MF A01 CSCL 10A
Data system areas covered are (1) an explicit definition of each data series including source methodology naming conventions and idiosyncrasies which do not follow directly from the published source (2) table of contents and description for the on-line FEDS (3) an explicit detailed description of the FEDS computer tape (4) completed summary of conversion factors and scalers (5) glossary of energy terms GRA

N79-11561# National Aviation Facilities Experimental Center Atlantic City, N J
EMISSION SAMPLE PROBE INVESTIGATION OF A MIXED FLOW JT8D-11 TURBOFAN ENGINE Final Report, Jan 1973 - Jun 1977
Gerald R Slusher Jul 1978 64 p refs
(AD-A058038, FAA-NA-77-40, FAA-RD-77-175) Avail NTIS HC A04/MF A01 CSCL 14/2
The exhaust plume of a mixed flow JT8D-11 turbofan engine was investigated to optimize the shape size and location of fixed probes for acquiring representative emission samples Traverse of 177 points over the exhaust nozzle were accomplished on a 2 inch square grid The average emission levels, contours and profile distributions were determined The predicted performance of area weighted cruciform and diamond probe designs were calculated from interpolations of the traverse contours Exhaust emissions were measured with (1) five mixing cruciform probes (2) multihole averaging probes in core and (3) the engine turbine discharge pressure probes Detailed traverses across engine power are considered necessary for representative emission measurement because of limitations existing in all fixed probing techniques investigated S B S

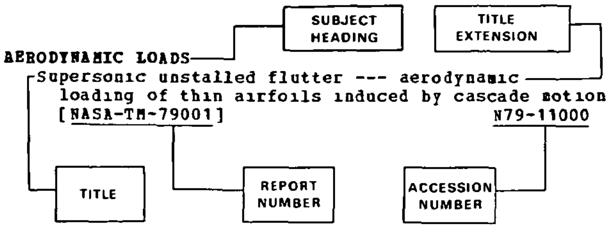
N79-11562# National Aviation Facilities Experimental Center Atlantic City N J
PILOT PROGRAM TO DEVELOP OPERATING TIME EMISSION DEGRADATION FACTORS FOR GENERAL AVIATION PISTON ENGINES Final Report, Jun - Oct 1977
Robert F Salmon Jul 1978 66 p refs
(AD-A058158 FAA-NA-78-25 FAA-RD-78-74) Avail NTIS HC A04/MF A01 CSCL 13B
Two aircraft were used as test vehicles to determine emission degradation characteristics of piston engines over a time period of 50 hours The results indicate that (1) no appreciable change in emissions occurs within the first 50 hours of engine operation (2) emissions can be measured on aircraft-installed engines with accuracies comparable to those obtained in test stands provided proper instrumentation and test procedures are used and (3) aircraft instrumentation is satisfactory for some parameters but in order to achieve EPA accuracy requirements manifold pressure fuel flow and induction airflow must be measured on laboratory-type instruments S B S

N79-11566# Aerospace Medical Research Labs Wright Patterson AFB Ohio
COMMUNITY NOISE EXPOSURE RESULTING FROM AIRCRAFT OPERATIONS VOLUME 6 ACOUSTIC DATA ON NAVY AIRCRAFT
Jerry D Speakman Robert G Powell and Robert A Lee Mar 1978 510 p
(AD-A056217 AMRL-TR-73-110-Vol-6) Avail NTIS HC A22/MF A01 CSCL 20/1
This series of reports presents the results of field test measurements to define the noise produced on the ground by military fixed wing aircraft during controlled level flyovers and ground runups For flight conditions data are presented in terms of various acoustic measures over the range 200-25 000 feet minimum slant distance to the aircraft For ground runups data are presented as a function of angle and distance to the aircraft All of the data are normalized to standard acoustic reference conditions of 59 F temperature and 70% relative humidity Noise data are presented in this volume for the following aircraft A 3 TA-4J RA-56 A-6A AV-8A F-8 F-14A P-3A S-3A and T-2C GRA

N79-11580# Acurex Corp Mountain View Calif Aerotherm Div
JET ENGINE TEST CELLS EMISSIONS AND CONTROL MEASURES, PHASE 1 Final Report, 13 Aug 1976 - 30 Sep 1976
D E Blake Apr 1978 139 p refs
(Contract EPA-68-01-3158)
(PB-283470/3 Aerotherm-FR-76-218 TR-78-102 EPA-340/1-78-001A) Avail NTIS HC A07/MF A01 CSCL 13B
The current state of the art of pollutant emission measurement and cleanup technology related to military jet engine test cells are discussed Considerable emissions data from jet engines is available but data from test cell stacks is sparse An electrostatic precipitator nucleation scrubber fuel additives thermal converter and fuel atomization improvement were evaluated Several methods are quite effective in reducing test cell emissions Fuel additives are effective in reducing test cell plume opacity Capital and operating cost data on these methods are presented GRA

N79-11632# National Technical Information Service Springfield Va
CLEAR AIR TURBULENCE A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, 1964 - Jul 1978
Guy E Habercom Jr Sep 1978 295 p Supersedes NTIS/PS-77/0857 NTIS/PS-76/0705 NTIS/PS-75/761 NTIS/PS-75/008
(NTIS/PS-78/0938/7 NTIS/PS-77/0857 NTIS/PS-76/0705 NTIS/PS-75/761 NTIS/PS-75/008) Avail NTIS HC $28 00/MF $28 00 CSCL 04B
Clear air turbulence and its relationship to air transportation is documented in the cited research reports Its meteorological occurrences its detection and aircraft encounters with the phenomena are investigated This bibliography contains 288 abstracts GRA

Typical Subject Index Listing



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A

ABRASION
Use of coatings in turbomachinery gas path seals
N79-11058
ACOUSTIC ATTENUATION
An active noise reduction system for aircrew helmets
N79-10853
ACOUSTIC EMISSION
Nondestructive inspection of aircraft structures and materials via acoustic emission
A79-10991
Potential applications of acoustic emission technology as a nondestructive evaluation method for naval aviation ground support
[AD-A056650] N79-10439
ACOUSTIC MEASUREMENTS
Community noise exposure resulting from aircraft operations. Volume 6: Acoustic data on Navy aircraft
[AD-A056217] N79-11566
ACOUSTIC PROPERTIES
Aerodynamic and acoustic effects of eliminating core swirl from a full scale 1.6 stage pressure ratio fan (QF-5A)
[NASA-TM-78991] N79-11001
ADAPTIVE CONTROL
Development of gas turbine performance seeking logic
[ASME PAPER 78-GT-13] A79-10257
AEROACOUSTICS
Qualitative analysis of the effect of jet aircraft acoustic characteristics on the optimal take-off program
A79-12233
Helicopter Acoustics, part 2 --- conferences
[NASA-CP-2052-PT-2] N79-10843
Aeroacoustic research: An Army perspective
N79-10864
AERODYNAMIC BALANCE
Turbine engine automated trim balancing and vibration diagnostics
[ASME PAPER 78-GT-129] A79-10793
AERODYNAMIC CHARACTERISTICS
Detached flow about an opening canopy
A79-11006
Parachute canopy opening dynamics
A79-11008
Experimental method for investigating preintake vortex circulation --- in engine air intakes
A79-11367
Control and stabilization in aerodynamics --- Russian book
A79-11392
Recent theoretical developments and experimental studies pertinent to vortex flow aerodynamics - With a view towards design
A79-11549
Some types of separated flow past slotted wings
A79-12148
Calculation of the transient aerodynamic characteristics of a supersonic flight vehicle
A79-12182
Regimes of supersonic flow past thin wings
A79-12188
Effect of viscosity on nonseparated transonic flow past a profile
A79-12205
Problems in the method of discrete vortices for solving linear wing theory problems
A79-12224
Theory of large-aspect ratio wings in transonic gas flow
A79-12226
Calculation of flow past conical bodies with supersonic leading edges
A79-12227
Features of flow past slotted wings
A79-12236
Calculation of effect of viscosity on nonseparated subsonic flow past a wing with flap
A79-12240
Skirt components of the aerodynamic characteristics of an air-cushion vehicle using the oncoming flow to generate lift
A79-12949
The smooth approximation method and its application to the mathematical description of the aerodynamic characteristics of a wing
A79-12955
Overall aerodynamic characteristics of conical and delta wings at supersonic speeds
A79-12966
Inverse mixed problem for a profile with a prescribed velocity distribution on one of its sides and a known thickness distribution
A79-12970
Utilization of the wing-body aerodynamic analysis program
[NASA-TM-72856] N79-10020
Aerodynamic performance of a 1.35-pressure-ratio axial-flow fan stage
[NASA-TP-1299] N79-10022
Study of aerodynamic technology for VSTOL fighter/attack aircraft: Horizontal attitude concept
[NASA-CR-152130] N79-10024
Study of aerodynamic technology for VSTOL fighter/attack aircraft: Vertical attitude concept
[NASA-CR-152131] N79-10026
Study of aerodynamic technology for VSTOL fighter attack aircraft
[NASA-CR-152129] N79-10027
Study of aerodynamic technology for VSTOL fighter/attack aircraft, phase 1
[NASA-CR-152132] N79-10028
Aerodynamic characteristics of a 1/24-scale F-111 aircraft with various external stores at Mach numbers from 0.5 to 1.3
[AD-A057409] N79-11005
Determining and improving labyrinth seal performance in current and advanced high performance gas turbines
N79-11068

AERODYNAMIC COEFFICIENTS
An instrumentation modeling technique used in the identification of aerodynamic coefficients from flight test data
[IAF PAPER 78-99] A79-11239

AERODYNAMIC CONFIGURATIONS
On the conventional definitions of thrust/drag of an aircraft equipped with a turbojet engine
A79-10618
Determination of the geometrical parameters and position of the nose flap at the root section of a swept wing on the basis of wind tunnel data. I
A79-12953
Study of aerodynamic technology for VSTOL fighter/attack aircraft, volume 1
[NASA-CR-152128] N79-10025
Northrop F-5F shark nose development
[NASA-CR-158936] N79-10047
Aerodynamic design and analysis of propellers for mini-remotely piloted air vehicles. Volume 2: Ducted propellers
[AD-A056948] N79-10062

AERODYNAMIC DRAG
On the conventional definitions of thrust/drag of an aircraft equipped with a turbojet engine
A79-10618
Investigation of the profile drag and the mean and pulsation velocities in the wake of wings by means of a laser Doppler anemometer
A79-12151
Improved transonic nose drag estimates for the NSWC missile aerodynamic computer program
[AD-A056795] N79-10030

AERODYNAMIC FORCES
Aerodynamic force and moment on oscillating airfoils in cascade
[ASME PAPER 78-GT-181] A79-10812
Control and stabilization in aerodynamics --- Russian book
A79-11392
Iterative method of aircraft wing strength calculation taking into account the effect of deformations on distribution of aerodynamic forces
A79-12213

AERODYNAMIC INTERFERENCE
Numerical study of the induction of porous walls of the working section of a low-velocity wind tunnel
A79-12228

AERODYNAMIC LOADS
A method of solving multicriterial optimization problems for load-bearing structures --- for large aspect ratio wings
A79-12163
Improved sonic-box computer program for calculating transonic aerodynamic loads on oscillating wings with thickness
[NASA-CR-158906] N79-10998
Supersonic unstalled flutter --- aerodynamic loading of thin airfoils induced by cascade motion
[NASA-TM-79001] N79-11000

AERODYNAMIC NOISE
Aerodynamic and acoustic effects of eliminating core swirl from a full scale 1.6 stage pressure ratio fan (QF-5A)
[NASA-TM-78991] N79-11001

AERODYNAMIC STABILITY
Determination of the aerodynamic damping of turbine blade vibrations with allowance for the pitch, exit blade angle, and blade curvature
A79-10568
The Wright brothers' flight-control system --- canard configuration
A79-11125
Control and stabilization in aerodynamics --- Russian book
A79-11392
Application of the lifting line concept to helicopter computation
[ONERA, TP NO. 1978-90] A79-11571
Gas turbine engine inlet flow distortion guidelines
[SAE ARP 1420] A79-11624
Free periodic oscillations of a parachute system in the longitudinal plane
A79-12971
Aerodynamic center of wing-fuselage-nacelle combinations: Effect of rear-fuselage pylon mounted nacelles
[ESDU-78013] N79-10016
Comparison of the effect of structural coupling parameters on flap-lag forced response and stability of a helicopter rotor blade in forward flight
[AD-A056485] N79-11037

AERODYNAMIC STALLING
A new stage stacking technique for axial-flow compressor performance prediction
[ASME PAPER 78-GT-139] A79-10268
A rotating stall control system for turbojet engines
[ASME PAPER 78-GT-115] A79-10757
An axial compressor end-wall boundary layer calculation method
[ASME PAPER 78-GT-81] A79-10767
Dynamic stall of an airfoil with leading edge bubble separation involving time dependent re-attachment
[ASME PAPER 78-GT-194] A79-10817
Aerodynamic response for the airfoil experiencing sudden change in angle of attack
A79-10869

AERODYNAMICS
Numerical aerodynamic simulation facility --- for flows about three-dimensional configurations
N79-10450

AEROELASTICITY
Determination of the aerodynamic damping of turbine blade vibrations with allowance for the pitch, exit blade angle, and blade curvature
A79-10568
Application of the lifting line concept to helicopter computation
[ONERA, TP NO. 1978-90] A79-11571
Iterative method of aircraft wing strength calculation taking into account the effect of deformations on distribution of aerodynamic forces
A79-12213
Moments on the hub of a lifting propeller with hinge-mounted blades
A79-12216
Synthesis and analysis of systems for active control and suppression of flutter of flying craft
A79-12755

AERONAUTICAL ENGINEERING
Near-net-shape engine methods emerge --- aircraft engine parts fabrication technologies
A79-11449
Aerodynamic center of wing-fuselage-nacelle combinations: Effect of rear-fuselage pylon mounted nacelles
[ESDU-78013] N79-10016

AEROTHERMODYNAMICS
Influence of geometric effects on the aspect ratio optimization of axial turbine bladings
[ASME PAPER 78-GT-173] A79-10809

AFTERBODIES
Exhaust plume thermodynamic effects on nonaxisymmetric nozzle afterbody performance in transonic flow
[AD-A057363] N79-11052

AFTERBURNING
Jet curtain flameholder for aircraft afterburners
[ASME PAPER 78-GT-95] A79-10761

AH-64 HELICOPTER
The effects of latest military criteria on the structural weight of the Hughes advanced attack helicopter - YAH-64
A79-10904
Damage tolerant design of the YAH-64 main rotor blade
A79-10914
Advanced technology helicopter landing gear
A79-10918
Ultrasonic welding /solid state bonding/ of aircraft structure - Fact or fancy
A79-10921

AIR CARGO
Overview of the small package air carrier industry - A study of the operations in Federal Express
[SAE PAPER 780540] A79-10406
Directions for developing an air cargo system planning model
[SAE PAPER 780556] A79-10411
Network design
N79-11008

AIR CONDITIONING
The F-16 environmental control system
[ASME PAPER 78-ENAS-11] A79-12560

AIR CONDITIONING EQUIPMENT
Aircraft air conditioning systems --- Russian book
A79-11442
Advanced environmental cooling concepts for supersonic aircraft
[ASME PAPER 78-ENAS-21] A79-12570
F-18 air conditioning system
[ASME PAPER 78-ENAS-23] A79-12572
AIR COOLING
Thermal-structural mission analyses of air-cooled gas turbine blades
[NASA-TM-78963] N79-11433
AIR FLOW
Investigation of the electrification of an aircraft model by a humid airstream in a wind tunnel
A79-12162
Skirt components of the aerodynamic characteristics of an air-cushion vehicle using the oncoming flow to generate lift
A79-12949
An investigation of the performance of a J52-P-8A engine operating under the influence of high bleed flow extraction rates
[AD-A057325] N79-11054
AIR INTAKES
Experimental method for investigating preintake vortex circulation --- in engine air intakes
A79-11367
AIR NAVIGATION
Experimental design study of an airborne interferometer for terrain avoidance
A79-10381
AIR POLLUTION
Pollution sources caused by aviation
A79-10453
Wide range operation of advanced low NOx aircraft gas turbine combustors
[ASME PAPER 78-GT-128] A79-10792
Jet engines test cells: Emissions and control measures, phase 2
[PB-282412/6] N79-10072
Pilot program to develop operating time emission degradation factors for general aviation piston engines
[AD-A058158] N79-11562
AIR TRAFFIC CONTROL
Polish radar developments
A79-10283
Moving target detector data utilization study
A79-10318
A technical review of the radar systems implemented by Eurocontrol
A79-10329
Developments in radar data processing at the London Air Traffic Control Centre
A79-10330
Multisensor utilization investigation --- for automated ATC surveillance
A79-10332
Operational benefits from the Terminal Configured Vehicle --- aircraft equipment for air traffic improvement
A79-10390
Cascade - Queue model of airport users
[SAE PAPER 780518] A79-10394
Commercial STOL - The airplane, the airport
[SAE PAPER 780520] A79-10396
Simulation study of the effect of fuel-conservative approaches on ATC procedures and terminal area capacity
[SAE PAPER 780523] A79-10398
Planning the high elevation/high temperature airport
[SAE PAPER 780532] A79-10402
A Hub operator's view of small aircraft operations
[SAE PAPER 780562] A79-10412
The airport capacity increasing potential of angled runway exit designs
[SAE PAPER 780567] A79-10414
Experimental design for real-time simulations of air traffic control concepts
A79-11481
Track-while-scan algorithm in a clutter environment
A79-11492
'Strategic' time-based ATC --- by long-term flight planning
A79-12473
Air traffic control simulation models, volume 1. A bibliography with abstracts
[NTIS/PS-78/0787/8] N79-10043
Air traffic control simulation models, volume2. A bibliography with abstracts
[NTIS/PS-78/0788/6] N79-10044
AIR TRANSPORTATION
Airport development in Micronesia
[SAE PAPER 780530] A79-10400
Rotorcraft for transport use - European requirements
[SAE PAPER 780535] A79-10404
Directions for developing an air cargo system planning model
[SAE PAPER 780556] A79-10411
Evolution of the turboprop for high speed air transportation
[ASME PAPER 78-GT-201] A79-10821
Energy conservation aircraft design and operational procedures
[ONERA, TP NO. 1978-107] A79-11572
Planning for airport access: An analysis of the San Francisco Bay area. The setting
N79-10944
Clear air turbulence. A bibliography with abstracts
[NTIS/PS-78/0938/7] N79-11632
AIRBORNE EQUIPMENT
Antenna to IMU mounting for SAR motion compensation --- Inertial Measurement Unit
A79-11913
Thermal design of airborne radars - Present and future
A79-11919
E-3A antenna pedestal turntable
A79-11923
The control of tolerances in an array antenna
A79-11934
AIRBORNE SURVEILLANCE RADAR
Multi-filter MTI system
A79-10320
A yaw stabilised S.A.R. aerial
A79-10364
AIRCRAFT ACCIDENT INVESTIGATION
Listing of accidents/incidents by aircraft make and model, US Civil Aviation, 1976
[PB-283000/8] N79-11016
AIRCRAFT ACCIDENTS
Single pilot IFR operating problems determined from accidental data analysis
[NASA-TM-78773] N79-11013
AIRCRAFT COMPARTMENTS
Operational reliability of climate and pressure control equipment for passenger aircraft --- Russian book
A79-10850
The F-16 environmental control system
[ASME PAPER 78-ENAS-11] A79-12560
Three-dimensional radiative heat-transfer problem with shading --- modeling aircraft compartments thermodynamics
A79-12784
The effective acoustic environment of helicopter crewmen
N79-10850
Helicopter cabin noise: Methods of source and path identification and characterization
N79-10856
A practical approach to helicopter internal noise prediction
N79-10857
Helicopter internal noise control: Three case histories
N79-10858
The influence of the noise environment on crew communications
N79-10860
Helicopter internal noise reduction research and development application to the SA 360 and SA 365 Dauphin
N79-10861
AIRCRAFT CONFIGURATIONS
Unsteady subsonic and supersonic potential aerodynamics for complex configurations
A79-12366
Load and dynamic assessment of B-52B-008 carrier aircraft for finned configuration 1 space shuttle solid rocket booster decelerator subsystem drop test vehicle. Volume 3: Pylon load data method 1
[NASA-CR-150835] N79-10050

Load and dynamic assessment of B-52B-008 carrier aircraft for finned configuration 1 space shuttle solid rocket booster deceleration subsystem drop test vehicle. Volume 4: Pylon load data
[NASA-CR-150836] N79-10051

AIRCRAFT CONSTRUCTION MATERIALS

All weather cockpit canopies. I - The F16
A79-10619

Damage tolerance in advanced composite materials
A79-10915

Survey of the application of reinforced composites in European helicopters
A79-10917

Development of a multitubular spar composite main rotor blade
A79-10919

Nondestructive inspection of aircraft structures and materials via acoustic emission
A79-10991

New construction materials for gas turbine engines and technology for processing these materials
A79-12533

AIRCRAFT CONTROL

Flight and propulsion control integration for selected in-flight thrust vectoring modes
[ASME PAPER 78-GT-79] A79-10768

The Wright brothers' flight-control system --- canard configuration
A79-11125

Method of eliminating static and dynamic errors in the reproduction of motion of TV-simulator displays --- for aircraft flight
A79-12153

Desensitizing constant gain feedback linear regulators
A79-12290

Active control --- aircraft systems
A79-12534

Implementation of an optimum profile guidance system on STOLAND
[NASA-CR-152187] N79-10038

Investigations for the calculation of robust control systems --- aircraft control, sensor failure
[ESA-TT-488] N79-11076

AIRCRAFT DESIGN

Relative pavement bearing strength requirements of aircraft
[SAE PAPER 780568] A79-10415

Propulsion cycle and configuration commonality considerations for subsonic V/STOL design
[ASME PAPER 78-GT-88] A79-10764

The Wright brothers' flight-control system --- canard configuration
A79-11125

Method for determining maximum allowable stress for preliminary aircraft wing design
A79-11370

Aircraft air conditioning systems --- Russian book
A79-11442

Aspects of short-takeoff aircraft --- optimization of aircraft, airports and flight regimes
A79-11444

Recent theoretical developments and experimental studies pertinent to vortex flow aerodynamics - With a view towards design
A79-11549

Energy conservation aircraft design and operational procedures
[ONERA, TP NO. 1978-107] A79-11572

Method of calculating potential flows of an incompressible fluid past a wing with a high-lift device
A79-12126

Numerical solution of a linear integral equation of the first kind in the inverse problem of symmetric flow past a wing
A79-12138

Application of gradient methods to the optimal design of components of load-bearing structures --- for aircraft minimum weight design
A79-12144

Quality index for an iterative process of optimizing long-range aircraft parameters
A79-12152

A method of solving multicriterial optimization problems for load-bearing structures --- for large aspect ratio wings
A79-12163

Lift and longitudinal moment of a small-aspect-ratio wing in the proximity of a body of revolution
A79-12168

Calculation of the transient aerodynamic characteristics of a supersonic flight vehicle
A79-12182

Effect of viscosity on nonseparated transonic flow past a profile
A79-12205

Iterative method of aircraft wing strength calculation taking into account the effect of deformations on distribution of aerodynamic forces
A79-12213

Application of an interactive graphics system for the design and optimization of aircraft lifting surfaces
A79-12436

Program REV - A wing structural optimization computer program for preliminary design of fighter aircraft
A79-12460

Advanced environmental cooling concepts for supersonic aircraft
[ASME PAPER 78-ENAS-21] A79-12570

Determination of the geometrical parameters and position of the nose flap at the root section of a swept wing on the basis of wind tunnel data. I
A79-12953

The smooth approximation method and its application to the mathematical description of the aerodynamic characteristics of a wing
A79-12955

Solution of the inverse problem of aerodynamics by a random search technique
A79-12956

Choice of a fuselage for a passenger aircraft
A79-12968

Aerodynamic center of wing-fuselage-nacelle combinations: Effect of rear-fuselage pylon mounted nacelles
[ESDU-78013] N79-10016

Study of aerodynamic technology for VSTOL fighter attack aircraft
[NASA-CR-152129] N79-10027

Study of aerodynamic technology for VSTOL fighter/attack aircraft, phase 1
[NASA-CR-152132] N79-10028

AIRCRAFT DETECTION

Stochastic Response Secondary Surveillance Radar /S.R.S.S.R./
A79-10341

AIRCRAFT ENGINES

The effects of aircraft engine pollutant emission measurement variability on engine certification policy
[ASME PAPER 78-GT-86] A79-10261

The effects of ambient conditions on gas turbine emissions - Generalized correction factors
[ASME PAPER 78-GT-87] A79-10262

The CF6-32 as a derivative engine of the CF6-6
[SAE PAPER 780511] A79-10391

The RB211-535 - New member of the family
[SAE PAPER 780512] A79-10392

Jet curtain flameholder for aircraft afterburners
[ASME PAPER 78-GT-95] A79-10761

Military engine usage monitoring developments in the United Kingdom
[ASME PAPER 78-GT-65] A79-10772

Powerplant integration - The application of current experience to future developments
[ASME PAPER 78-GT-113] A79-10788

Wide range operation of advanced low NOx aircraft gas turbine combustors
[ASME PAPER 78-GT-128] A79-10792

Turbine engine automated trim balancing and vibration diagnostics
[ASME PAPER 78-GT-129] A79-10793

An evaluation technique for determining the cost effectiveness of condition monitoring systems
[ASME PAPER 78-GT-166] A79-10806

Time-phased development methodology - The key for reliable engines in future military aircraft weapons systems
[ASME PAPER 78-GT-167] A79-10807

Making turbofan engines more energy efficient
[ASME PAPER 78-GT-198] A79-10818
20 hp mini-RPV demonstrator engine programs
[ASME PAPER 78-GT-200] A79-10820
Evolution of the turboprop for high speed air transportation
[ASME PAPER 78-GT-201] A79-10821
The application of low cost manufacturing technology to a turbine gas generator
[ASME PAPER 78-GT-202] A79-10822
Near-net-shape engine methods emerge --- aircraft engine parts fabrication technologies
A79-11449
Impact of future fuel properties on aircraft engines and fuel systems
A79-11600
Design of a multivariable controller for a high-order turbofan engine model by Zakian's method of inequalities
A79-12287
Aircraft piston oils: Past - present - future
A79-12377
Turbine engines in light aircraft
A79-12380
Choice of the main parameters in the design of aircraft engines
A79-12528
Current problems in the development and production of small gas turbine engines
A79-12529
Control system requirements for aircraft gas turbine engines
A79-12530
Control systems and problems of their development from the viewpoint of technological and operational requirements --- for aircraft gas turbine engines
A79-12531
Certain problems which had to be solved between the prototype stage and mass production stage in the development of an engine --- turboprop engine tests
A79-12532
The application of foil air bearing turbomachinery in aircraft environmental control systems
[ASME PAPER 78-ENAS-18] A79-12567
Statistical diagnostics of aircraft engines
A79-12950
Aircraft engine icing, technical summary
N79-10011
Evaluation of the cyclic behavior of aircraft turbine disk alloys
[NASA-CR-159409] N79-10058
Principles of jet engine operation
[AD-A056158] N79-11050

AIRCRAFT EQUIPMENT
Operational benefits from the Terminal Configured Vehicle --- aircraft equipment for air traffic improvement
A79-10390
Operational reliability of climate and pressure control equipment for passenger aircraft --- Russian book
A79-10850
The solid state remote power controller - Its status, use and perspective --- for aircraft and spacecraft
A79-10896
Aircraft electric power networks - Structures. I
A79-11369
Aircraft radio equipment --- Russian book
A79-11439
Aircraft air conditioning systems --- Russian book
A79-11442

AIRCRAFT FUEL SYSTEMS
Aircraft fuel pumps - Where we're at /A review of some problems and their current solutions/
[ASME PAPER 78-GT-10] A79-10777

AIRCRAFT FUELS
Simulation study of the effect of fuel-conservative approaches on ATC procedures and terminal area capacity
[SAE PAPER 780523] A79-10398
Advanced turbofan engines for low fuel consumption
[ASME PAPER 78-GT-192] A79-10816
Alternative aircraft fuels
A79-10824
Some aspects of aircraft jet engine fuels
A79-11368
Characteristics and combustion of future hydrocarbon fuels
A79-11599
Alternative aviation turbine fuels
A79-12378

AIRCRAFT GUIDANCE
'Strategic' time-based ATC --- by long-term flight planning
A79-12473
Implementation of an optimum profile guidance system on STOLAND
[NASA-CR-152187] N79-10038
Better performance for aircraft tracking and holding under gust and shearwind influence by use of direct digital control
[ESA-TT-506] N79-11033
A contribution to the increase of aircraft guidance precision under wind disturbance conditions by using direct digital control
[DLR-FB-77-48] N79-11075

AIRCRAFT HAZARDS
Possible near-term solutions to the wind shear hazard
[SAE PAPER 780572] A79-10416
Hazard criticality analysis --- with emphasis on aircraft components
A79-10621

AIRCRAFT INSTRUMENTS
The electronic flight deck
A79-11175
Flying angle of attack
A79-12384
Performance analysis of a particularly simple Kalman filter --- for strapdown inertial navigation system
A79-12610

AIRCRAFT LANDING
Possible near-term solutions to the wind shear hazard
[SAE PAPER 780572] A79-10416
Aircraft radio equipment --- Russian book
A79-11439
A performance measure for evaluating aircraft landing trajectories
A79-11494
Arresting hook installation, land based aircraft, emergency
[SAE ARP 1538] A79-11625
Infrared landing system for a mini remotely-piloted vehicle
A79-12093

AIRCRAFT LIGHTS
Aircraft lighting equipment --- interior and exterior illumination
A79-11366

AIRCRAFT MAINTENANCE
A gas path performance diagnostic system to reduce J75-P-17 engine overhaul costs
[ASME PAPER 78-GT-116] A79-10267
Determination of inspection intervals for aircraft structures with allowance for the two-stage nature of fatigue damage
A79-12135
F-16 Avionics Intermediate Shop self-test
A79-12302
Aircraft RAM (MMH/FH) data comparative analysis
[AD-A056893] N79-10001
Potential applications of acoustic emission technology as a nondestructive evaluation method for naval aviation ground support
[AD-A056650] N79-10439
American Airlines' operational and maintenance experience with aerodynamic seals and oil seals in turbofan engines
N79-11061

AIRCRAFT MANEUVERS
Structural design flight maneuver loads using PDP-10 flight dynamics model
A79-10905
The effect of operations on the ground noise footprints associated with a large multibladed, nonbanging helicopter
N79-10851

AIRCRAFT MODELS
The role of flight dynamic modeling in helicopter certification
[SAE PAPER 780550] A79-10409

Investigation of the electrification of an aircraft model by a humid airstream in a wind tunnel
A79-12162
Vortex system at the nose part of a fuselage model at supercritical angles of attack and different Reynolds numbers
A79-12199

AIRCRAFT NOISE
A method for assessing turbine engine run-up noise impact on airport neighbors
[SAE PAPER 780522] A79-10397
Helicopter noise - State-of-the-art
[AIAA PAPER 77-1337] A79-12395
Internal mixer investigation for JT8D engine jet noise reduction. Volume 1: Results
[AD-A057309] N79-10059
Internal mixer investigation for JT8D engine jet noise reduction. Volume 2: Appendices A, B, C, and D
[AD-A057310/5] N79-10065
LAX airport/land use planning study. Phase 1 report: Short term noise abatement
[PB-281622/1] N79-10071
Helicopter Acoustics, part 2 --- conferences
[NASA-CP-2052-PT-2] N79-10843
Subjective evaluation of helicopter blade slap noise
N79-10844
Rating helicopter noise
N79-10845
The effective acoustic environment of helicopter crewmen
N79-10850
The effect of operations on the ground noise footprints associated with a large multibladed, nonbanging helicopter
N79-10851
A static acoustic signature system for the analysis of dynamic flight information
N79-10852
An active noise reduction system for aircrew helmets
N79-10853
Design of helicopter rotors to noise constraints
N79-10854
The cost of applying current helicopter external noise reduction methods while maintaining realistic vehicle performance
N79-10855
Helicopter cabin noise: Methods of source and path identification and characterization
N79-10856
A practical approach to helicopter internal noise prediction
N79-10857
Helicopter internal noise control: Three case histories
N79-10858
An analytical method for designing low noise helicopter transmissions
N79-10859
The influence of the noise environment on crew communications
N79-10860
Helicopter internal noise reduction research and development application to the SA 360 and SA 365 Dauphin
N79-10861
The status of rotor noise technology: One man's opinion
N79-10862
Trends in Langley helicopter noise research
N79-10863
Aeroacoustic research: An Army perspective
N79-10864

AIRCRAFT PARTS
Pivoting output unit control systems activated by jacks --- for controlling aircraft flaps
[NASA-TM-75581] N79-10066

AIRCRAFT PRODUCTION
Certain problems which had to be solved between the prototype stage and mass production stage in the development of an engine --- turboprop engine tests
A79-12532

AIRCRAFT RELIABILITY
The effects of aircraft engine pollutant emission measurement variability on engine certification policy
[ASME PAPER 78-GT-86] A79-10261
Certification-compliance demonstration by flight or simulation
[SAE PAPER 780549] A79-10408
The effects of latest military criteria on the structural weight of the Hughes advanced attack helicopter - YAH-64
A79-10904
Damage-tolerant design of the YUH-61A main rotor system
A79-10911
Improved ballistic damage tolerant design through laminated metal construction
A79-10912
The survivability of helicopters to rotor blade ballistic damage
A79-10913
Damage tolerant design of the YAH-64 main rotor blade
A79-10914
Development of a multitubular spar composite main rotor blade
A79-10919
Determination of inspection intervals for aircraft structures with allowance for the two-stage nature of fatigue damage
A79-12135
Processing a random loading process by computer to obtain life information --- in-flight critical stress measurements in aircraft wing structures
A79-12535

AIRCRAFT STABILITY
Method of determining the stability and controllability characteristics of an aircraft from the transient processes
A79-12176
Synthesis and analysis of systems for active control and suppression of flutter of flying craft
A79-12755
Utilization of the wing-body aerodynamic analysis program
[NASA-TM-72856] N79-10020
Flight-determined stability and control derivatives for the F-111 Tact research aircraft
[NASA-TP-1350] N79-10068

AIRCRAFT STRUCTURES
Conference on Helicopter Structures Technology, Moffett Field, Calif., November 16-18, 1977, Proceedings
A79-10903
Impact of operational issues on design of advanced composite structures for Army helicopters
A79-10907
A glance at Soviet helicopter design philosophy
A79-10910
Ultrasonic welding /solid state bonding/ of aircraft structure - Fact or fancy
A79-10921
Nondestructive inspection of aircraft structures and materials via acoustic emission
A79-10991
Cyclic linkage of finite elements with application --- to aircraft structural analysis
[IAF PAPER 78-213] A79-11294
Thermal stability of ribbed sheet systems
A79-12137
Decreasing stress concentrations in structures made of high-strength materials
A79-12145
Time-frequency method of solving large problems in the dynamics of elastic structures with local nonlinearities --- for aircraft structures
A79-12155
Approximate solution of some boundary value problems on aircraft structural integrity
A79-12234
Tow bar for aircraft
[NASA-CASE-FRC-11022-1] N79-10069

AIRCRAFT WAKES
Approximate calculation of the velocity field and the motion of vortices in the wake of a low-flying biplane
A79-12198

AIRFIELD SURFACE MOVEMENTS
Issues in the design and analysis of airport ground transport systems
[SAE PAPER 780519] A79-10395

AIRFOIL PROFILES
Measurement of flow fields around an airfoil section with separation
A79-10868
Aerodynamic response for the airfoil experiencing sudden change in angle of attack
A79-10869
Method of calculating potential flows of an incompressible fluid past a wing with a high-lift device
A79-12126
Inverse mixed problem for a profile with a prescribed velocity distribution on one of its sides and a known thickness distribution
A79-12970
AIRFOILS
Application of nonseries airfoil design technology to highly loaded turbine exit guide vanes
[ASME PAPER 78-GT-108] A79-10787
Flying hot-wire study of two-dimensional turbulent separation on an NACA 4412 airfoil at maximum lift
N79-10019
Wind tunnel tests of the GA(W)-2 airfoil with 20% aileron, 25% slotted flap, 30% Fowler flap and 10% slot-lip spoiler
[NASA-CR-145139] N79-10021
Velocity measurement about a NACA 0012 airfoil with a laser velometer
[AD-A056447] N79-10029
Direct numerical solution of the transonic perturbation integral equation for lifting and nonlifting airfoils
[NASA-TM-78518] N79-10045
AIRFRAMES
Application of gradient methods to the optimal design of components of load-bearing structures --- for aircraft minimum weight design
A79-12144
Engine/airframe/drive train dynamic interface documentation
[AD-A056956] N79-10064
Synthesis of aircraft structures using integrated design and analysis methods
N79-10454
Cast Aluminum Structures Technology, phase 3 (CAST)
[AD-A057422] N79-11188
Probability that the propagation of an undetected fatigue crack will not cause a structural failure
[AD-A057335] N79-11439
AIRLINE OPERATIONS
Planning the passenger terminal
[SAE PAPER 780517] A79-10393
Overview of the small package air carrier industry - A study of the operations in Federal Express
[SAE PAPER 780540] A79-10406
The need and impact of long-term advances in aircraft technology - The airlines' point of view
[SAE PAPER 780554] A79-10410
Directions for developing an air cargo system planning model
[SAE PAPER 780556] A79-10411
A Hub operator's view of small aircraft operations
[SAE PAPER 780562] A79-10412
Economy in flight operations
A79-12383
American Airlines' operational and maintenance experience with aerodynamic seals and oil seals in turbofan engines
N79-11061
AIRPORT PLANNING
Planning the passenger terminal
[SAE PAPER 780517] A79-10393
Cascade - Queue model of airport users
[SAE PAPER 780518] A79-10394
Issues in the design and analysis of airport ground transport systems
[SAE PAPER 780519] A79-10395
Commercial STOL - The airplane, the airport
[SAE PAPER 780520] A79-10396
A method for assessing turbine engine run-up noise impact on airport neighbors
[SAE PAPER 780522] A79-10397
Simulation study of the effect of fuel-conservative approaches on ATC procedures and terminal area capacity
[SAE PAPER 780523] A79-10398
Airport development in Micronesia
[SAE PAPER 780530] A79-10400
Planning, design and construction of the Queen Alia International Airport
[SAE PAPER 780531] A79-10401
Planning the high elevation/high temperature airport
[SAE PAPER 780532] A79-10402
A Hub operator's view of small aircraft operations
[SAE PAPER 780562] A79-10412
The airport capacity increasing potential of angled runway exit designs
[SAE PAPER 780567] A79-10414
Possible near-term solutions to the wind shear hazard
[SAE PAPER 780572] A79-10416
Pollution sources caused by aviation
A79-10453
Aspects of short-takeoff aircraft --- optimization of aircraft, airports and flight regimes
A79-11444
LAX airport/land use planning study. Phase 1 report: Short term noise abatement
[PB-281622/1] N79-10071
Planning for airport access: An analysis of the San Francisco Bay area
[NASA-CP-2044] N79-10942
Planning for airport access: An analysis of the San Francisco Bay area. Introduction and conclusions
N79-10943
Planning for airport access: An analysis of the San Francisco Bay area. The setting
N79-10944
Components of the airport access system
N79-10945
Planning for airport access: An analysis of the San Francisco Bay area. Existing studies
N79-10946
Planning for airport access: An analysis of the San Francisco Bay area. Technological options
N79-10947
Planning for airport access: An analysis of the San Francisco Bay area. Three subsystem designs
N79-10948
AIRPORTS
Community noise exposure resulting from aircraft operations. Volume 6: Acoustic data on Navy aircraft
[AD-A056217] N79-11566
ALGORITHMS
Cascade - Queue model of airport users
[SAE PAPER 780518] A79-10394
Track-while-scan algorithm in a clutter environment
A79-11492
ALL-WEATHER AIR NAVIGATION
All weather cockpit canopies. I - The F16
A79-10619
All weather cockpit canopies. II - 'The Challenger'
A79-10620
ALUMINUM ALLOYS
Residual strength of a cracked lug --- stress corrosion cracking of aluminum alloy lugs
[ARL-STRUC-NOTE-442] N79-10445
Cast Aluminum Structures Technology, phase 3 (CAST)
[AD-A057422] N79-11188
Influence of thermomechanical treatment on microstructure and mechanical properties of high strength aluminum alloys
[DLR-FB-77-50] N79-11203
ANGLE OF ATTACK
Aerodynamic response for the airfoil experiencing sudden change in angle of attack
A79-10869
Vortex system at the nose part of a fuselage model at supercritical angles of attack and different Reynolds numbers
A79-12199
Flying angle of attack
A79-12384
The influence of aerodynamic interference on high angle of attack wind tunnel testing
[AD-A056045] N79-11002
ANNULAR FLOW
Asymmetric swirling flows in turbomachine annuli
[ASME PAPER 78-GT-109] A79-10260
ANNULAR NOZZLES
Design and test of an annular sting support concept for aftbody nozzle wind tunnel testing
[AD-A056945] N79-10063

ANTENNA ARRAYS
The control of tolerances in an array antenna
A79-11934
ANTENNA DESIGN
Some novel techniques for avoiding antenna obscurations and E.M.C. effects
A79-10363
Radio navigation and antenna technology, an area of study of many years' standing at the Institute for Communications Engineering of Braunschweig Technical University
A79-12526
ANTENNA RADIATION PATTERNS
Some novel techniques, for avoiding antenna obscurations and E.M.C. effects
A79-10363
APPROACH CONTROL
'Strategic' time-based ATC --- by long-term flight planning
A79-12473
Flight experience with advanced controls and displays during piloted curved decelerating approaches in a powered-lift STOL aircraft
[NASA-TM-78527] N79-10054
APPROACH INDICATORS
Flight experience with advanced controls and displays during piloted curved decelerating approaches in a powered-lift STOL aircraft
[NASA-TM-78527] N79-10054
Description and preliminary studies of a computer drawn instrument landing approach display
[NASA-TM-78771] N79-11039
APPROXIMATION
The smooth approximation method and its application to the mathematical description of the aerodynamic characteristics of a wing
A79-12955
ARRESTING GEAR
Arresting hook installation, land based aircraft, emergency
[SAE ARP 1538] A79-11625
ARROW WINGS
Numerical solution of a linear integral equation of the first kind in the inverse problem of symmetric flow past a wing
A79-12138
Determination of the geometrical parameters and position of the nose flap at the root section of a swept wing on the basis of wind tunnel data. I
A79-12953
Overall aerodynamic characteristics of conical and delta wings at supersonic speeds
A79-12966
ASPECT RATIO
Influence of geometric effects on the aspect ratio optimization of axial turbine bladings
[ASME PAPER 78-GT-173] A79-10809
ASYMMETRY
Asymmetric swirling flows in turbomachine annuli
[ASME PAPER 78-GT-109] A79-10260
ASYMPTOTIC METHODS
Contribution to the asymptotic theory of flows at the trailing edge of a slender wing
A79-12127
ATTACK AIRCRAFT
The effects of latest military criteria on the structural weight of the Hughes advanced attack helicopter - YAH-64
A79-10904
Study of aerodynamic technology for VSTOL fighter/attack aircraft: Vertical attitude concept
[NASA-CR-152131] N79-10026
Study of aerodynamic technology for VSTOL fighter attack aircraft
[NASA-CR-152129] N79-10027
Study of aerodynamic technology for VSTOL fighter/attack aircraft, phase 1
[NASA-CR-152132] N79-10028
AUTOMATIC CONTROL
Multisensor utilization investigation --- for automated ATC surveillance
A79-10332
AUTOMATIC LANDING CONTROL
Infrared landing system for a mini remotely-piloted vehicle
A79-12093
AUTOMATIC TEST EQUIPMENT
Turbine engine automated trim balancing and vibration diagnostics
[ASME PAPER 78-GT-129] A79-10793
F-16 Avionics Intermediate Shop self-test
A79-12302
Support systems for advanced military electronics --- ATE design trends
A79-12305
Advanced technology impact upon ATE self test --- by use of microprocessors and LSI
A79-12306
Testing of avionics display systems
A79-12309
Management of test program development for S-3A --- avionics, maintainability and automatic test equipment
A79-12319
Commercial test software development practices for military applications --- for avionics support equipment
A79-12320
F-16 LRU test programs - A systems approach --- Line Replaceable Units
A79-12321
AVIONICS
The electronic flight deck
A79-11175
F-16 Avionics Intermediate Shop self-test
A79-12302
Support systems for advanced military electronics --- ATE design trends
A79-12305
Testing of avionics display systems
A79-12309
Management of test program development for S-3A --- avionics, maintainability and automatic test equipment
A79-12319
Commercial test software development practices for military applications --- for avionics support equipment
A79-12320
F-16 LRU test programs - A systems approach --- Line Replaceable Units
A79-12321
Implementation of an optimum profile guidance system on STOLAND
[NASA-CR-152187] N79-10038
Spare memory and timing parameters in avionics computer system requirements
[AD-A056521] N79-10055
Integrated Avionics Control System (IACS)
[AD-A056476] N79-10056
AXIAL FLOW
A design point correlation for losses due to part-span dampers on transonic rotors
[ASME PAPER 78-GT-153] A79-10802
Aerodynamic performance of a 1.35-pressure-ratio axial-flow fan stage
[NASA-TP-1299] N79-10022
Axial flow in trailing line vortices
[AD-A057075] N79-10034
AXIAL FLOW TURBINES
Influence of geometric effects on the aspect ratio optimization of axial turbine bladings
[ASME PAPER 78-GT-173] A79-10809

B

B-52 AIRCRAFT
Load and dynamic assessment of B-52B-008 carrier aircraft for finned configuration 1 space shuttle solid rocket booster decelerator subsystem drop test vehicle. Volume 1: Summary
[NASA-CR-150833] N79-10048
Load and dynamic assessment of B-52B-008 carrier aircraft for finned configuration 1 space shuttle solid rocket booster decelerator subsystem drop test vehicle. Volume 2: Airplane flutter and load analysis results
[NASA-CR-150834] N79-10049
Giant image 2 reliability and maintainability B-52D
[AD-A057938] N79-11291
BARRIERS
Experimental and theoretical study of the influence of various parameters on an icing section
N79-10012

BEAMS (SUPPORTS)
Tow bar for aircraft
[NASA-CASE-FRC-11022-1] N79-10069
BEARINGLESS ROTORS
Derivation of control loads for bearingless rotor systems --- in helicopter design
A79-10906
Boeing Vertol bearingless main rotor structural design approach using advanced composites
A79-10920
BEARINGS
E-3A antenna pedestal turntable
A79-11923
Oil sealing of aero engine bearing compartments
N79-11062
Helicopter bearing failure detection utilizing shock pulse techniques
[AD-A057308] N79-11410
BENDING THEORY
Derivation of control loads for bearingless rotor systems --- in helicopter design
A79-10906
BIBLIOGRAPHIES
Air traffic control simulation models, volume 1. A bibliography with abstracts
[NTIS/PS-78/0787/8] N79-10043
Air traffic control simulation models, volume2. A bibliography with abstracts
[NTIS/PS-78/0788/6] N79-10044
Airfield pavement evaluation, volume 4. A bibliography with abstracts
[NTIS/PS-78/0685/4] N79-10070
Clear air turbulence. A bibliography with abstracts
[NTIS/PS-78/0938/7] N79-11632
BIOACOUSTICS
An active noise reduction system for aircrew helmets
N79-10853
BIPLANES
Approximate calculation of the velocity field and the motion of vortices in the wake of a low-flying biplane
A79-12198
BLADE TIPS
Turbine blade tip clearance measurement utilizing borescope photography
[ASME PAPER 78-GT-164] A79-10805
BO-105 HELICOPTER
Tests under snow and icing conditions with the BO 105 engine installation
N79-10014
BODIES OF REVOLUTION
Lift and longitudinal moment of a small-aspect-ratio wing in the proximity of a body of revolution
A79-12168
BODY-WING CONFIGURATIONS
Aerodynamic center of wing-fuselage-nacelle combinations: Effect of rear-fuselage pylon mounted nacelles
[ESDU-78013] N79-10016
BOEING AIRCRAFT
Boeing Vertol bearingless main rotor structural design approach using advanced composites
A79-10920
BOOMS (EQUIPMENT)
Highly survivable truss type tail boom
[AD-A056430] N79-10052
BOUNDARY LAYER EQUATIONS
An axial compressor end-wall boundary layer calculation method
[ASME PAPER 78-GT-81] A79-10767
BOUNDARY LAYER FLOW
A general correction method of the interference in 2-dimensional wind tunnels with ventilated walls
A79-10867
Contribution to the asymptotic theory of flows at the trailing edge of a slender wing
A79-12127
BOUNDARY LAYER SEPARATION
Measurement of flow fields around an airfoil section with separation
A79-10868
BOUNDARY VALUE PROBLEMS
Approximate solution of some boundary value problems on aircraft structural integrity
A79-12234
BRAYTON CYCLE
Analysis, design, fabrication and testing of the Mini-Brayton rotating unit (MINI-BRU). Volume 2: Figures and drawings
[NASA-CR-159441-VOL-2] N79-11409

C

CANADAIR AIRCRAFT
All weather cockpit canopies. II - 'The Challenger'
A79-10620
CANARD CONFIGURATIONS
The Wright brothers' flight-control system --- canard configuration
A79-11125
CANOPIES
All weather cockpit canopies. I - The F16
A79-10619
All weather cockpit canopies. II - 'The Challenger'
A79-10620
Detached flow about an opening canopy
A79-11006
Parachute canopy opening dynamics
A79-11008
CANTILEVER MEMBERS
Numerical-analytical solution of the problem of the constrained torsion of a cantilever wing
A79-12195
CARGO AIRCRAFT
Overview of the small package air carrier industry - A study of the operations in Federal Express
[SAE PAPER 780540] A79-10406
CASCADE CONTROL
Cascade - Queue model of airport users
[SAE PAPER 780518] A79-10394
CASCADE FLOW
Aerodynamic force and moment on oscillating airfoils in cascade
[ASME PAPER 78-GT-181] A79-10812
Numerical solution of the direct problem of ideal gas flow in three-dimensional turbine cascades
A79-12194
Supersonic unstalled flutter
A79-12599
Supersonic unstalled flutter --- aerodynamic loading of thin airfoils induced by cascade motion
[NASA-TM-79001] N79-11000
CASCADE WIND TUNNELS
On-line computer for transient turbine cascade instrumentation
A79-11488
CASTINGS
Cast Aluminum Structures Technology, phase 3 (CAST)
[AD-A057422] N79-11188
CENTRIFUGAL COMPRESSORS
Small perturbation analysis of nonuniform rotating disturbances in a vaneless diffuser
[ASME PAPER 78-GT-154] A79-10270
Analysis of the flow field in a radial compressor
[ASME PAPER 78-GT-7] A79-10776
CERAMICS
Demonstration of ceramic design methodology for a ceramic combustor liner
[ASME PAPER 78-GT-137] A79-10794
The utilization of data relating to fin geometry and manufacturing processes of ceramic matrix systems to the design of ceramic heat exchangers
A79-12824
CERTIFICATION
The effects of aircraft engine pollutant emission measurement variability on engine certification policy
[ASME PAPER 78-GT-86] A79-10261
Certification-compliance demonstration by flight or simulation
[SAE PAPER 780549] A79-10408
The role of flight dynamic modeling in helicopter certification
[SAE PAPER 780550] A79-10409
CH-54 HELICOPTER
Composite rotor hub. I, II --- fatigue and load tests for CH-54B helicopter design
A79-10916
CHANNEL FLOW
An experimental study of three-dimensional turbulent boundary layer and turbulence characteristics inside a turbomachinery rotor passage
[ASME PAPER 78-GT-114] A79-10266

CHANNELS (DATA TRANSMISSION)
Enhancements of radar data-handling networks
A79-10299
CHEMICAL COMPOSITION
Alternative aviation turbine fuels
A79-12378
CIVIL AVIATION
Developments in radar data processing at the London Air Traffic Control Centre
A79-10330
Pollution sources caused by aviation
A79-10453
Listing of accidents/incidents by aircraft make and model, US Civil Aviation, 1976
[PB-283000/8] N79-11016
CLEAR AIR TURBULENCE
Clear air turbulence. A bibliography with abstracts
[NTIS/PS-78/0938/7] N79-11632
CLEARANCES
Turbine blade tip clearance measurement utilizing borescope photography
[ASME PAPER 78-GT-164] A79-10805
CLUTTER
Track-while-scan algorithm in a clutter environment
A79-11492
COAL UTILIZATION
Alternative aircraft fuels
A79-10824
COATINGS
Seal Technology in Gas Turbine Engines
[AGARD-CP-237] N79-11056
Use of coatings in turbomachinery gas path seals
N79-11058
COCKPITS
All weather cockpit canopies. I - The F16
A79-10619
All weather cockpit canopies. II - 'The Challenger'
A79-10620
The electronic flight deck
A79-11175
F-18 air conditioning system
[ASME PAPER 78-ENAS-23] A79-12572
COLLISION AVOIDANCE
Experimental design study of an airborne interferometer for terrain avoidance
A79-10381
COLLISIONS
Listing of accidents/incidents by aircraft make and model, US Civil Aviation, 1976
[PB-283000/8] N79-11016
COMBUSTION CHAMBERS
Wide range operation of advanced low NOx aircraft gas turbine combustors
[ASME PAPER 78-GT-128] A79-10792
Demonstration of ceramic design methodology for a ceramic combustor liner
[ASME PAPER 78-GT-137] A79-10794
Computations of three-dimensional gas-turbine combustion chamber flows
[ASME PAPER 78-GT-142] A79-10797
Weak extinction limits of turbulent flowing mixtures --- flame stabilization
[ASME PAPER 78-GT-144] A79-10798
Development of a compact gas turbine combuster to give extended life and acceptable exhaust emissions
[ASME PAPER 78-GT-146] A79-10799
An experimental study of a catalytic combustor for an expendable turbojet engine
[AD-A056512] N79-11048
COMFORT
Passenger ride quality in transport aircraft
A79-12396
COMMERCIAL AIRCRAFT
The RB211-535 - New member of the family
[SAE PAPER 780512] A79-10392
Commercial STOL - The airplane, the airport
[SAE PAPER 780520] A79-10396
Advanced turbofan engines for low fuel consumption
[ASME PAPER 78-GT-192] A79-10816
American Airlines' operational and maintenance experience with aerodynamic seals and oil seals in turbofan engines
N79-11061
COMMONALITY (EQUIPMENT)
Propulsion cycle and configuration commonality considerations for subsonic V/STOL design
[ASME PAPER 78-GT-88] A79-10764
COMMUNICATION EQUIPMENT
Aircraft radio equipment --- Russian book
A79-11439
COMPLEX SYSTEMS
Time-frequency method of solving large problems in the dynamics of elastic structures with local nonlinearities --- for aircraft structures
A79-12155
COMPONENT RELIABILITY
American Airlines' operational and maintenance experience with aerodynamic seals and oil seals in turbofan engines
N79-11061
Determining and improving labyrinth seal performance in current and advanced high performance gas turbines
N79-11068
COMPOSITE MATERIALS
Survey of the application of reinforced composites in European helicopters
A79-10917
Boeing Vertol bearingless main rotor structural design approach using advanced composites
A79-10920
Synthesis of aircraft structures using integrated design and analysis methods
N79-10454
COMPOSITE STRUCTURES
Impact of operational issues on design of advanced composite structures for Army helicopters
A79-10907
Composite rotor hub. I, II --- fatigue and load tests for CH-54B helicopter design
A79-10916
Development of a multitubular spar composite main rotor blade
A79-10919
COMPRESSOR BLADES
Seal Technology in Gas Turbine Engines
[AGARD-CP-237] N79-11056
Factors associated with rub tolerance of compressor tip seals --- self sustained combustion of titanium
N79-11069
COMPRESSORS
A discussion of turbine and compressor sealing devices and systems
A79-12373
Transonic 3-D flow analysis of compressor cascade with splinter vanes
[AD-A057504] N79-11004
COMPUTER DESIGN
Description and preliminary studies of a computer drawn instrument landing approach display
[NASA-TM-78771] N79-11039
COMPUTER GRAPHICS
Cyclic linkage of finite elements with application --- to aircraft structural analysis
[IAF PAPER 78-213] A79-11294
Present and potential capabilities of three-dimensional displays using sequential excitation of fluorescence
A79-12033
Application of an interactive graphics system for the design and optimization of aircraft lifting surfaces
A79-12436
Gas turbine analysis and design using interactive computer graphics
A79-12459
COMPUTER NETWORKS
Enhancements of radar data-handling networks
A79-10299
COMPUTER PROGRAMS
Commercial test software development practices for military applications --- for avionics support equipment
A79-12320
Program REV - A wing structural optimization computer program for preliminary design of fighter aircraft
A79-12460
Utilization of the wing-body aerodynamic analysis program
[NASA-TM-72856] N79-10020

A computer program for the calculation of the flow field in supersonic mixed-compression inlets at angle of attack wing the three-dimensional method of characteristics with discrete shock wave fitting
[NASA-TM-78947] N79-10023
Improved transonic nose drag estimates for the NSWC missile aerodynamic computer program
[AD-A056795] N79-10030
Implementation of an optimum profile guidance system on STOLAND
[NASA-CR-152187] N79-10038
Improved sonic-box computer program for calculating transonic aerodynamic loads on oscillating wings with thickness
[NASA-CR-158906] N79-10998
SPINEQ: A program for determining aircraft equilibrium spin characteristics including stability
[NASA-TM-78759] N79-11074
Investigations for the calculation of robust control systems --- aircraft control, sensor failure
[ESA-TT-488] N79-11076

COMPUTER SYSTEMS PROGRAMS
Spare memory and timing parameters in avionics computer system requirements
[AD-A056521] N79-10055

COMPUTER TECHNIQUES
On-line computer for transient turbine cascade instrumentation
A79-11488
Processing a random loading process by computer to obtain life information --- in-flight critical stress measurements in aircraft wing structures
A79-12535

COMPUTERIZED DESIGN
The use of 3-D finite element analysis in the design of helicopter mechanical components
A79-10909
Application of optimization techniques in engineering design --- computerized structural design
A79-12404
Application of an interactive graphics system for the design and optimization of aircraft lifting surfaces
A79-12436
Gas turbine analysis and design using interactive computer graphics
A79-12459
Program REV - A wing structural optimization computer program for preliminary design of fighter aircraft
A79-12460
Choice of the main parameters in the design of aircraft engines
A79-12528
Solution of the inverse problem of aerodynamics by a random search technique
A79-12956
Synthesis of aircraft structures using integrated design and analysis methods
N79-10454

COMPUTERIZED SIMULATION
The role of flight dynamic modeling in helicopter certification
[SAE PAPER 780550] A79-10409
Simulation of helicopter powerplant performance
[ASME PAPER 78-GT-51] A79-10774
Structural design flight maneuver loads using PDP-10 flight dynamics model
A79-10905
The survivability of helicopters to rotor blade ballistic damage
A79-10913
Method of determining the stability and controllability characteristics of an aircraft from the transient processes
A79-12176
Air traffic control simulation models, volume 1. A bibliography with abstracts
[NTIS/PS-78/0787/8] N79-10043
Air traffic control simulation models, volume2. A bibliography with abstracts
[NTIS/PS-78/0788/6] N79-10044
Numerical aerodynamic simulation facility --- for flows about three-dimensional configurations
N79-10450
Finite element analysis of helicopter structures
N79-10453

CONCORDE AIRCRAFT
Powerplant integration - The application of current experience to future developments
[ASME PAPER 78-GT-113] A79-10788

CONDUCTING FLUIDS
Theory of lifting surface in fluids of high electrical conductivity
A79-12394

CONFERENCES
Conference on Helicopter Structures Technology, Moffett Field, Calif., November 16-18, 1977, Proceedings
A79-10903
National Conference on Energy Conservation in General Aviation, 1st, Kalamazoo, Mich., October 10, 11, 1977, Proceedings
A79-12376
Icing testing for aircraft engines
[AGARD-CP-236] N79-10002
Helicopter Acoustics, part 2 --- conferences
[NASA-CP-2052-PT-2] N79-10843

CONICAL BODIES
Calculation of flow past conical bodies with supersonic leading edges
A79-12227
Overall aerodynamic characteristics of conical and delta wings at supersonic speeds
A79-12966

CONICAL NOZZLES
Investigation of an ejector thrust-augmentor with a perforated nozzle for the ejected gas
A79-12196

CONTAMINANTS
The effects of aircraft engine pollutant emission measurement variability on engine certification policy
[ASME PAPER 78-GT-86] A79-10261

CONTROL BOARDS
Integrated Avionics Control System (IACS)
[AD-A056476] N79-10056

CONTROL CONFIGURED VEHICLES
Method of determining the stability and controllability characteristics of an aircraft from the transient processes
A79-12176
Active control --- aircraft systems
A79-12534
Investigations for the calculation of robust control systems --- aircraft control, sensor failure
[ESA-TT-488] N79-11076

CONTROL EQUIPMENT
The solid state remote power controller - Its status, use and perspective --- for aircraft and spacecraft
A79-10896
Control system requirements for aircraft gas turbine engines
A79-12530
Control systems and problems of their development from the viewpoint of technological and operational requirements --- for aircraft gas turbine engines
A79-12531
Investigations for the calculation of robust control systems --- aircraft control, sensor failure
[ESA-TT-488] N79-11076

CONTROL SIMULATION
Simulation study of the effect of fuel-conservative approaches on ATC procedures and terminal area capacity
[SAE PAPER 780523] A79-10398
Structural design flight maneuver loads using PDP-10 flight dynamics model
A79-10905
Experimental design for real-time simulations of air traffic control concepts
A79-11481

CONTROL STABILITY
Active control --- aircraft systems
A79-12534

CONTROL SURFACES
Control and stabilization in aerodynamics --- Russian book
A79-11392

Synthesis and analysis of systems for active control and suppression of flutter of flying craft
A79-12755

CONTROL THEORY
Pivoting output unit control systems activated by jacks --- for controlling aircraft flaps
[NASA-TM-75581] N79-10066

CONTROLLERS
Design of a multivariable controller for a high-order turbofan engine model by Zakian's method of inequalities
A79-12287

COOLING
Thermal design of airborne radars - Present and future
A79-11919

COOLING FINS
The utilization of data relating to fin geometry and manufacturing processes of ceramic matrix systems to the design of ceramic heat exchangers
A79-12824

COOLING SYSTEMS
Performance and design of transpiration-cooled turbine blading
[ASME PAPER 78-GT-122] A79-10790
Turbine-driven refrigeration units in gas turbine engine cooling systems --- Russian book
A79-11441
The application of foil air bearing turbomachinery in aircraft environmental control systems
[ASME PAPER 78-ENAS-18] A79-12567
Advanced environmental cooling concepts for supersonic aircraft
[ASME PAPER 78-ENAS-21] A79-12570
F-18 air conditioning system
[ASME PAPER 78-ENAS-23] A79-12572
Gas turbine disc sealing system design
N79-11072

CORE FLOW
Aerodynamic and acoustic effects of eliminating core swirl from a full scale 1.6 stage pressure ratio fan (QF-5A)
[NASA-TM-78991] N79-11001

COST EFFECTIVENESS
An evaluation technique for determining the cost effectiveness of condition monitoring systems
[ASME PAPER 78-GT-166] A79-10806
Evolution of the turboprop for high speed air transportation
[ASME PAPER 78-GT-201] A79-10821
A glance at Soviet helicopter design philosophy
A79-10910
Advanced technology impact upon ATE self test --- by use of microprocessors and LSI
A79-12306

COST REDUCTION
A gas path performance diagnostic system to reduce J75-P-17 engine overhaul costs
[ASME PAPER 78-GT-116] A79-10267
Economy in flight operations
A79-12383

COWLINGS
Experimental and theoretical study of the influence of various parameters on an icing section
N79-10012

CRACK PROPAGATION
Probability that the propagation of an undetected fatigue crack will not cause a structural failure
[AD-A057335] N79-11439

CRACKS
Residual strength of a cracked lug --- stress corrosion cracking of aluminum alloy lugs
[ARL-STRUC-NOTE-442] N79-10445

CREEP ANALYSIS
Summation of defects in the case of nonisothermal programmed loads --- for supersonic transport propulsion system components
A79-12164
Thermal-structural mission analyses of air-cooled gas turbine blades
[NASA-TM-78963] N79-11433

CRITICAL LOADING
Method for determining maximum allowable stress for preliminary aircraft wing design
A79-11370

CUMULATIVE DAMAGE
Summation of defects in the case of nonisothermal programmed loads --- for supersonic transport propulsion system components
A79-12164

CUSHIONCRAFT GROUND EFFECT MACHINE
Skirt components of the aerodynamic characteristics of an air-cushion vehicle using the oncoming flow to generate lift
A79-12949

D

DAMPING
A design point correlation for losses due to part-span dampers on transonic rotors
[ASME PAPER 78-GT-153] A79-10802

DATA ACQUISITION
An instrumentation modeling technique used in the identification of aerodynamic coefficients from flight test data
[IAF PAPER 78-99] A79-11239
On-line computer for transient turbine cascade instrumentation
A79-11488

DATA PROCESSING
Enhancements of radar data-handling networks
A79-10299
Developments in radar data processing at the London Air Traffic Control Centre
A79-10330
Aircraft RAM (MMH/FH) data comparative analysis
[AD-A056893] N79-10001
Single pilot IFR operating problems determined from accidental data analysis
[NASA-TM-78773] N79-11013

DATA SYSTEMS
Federal Energy Data System (FEDS) technical documentation
[PB-281815/1] N79-11542

DC 10 AIRCRAFT
Numerical calculation of transonic flow past a swept wing by a finite volume method
[CONF-771204-3] N79-10036

DECELERATION
Load and dynamic assessment of B-52B-008 carrier aircraft for finned configuration 1 space shuttle solid rocket booster decelerator subsystem drop test vehicle. Volume 2: Airplane flutter and load analysis results
[NASA-CR-150834] N79-10049

DECISION THEORY
Hazard criticality analysis --- with emphasis on aircraft components
A79-10621

DEGRADATION
Pilot program to develop operating time emission degradation factors for general aviation piston engines
[AD-A058158] N79-11562

DEICERS
Vibratory ice protection for helicopter rotor blades
[AD-A057329] N79-11038

DEICING
Icing tests of a small gas turbine with inertial separation anti-icing system
N79-10015

DELTA WINGS
Regimes of supersonic flow past thin wings
A79-12188
Longitudinal distribution of hydrodynamic load on a gliding flat-bottomed plate with keel
A79-12200
Calculation of flow past conical bodies with supersonic leading edges
A79-12227
Overall aerodynamic characteristics of conical and delta wings at supersonic speeds
A79-12966
A numerical solution of supersonic and hypersonic viscous flow fields around thin planar delta wings
N79-10018
A numerical solution of supersonic and hypersonic viscous flow fields around thin planar delta wings
[AD-A056513] N79-11003

DESIGN ANALYSIS
Issues in the design and analysis of airport ground transport systems
[SAE PAPER 780519] A79-10395

Energy conservation aircraft design and operational procedures
[ONERA, TP NO. 1978-107] A79-11572
Gas turbine analysis and design using interactive computer graphics
A79-12459
Aerodynamic design and analysis of propellers for mini-remotely piloted air vehicles. Volume 2: Ducted propellers
[AD-A056948] N79-10062

DETECTORS
The dynamic ice detector for helicopters
N79-10010

DEVELOPING NATIONS
Airport development in Micronesia
[SAE PAPER 780530] A79-10400

DIAGNOSIS
A gas path performance diagnostic system to reduce J75-P-17 engine overhaul costs
[ASME PAPER 78-GT-116] A79-10267

DIFFUSION WELDING
Superalloy knife edge seal repair
[AD-A057269] N79-11055

DIGITAL FILTERS
Multi-filter MTI system
A79-10320

DIGITAL INTEGRATORS
Implementation of an optimum profile guidance system on STOLAND
[NASA-CR-152187] N79-10038

DIGITAL NAVIGATION
Better performance for aircraft tracking and holding under gust and shearwind influence by use of direct digital control
[ESA-TT-506] N79-11033
A contribution to the increase of aircraft guidance precision under wind disturbance conditions by using direct digital control
[DLR-FB-77-48] N79-11075

DIGITAL RADAR SYSTEMS
Enhancements of radar data-handling networks
A79-10299
A technical review of the radar systems implemented by Eurocontrol
A79-10329
Developments in radar data processing at the London Air Traffic Control Centre
A79-10330
Multisensor utilization investigation --- for automated ATC surveillance
A79-10332
Track-while-scan algorithm in a clutter environment
A79-11492

DIGITAL SIMULATION
Experimental design for real-time simulations of air traffic control concepts
A79-11481

DIGITAL SYSTEMS
A digital fuel control system for gas turbines
[ASME PAPER 78-GT-99] A79-10759

DIMENSIONAL MEASUREMENT
Turbine blade tip clearance measurement utilizing borescope photography
[ASME PAPER 78-GT-164] A79-10805

DIRECTIONAL STABILITY
A yaw stabilised S.A.R. aerial
A79-10364

DISPLAY DEVICES
The electronic flight deck
A79-11175
Present and potential capabilities of three-dimensional displays using sequential excitation of fluorescence
A79-12033
Method of eliminating static and dynamic errors in the reproduction of motion of TV-simulator displays --- for aircraft flight
A79-12153
Testing of avionics display systems
A79-12309
Integrated Avionics Control System (IACS)
[AD-A056476] N79-10056
Description and preliminary studies of a computer drawn instrument landing approach display
[NASA-TM-78771] N79-11039

DOPPLER NAVIGATION
Doppler Hover System (DHS) flight test report
[AD-A056777] N79-10053

DROP SIZE
Installation of icing tests
N79-10007
Experimental and theoretical study of the influence of various parameters on an icing section
N79-10012

DROP TESTS
Load and dynamic assessment of B-52B-008 carrier aircraft for finned configuration 1 space shuttle solid rocket booster decelerator subsystem drop test vehicle. Volume 1: Summary
[NASA-CR-150833] N79-10048

DYNAMIC CHARACTERISTICS
Time-frequency method of solving large problems in the dynamics of elastic structures with local nonlinearities --- for aircraft structures
A79-12155

DYNAMIC RESPONSE
Stochastic Response Secondary Surveillance Radar /S.R.S.S.R./
A79-10341
Aerodynamic response for the airfoil experiencing sudden change in angle of attack
A79-10869
Study of T53 engine vibration
[NASA-CR-135449] N79-10061

DYNAMIC STRUCTURAL ANALYSIS
Finite element analysis of helicopter structures
N79-10453
Synthesis of aircraft structures using integrated design and analysis methods
N79-10454

E

E-3A AIRCRAFT
E-3A antenna pedestal turntable
A79-11923

ECONOMIC ANALYSIS
Directions for developing an air cargo system planning model
[SAE PAPER 780556] A79-10411
Components of the airport access system
N79-10945

EIGENVALUES
Approximate solution of some boundary value problems on aircraft structural integrity
A79-12234

EJECTION
An evaluation of a new format for ejection information in a NATOPS manual
[AD-A056910] N79-10037

EJECTORS
Investigation of an ejector thrust-augmentor with a perforated nozzle for the ejected gas
A79-12196
End wall and corner flow improvements of the rectangular Alperin jet-diffuser ejector
[AD-A057663] N79-11051

ELASTIC BODIES
Time-frequency method of solving large problems in the dynamics of elastic structures with local nonlinearities --- for aircraft structures
A79-12155

ELASTODYNAMICS
Time-frequency method of solving large problems in the dynamics of elastic structures with local nonlinearities --- for aircraft structures
A79-12155

ELASTOPLASTICITY
Decreasing stress concentrations in structures made of high-strength materials
A79-12145

ELECTRIC NETWORKS
Aircraft electric power networks - Structures. I
A79-11369

ELECTRIC POWER SUPPLIES
Aircraft electric power networks - Structures. I
A79-11369

ELECTRIFICATION
Investigation of the electrification of an aircraft model by a humid airstream in a wind tunnel
A79-12162

ELECTROMAGNETIC COMPATIBILITY
Some novel techniques for avoiding antenna obscurations and E.M.C. effects
A79-10363

ELECTROMAGNETIC INTERFERENCE
Some novel techniques for avoiding antenna obscurations and E.M.C. effects
A79-10363
ELECTRONIC CONTROL
A rotating stall control system for turbojet engines
[ASME PAPER 78-GT-115] A79-10757
ELECTRONIC EQUIPMENT
The electronic flight deck
A79-11175
ELECTRONIC EQUIPMENT TESTS
F-16 Avionics Intermediate Shop self-test
A79-12302
Support systems for advanced military electronics --- ATE design trends
A79-12305
Advanced technology impact upon ATE self test --- by use of microprocessors and LSI
A79-12306
Testing of avionics display systems
A79-12309
EMISSION
Jet engine test cells: Emissions and control measures, phase 1
[PB-283470/3] N79-11580
ENERGY CONSERVATION
Simulation study of the effect of fuel-conservative approaches on ATC procedures and terminal area capacity
[SAE PAPER 780523] A79-10398
Energy conservation aircraft design and operational procedures
[ONERA, TP NO. 1978-107] A79-11572
National Conference on Energy Conservation in General Aviation, 1st, Kalamazoo, Mich., October 10, 11, 1977, Proceedings
A79-12376
Turbine engines in light aircraft
A79-12380
Energy conservation in general aviation and operation and maintenance of Avco Lycoming piston engines
A79-12381
Energy conservation in general aviation piston powered aircraft
A79-12382
Economy in flight operations
A79-12383
Flying angle of attack
A79-12384
ENERGY CONVERSION EFFICIENCY
Making turbofan engines more energy efficient
[ASME PAPER 78-GT-198] A79-10818
ENERGY POLICY
Federal Energy Data System (FEDS) technical documentation
[PB-281815/1] N79-11542
ENGINE CONTROL
A digital fuel control system for gas turbines
[ASME PAPER 78-GT-99] A79-10759
Recent developments in sensors for the gas turbine engine
[ASME PAPER 78-GT-52] A79-10760
Simulation of helicopter powerplant performance
[ASME PAPER 78-GT-51] A79-10774
Powerplant integration - The application of current experience to future developments
[ASME PAPER 78-GT-113] A79-10788
ENGINE COOLANTS
Turbine-driven refrigeration units in gas turbine engine cooling systems --- Russian book
A79-11441
ENGINE DESIGN
Development of gas turbine performance seeking logic
[ASME PAPER 78-GT-13] A79-10257
The CF6-32 as a derivative engine of the CF6-6
[SAE PAPER 780511] A79-10391
The RB211-535 - New member of the family
[SAE PAPER 780512] A79-10392
A rotating stall control system for turbojet engines
[ASME PAPER 78-GT-115] A79-10757
A high temperature turbine research module
[ASME PAPER 78-GT-73] A79-10769
Application of nonseries airfoil design technology to highly loaded turbine exit guide vanes
[ASME PAPER 78-GT-108] A79-10787
Powerplant integration - The application of current experience to future developments
[ASME PAPER 78-GT-113] A79-10788
Development of an inlet for a tilt nacelle subsonic V/STOL aircraft
[ASME PAPER 78-GT-121] A79-10789
Performance and design of transpiration-cooled turbine blading
[ASME PAPER 78-GT-122] A79-10790
Demonstration of ceramic design methodology for a ceramic combustor liner
[ASME PAPER 78-GT-137] A79-10794
Computations of three-dimensional gas-turbine combustion chamber flows
[ASME PAPER 78-GT-142] A79-10797
Development of a compact gas turbine combuster to give extended life and acceptable exhaust emissions
[ASME PAPER 78-GT-146] A79-10799
A design point correlation for losses due to part-span dampers on transonic rotors
[ASME PAPER 78-GT-153] A79-10802
Time-phased development methodology - The key for reliable engines in future military aircraft weapons systems
[ASME PAPER 78-GT-167] A79-10807
Advanced turbofan engines for low fuel consumption
[ASME PAPER 78-GT-192] A79-10816
Making turbofan engines more energy efficient
[ASME PAPER 78-GT-198] A79-10818
20 hp mini-RPV demonstrator engine programs
[ASME PAPER 78-GT-200] A79-10820
Evolution of the turboprop for high speed air transportation
[ASME PAPER 78-GT-201] A79-10821
The application of low cost manufacturing technology to a turbine gas generator
[ASME PAPER 78-GT-202] A79-10822
Near-net-shape engine methods emerge --- aircraft engine parts fabrication technologies
A79-11449
Design of a multivariable controller for a high-order turbofan engine model by Zakian's method of inequalities
A79-12287
Gas turbine analysis and design using interactive computer graphics
A79-12459
Choice of the main parameters in the design of aircraft engines
A79-12528
Current problems in the development and production of small gas turbine engines
A79-12529
Control system requirements for aircraft gas turbine engines
A79-12530
Control systems and problems of their development from the viewpoint of technological and operational requirements --- for aircraft gas turbine engines
A79-12531
Optimal designing of gas-turbine engine thermogasdynamics on the basis of prototype elements. I
A79-12951
ENGINE FAILURE
A new stage stacking technique for axial-flow compressor performance prediction
[ASME PAPER 78-GT-139] A79-10268
An axial compressor end-wall boundary layer calculation method
[ASME PAPER 78-GT-81] A79-10767
Icing testing for aircraft engines
[AGARD-CP-236] N79-10002
Engine icing measurement capabilities at the AEDC
N79-10008
ENGINE INLETS
Experimental method for investigating preintake vortex circulation --- in engine air intakes
A79-11367
Gas turbine engine inlet flow distortion guidelines
[SAE ARP 1420] A79-11624
ENGINE MONITORING INSTRUMENTS
Military engine usage monitoring developments in the United Kingdom
[ASME PAPER 78-GT-65] A79-10772
An evaluation technique for determining the cost effectiveness of condition monitoring systems
[ASME PAPER 78-GT-166] A79-10806

On-line computer for transient turbine cascade instrumentation
A79-11488

ENGINE NOISE
A method for assessing turbine engine run-up noise impact on airport neighbors
[SAE PAPER 780522] A79-10397
Gas turbine jet exhaust noise prediction
[SAE ARP 876] A79-11623

ENGINE PARTS
Near-net-shape engine methods emerge --- aircraft engine parts fabrication technologies
A79-11449
Summation of defects in the case of nonisothermal programmed loads --- for supersonic transport propulsion system components
A79-12164
New construction materials for gas turbine engines and technology for processing these materials
A79-12533
Superalloy knife edge seal repair
[AD-A057269] N79-11055
Gas path sealing in turbine engines
N79-11057
Oil sealing of aero engine bearing compartments
N79-11062
Self active pad seal application for high pressure engines
N79-11071

ENGINE TESTS
A gas path performance diagnostic system to reduce J75-P-17 engine overhaul costs
[ASME PAPER 78-GT-116] A79-10267
Turbine engine automated trim balancing and vibration diagnostics
[ASME PAPER 78-GT-129] A79-10793
Turbine blade tip clearance measurement utilizing borescope photography
[ASME PAPER 78-GT-164] A79-10805
Propulsion test facilities technical capabilities and international use
[ASME PAPER 78-GT-184] A79-10813
20 hp mini-RPV demonstrator engine programs
[ASME PAPER 78-GT-200] A79-10820
Certain problems which had to be solved between the prototype stage and mass production stage in the development of an engine --- turboprop engine tests
A79-12532
Statistical diagnostics of aircraft engines
A79-12950
Tests under snow and icing conditions with the BO 105 engine installation
N79-10014
An investigation of the performance of a J52-P-8A engine operating under the influence of high bleed flow extraction rates
[AD-A057325] N79-11054
The contribution of dynamic X-ray to gas turbine air sealed technology
N79-11065

ENVIRONMENT POLLUTION
Pollution sources caused by aviation
A79-10453

ENVIRONMENT PROTECTION
The effects of ambient conditions on gas turbine emissions - Generalized correction factors
[ASME PAPER 78-GT-87] A79-10262

ENVIRONMENTAL CONTROL
Operational reliability of climate and pressure control equipment for passenger aircraft --- Russian book
A79-10850
The F-16 environmental control system
[ASME PAPER 78-ENAS-11] A79-12560
The application of foil air bearing turbomachinery in aircraft environmental control systems
[ASME PAPER 78-ENAS-18] A79-12567
The influence of the noise environment on crew communications
N79-10860

ENVIRONMENTAL SURVEYS
Jet engines test cells: Emissions and control measures, phase 2
[PB-282412/6] N79-10072

ENVIRONMENTAL TESTS
Intensive tropic function testing
[AD-A056416] N79-10440

EPOXY RESINS
Damage tolerance in advanced composite materials
A79-10915

EQUIPMENT SPECIFICATIONS
Arresting hook installation, land based aircraft, emergency
[SAE ARP 1538] A79-11625

ERROR CORRECTING DEVICES
Method of eliminating static and dynamic errors in the reproduction of motion of TV-simulator displays --- for aircraft flight
A79-12153

EVALUATION
Preliminary evaluation of several nondestructive-evaluation techniques for silicon nitride gas-turbine rotors
[ANL-77-89] N79-11414

EVOLUTION (DEVELOPMENT)
Evolution of the turboprop for high speed air transportation
[ASME PAPER 78-GT-201] A79-10821

EXHAUST DIFFUSERS
Study of aerodynamic technology for VSTOL fighter/attack aircraft, volume 1
[NASA-CR-152128] N79-10025
End wall and corner flow improvements of the rectangular Alperin jet-diffuser ejector
[AD-A057663] N79-11051

EXHAUST GASES
The effects of ambient conditions on gas turbine emissions - Generalized correction factors
[ASME PAPER 78-GT-87] A79-10262
Development of a compact gas turbine combuster to give extended life and acceptable exhaust emissions
[ASME PAPER 78-GT-146] A79-10799
Emission sample probe investigation of a mixed flow JT8D-11 turbofan engine
[AD-A058038] N79-11561
Pilot program to develop operating time emission degradation factors for general aviation piston engines
[AD-A058158] N79-11562
Jet engine test cells: Emissions and control measures, phase 1
[PB-283470/3] N79-11580

EXHAUST NOZZLES
Design and test of an annular sting support concept for aftbody nozzle wind tunnel testing
[AD-A056945] N79-10063
Exhaust plume thermodynamic effects on nonaxisymmetric nozzle afterbody performance in transonic flow
[AD-A057363] N79-11052

EXHAUST SYSTEMS
Internal mixer investigation for JT8D engine jet noise reduction. Volume 1: Results
[AD-A057309] N79-10059
Internal mixer investigation for JT8D engine jet noise reduction. Volume 2: Appendices A, B, C, and D
[AD-A057310/5] N79-10065

EXPERIMENTAL DESIGN
Experimental design for real-time simulations of air traffic control concepts
A79-11481

EXTERNAL STORES
Aerodynamic characteristics of a 1/24-scale F-111 aircraft with various external stores at Mach numbers from 0.5 to 1.3
[AD-A057409] N79-11005

EXTINCTION
Weak extinction limits of turbulent flowing mixtures --- flame stabilization
[ASME PAPER 78-GT-144] A79-10798

F

F-5 AIRCRAFT
Northrop F-5F shark nose development
[NASA-CR-158936] N79-10047

F-16 AIRCRAFT
All weather cockpit canopies. I - The F16
A79-10619
F-16 Avionics Intermediate Shop self-test
A79-12302
F-16 LRU test programs - A systems approach --- Line Replaceable Units
A79-12321

The F-16 environmental control system
[ASME PAPER 78-ENAS-11] A79-12560
Investigation of the YF-16 in high angle of attack asymmetric flight
[AD-A056511] N79-11036

F-18 AIRCRAFT
F-18 air conditioning system
[ASME PAPER 78-ENAS-23] A79-12572

F-111 AIRCRAFT
Flight-determined stability and control derivatives for the F-111 Tact research aircraft
[NASA-TP-1350] N79-10068
Aerodynamic characteristics of a 1/24-scale F-111 aircraft with various external stores at Mach numbers from 0.5 to 1.3
[AD-A057409] N79-11005

FABRICATION
Near-net-shape engine methods emerge --- aircraft engine parts fabrication technologies
A79-11449

FAILURE ANALYSIS
Hazard criticality analysis --- with emphasis on aircraft components
A79-10621
Advanced technology impact upon ATE self test --- by use of microprocessors and LSI
A79-12306
Helicopter bearing failure detection utilizing shock pulse techniques
[AD-A057308] N79-11410

FAILURE MODES
Improved ballistic damage tolerant design through laminated metal construction
A79-10912

FATIGUE (MATERIALS)
Probability that the propagation of an undetected fatigue crack will not cause a structural failure
[AD-A057335] N79-11439

FATIGUE LIFE
Method for determining maximum allowable stress for preliminary aircraft wing design
A79-11370
Summation of defects in the case of nonisothermal programmed loads --- for supersonic transport propulsion system components
A79-12164
Processing a random loading process by computer to obtain life information --- in-flight critical stress measurements in aircraft wing structures
A79-12535

FATIGUE TESTS
Composite rotor hub. I, II --- fatigue and load tests for CH-54B helicopter design
A79-10916

FEEDBACK CONTROL
A rotating stall control system for turbojet engines
[ASME PAPER 78-GT-115] A79-10757
Desensitizing constant gain feedback linear regulators
A79-12290

FIGHTER AIRCRAFT
Flight and propulsion control integration for selected in-flight thrust vectoring modes
[ASME PAPER 78-GT-79] A79-10768
Program REV - A wing structural optimization computer program for preliminary design of fighter aircraft
A79-12460
Study of aerodynamic technology for VSTOL fighter/attack aircraft: Horizontal attitude concept
[NASA-CR-152130] N79-10024

FINITE DIFFERENCE THEORY
Numerical solution of the direct problem of ideal gas flow in three-dimensional turbine cascades
A79-12194

FINITE ELEMENT METHOD
The use of 3-D finite element analysis in the design of helicopter mechanical components
A79-10909
Cyclic linkage of finite elements with application --- to aircraft structural analysis
[IAF PAPER 78-213] A79-11294
Application of an interactive graphics system for the design and optimization of aircraft lifting surfaces
A79-12436
Numerical calculation of transonic flow past a swept wing by a finite volume method
[CONF-771204-3] N79-10036
Finite element analysis of helicopter structures
N79-10453

FLAME HOLDERS
Jet curtain flameholder for aircraft afterburners
[ASME PAPER 78-GT-95] A79-10761

FLAME STABILITY
Weak extinction limits of turbulent flowing mixtures --- flame stabilization
[ASME PAPER 78-GT-144] A79-10798

FLAPS (CONTROL SURFACES)
Wind tunnel tests of the GA(W)-2 airfoil with 20% aileron, 25% slotted flap, 30% Fowler flap and 10% slot-lip spoiler
[NASA-CR-145139] N79-10021
Pivoting output unit control systems activated by jacks --- for controlling aircraft flaps
[NASA-TM-75581] N79-10066

FLAT SURFACES
Three-dimensional radiative heat-transfer problem with shading --- modeling aircraft compartments thermodynamics
A79-12784

FLEXING
Significance of disk flexing in viscous-damped jet engine dynamics
[ASME PAPER 78-GT-107] A79-10263

FLIGHT CHARACTERISTICS
The role of flight dynamic modeling in helicopter certification
[SAE PAPER 780550] A79-10409
Flight experience with advanced controls and displays during piloted curved decelerating approaches in a powered-lift STOL aircraft
[NASA-TM-78527] N79-10054

FLIGHT CONTROL
Operational benefits from the Terminal Configured Vehicle --- aircraft equipment for air traffic improvement
A79-10390
Flight and propulsion control integration for selected in-flight thrust vectoring modes
[ASME PAPER 78-GT-79] A79-10768
Structural design flight maneuver loads using PDP-10 flight dynamics model
A79-10905
The Wright brothers' flight-control system --- canard configuration
A79-11125
Control and stabilization in aerodynamics --- Russian book
A79-11392
Aircraft radio equipment --- Russian book
A79-11439
'Strategic' time-based ATC --- by long-term flight planning
A79-12473
Study of aerodynamic technology for VSTOL fighter/attack aircraft: Vertical attitude concept
[NASA-CR-152131] N79-10026
Better performance for aircraft tracking and holding under gust and shearwind influence by use of direct digital control
[ESA-TT-506] N79-11033
Investigation of the YF-16 in high angle of attack asymmetric flight
[AD-A056511] N79-11036
A contribution to the increase of aircraft guidance precision under wind disturbance conditions by using direct digital control
[DLR-FB-77-48] N79-11075

FLIGHT HAZARDS
Possible near-term solutions to the wind shear hazard
[SAE PAPER 780572] A79-10416

FLIGHT OPERATIONS
Energy conservation in general aviation and operation and maintenance of Avco Lycoming piston engines
A79-12381
Economy in flight operations
A79-12383

FLIGHT OPTIMIZATION
Quality index for an iterative process of optimizing long-range aircraft parameters
A79-12152

FLIGHT PATHS
'Strategic' time-based ATC --- by long-term flight planning
A79-12473
FLIGHT PLANS
A technical review of the radar systems implemented by Eurocontrol
A79-10329
FLIGHT SAFETY
Hazard criticality analysis --- with emphasis on aircraft components
A79-10621
Energy conservation in general aviation and operation and maintenance of Avco Lycoming piston engines
A79-12381
FLIGHT SIMULATION
Certification-compliance demonstration by flight or simulation
[SAE PAPER 780549] A79-10408
FLIGHT SIMULATORS
Method of eliminating static and dynamic errors in the reproduction of motion of TV-simulator displays --- for aircraft flight
A79-12153
FLIGHT TESTS
The role of flight dynamic modeling in helicopter certification
[SAE PAPER 780550] A79-10409
An instrumentation modeling technique used in the identification of aerodynamic coefficients from flight test data
[IAF PAPER 78-99] A79-11239
Doppler Hover System (DHS) flight test report
[AD-A056777] N79-10053
FLOW CHARACTERISTICS
Features of flow past slotted wings
A79-12236
FLOW DISTORTION
Asymmetric swirling flows in turbomachine annuli
[ASME PAPER 78-GT-109] A79-10260
Small perturbation analysis of nonuniform rotating disturbances in a vaneless diffuser
[ASME PAPER 78-GT-154] A79-10270
Gas turbine engine inlet flow distortion guidelines
[SAE ARP 1420] A79-11624
FLOW DISTRIBUTION
Analysis of the flow field in a radial compressor
[ASME PAPER 78-GT-7] A79-10776
Measurement of flow fields around an airfoil section with separation
A79-10868
A numerical solution of supersonic and hypersonic viscous flow fields around thin planar delta wings
N79-10018
A computer program for the calculation of the flow field in supersonic mixed-compression inlets at angle of attack wing the three-dimensional method of characteristics with discrete shock wave fitting
[NASA-TM-78947] N79-10023
A numerical solution of supersonic and hypersonic viscous flow fields around thin planar delta wings
[AD-A056513] N79-11003
FLOW EQUATIONS
Numerical solution of a linear integral equation of the first kind in the inverse problem of symmetric flow past a wing
A79-12138
FLOW MEASUREMENT
Analysis of the flow field in a radial compressor
[ASME PAPER 78-GT-7] A79-10776
Measurement of flow fields around an airfoil section with separation
A79-10868
Experimental method for investigating preintake vortex circulation --- in engine air intakes
A79-11367
FLOW THEORY
Contribution to the asymptotic theory of flows at the trailing edge of a slender wing
A79-12127
FLOW VELOCITY
Investigation of the profile drag and the mean and pulsation velocities in the wake of wings by means of a laser Doppler anemometer
A79-12151
Approximate calculation of the velocity field and the motion of vortices in the wake of a low-flying biplane
A79-12198
Inverse mixed problem for a profile with a prescribed velocity distribution on one of its sides and a known thickness distribution
A79-12970
Installation of icing tests
N79-10007
FLOW VISUALIZATION
Jet curtain flameholder for aircraft afterburners
[ASME PAPER 78-GT-95] A79-10761
FLUID DYNAMICS
Transonic 3-D flow analysis of compressor cascade with splinter vanes
[AD-A057504] N79-11004
FLUID FILMS
High efficiency fluid film thrust bearings for turbomachinery
A79-12371
FLUID TRANSMISSION LINES
Transmission seal development
[NASA-CR-135372] N79-10423
FLUORESCENCE
Present and potential capabilities of three-dimensional displays using sequential excitation of fluorescence
A79-12033
FLUTTER
Load and dynamic assessment of B-52B-008 carrier aircraft for finned configuration 1 space shuttle solid rocket booster decelerator subsystem drop test vehicle. Volume 1: Summary
[NASA-CR-150833] N79-10048
Load and dynamic assessment of B-52B-008 carrier aircraft for finned configuration 1 space shuttle solid rocket booster decelerator subsystem drop test vehicle. Volume 2: Airplane flutter and load analysis results
[NASA-CR-150834] N79-10049
FLUTTER ANALYSIS
Dynamic stall of an airfoil with leading edge bubble separation involving time dependent re-attachment
[ASME PAPER 78-GT-194] A79-10817
Supersonic unstalled flutter
A79-12599
Synthesis and analysis of systems for active control and suppression of flutter of flying craft
A79-12755
Harmonic vibrations of an annular wing in the steady flow of an ideal fluid
A79-12963
Supersonic unstalled flutter --- aerodynamic loading of thin airfoils induced by cascade motion
[NASA-TM-79001] N79-11000
FLY BY WIRE CONTROL
Active control --- aircraft systems
A79-12534
FOIL BEARINGS
The application of foil air bearing turbomachinery in aircraft environmental control systems
[ASME PAPER 78-ENAS-18] A79-12567
FORMAT
An evaluation of a new format for ejection information in a NATOPS manual
[AD-A056910] N79-10037
FORMING TECHNIQUES
The utilization of data relating to fin geometry and manufacturing processes of ceramic matrix systems to the design of ceramic heat exchangers
A79-12824
FRACTURE STRENGTH
Damage tolerance in advanced composite materials
A79-10915
Residual strength of a cracked lug --- stress corrosion cracking of aluminum alloy lugs
[ARL-STRUC-NOTE-442] N79-10445
FREE VIBRATION
Free periodic oscillations of a parachute system in the longitudinal plane
A79-12971
FRICTION FACTOR
Factors associated with rub tolerance of compressor tip seals --- self sustained combustion of titanium
N79-11069

FUEL COMBUSTION
Characteristics and combustion of future hydrocarbon fuels
A79-11599
Impact of future fuel properties on aircraft engines and fuel systems
A79-11600
FUEL CONSUMPTION
Simulation study of the effect of fuel-conservative approaches on ATC procedures and terminal area capacity
[SAE PAPER 780523] A79-10398
Advanced turbofan engines for low fuel consumption
[ASME PAPER 78-GT-192] A79-10816
Making turbofan engines more energy efficient
[ASME PAPER 78-GT-198] A79-10818
Energy conservation aircraft design and operational procedures
[ONERA, TP NO. 1978-107] A79-11572
National Conference on Energy Conservation in General Aviation, 1st, Kalamazoo, Mich., October 10, 11, 1977, Proceedings
A79-12376
Energy conservation in general aviation piston powered aircraft
A79-12382
Economy in flight operations
A79-12383
Federal Energy Data System (FEDS) technical documentation
[PB-281815/1] N79-11542
FUEL CONTROL
A digital fuel control system for gas turbines
[ASME PAPER 78-GT-99] A79-10759
FUEL PUMPS
Aircraft fuel pumps - Where we're at /A review of some problems and their current solutions/
[ASME PAPER 78-GT-10] A79-10777
FUEL SYSTEMS
Impact of future fuel properties on aircraft engines and fuel systems
A79-11600
FUEL TESTS
Some aspects of aircraft jet engine fuels
A79-11368
FUEL-AIR RATIO
Energy conservation in general aviation piston powered aircraft
A79-12382
FUNCTIONAL ANALYSIS
The smooth approximation method and its application to the mathematical description of the aerodynamic characteristics of a wing
A79-12955
FUSELAGES
A study of structural concepts for low radar cross section /LRCS/ fuselage configurations
A79-10908
Vortex system at the nose part of a fuselage model at supercritical angles of attack and different Reynolds numbers
A79-12199
Choice of a fuselage for a passenger aircraft
A79-12968

G

GAS BEARINGS
The application of foil air bearing turbomachinery in aircraft environmental control systems
[ASME PAPER 78-ENAS-18] A79-12567
GAS DETECTORS
Emission sample probe investigation of a mixed flow JT8D-11 turbofan engine
[AD-A058038] N79-11561
GAS FLOW
Gas path sealing in turbine engines
N79-11057
Use of coatings in turbomachinery gas path seals
N79-11058
GAS GENERATORS
The application of low cost manufacturing technology to a turbine gas generator
[ASME PAPER 78-GT-202] A79-10822
GAS MIXTURES
Weak extinction limits of turbulent flowing mixtures --- flame stabilization
[ASME PAPER 78-GT-144] A79-10798
GAS TURBINE ENGINES
Development of gas turbine performance seeking logic
[ASME PAPER 78-GT-13] A79-10257
Asymmetric swirling flows in turbomachine annuli
[ASME PAPER 78-GT-109] A79-10260
The effects of ambient conditions on gas turbine emissions - Generalized correction factors
[ASME PAPER 78-GT-87] A79-10262
A digital fuel control system for gas turbines
[ASME PAPER 78-GT-99] A79-10759
Recent developments in sensors for the gas turbine engine
[ASME PAPER 78-GT-52] A79-10760
A high temperature turbine research module
[ASME PAPER 78-GT-73] A79-10769
Application of nonseries airfoil design technology to highly loaded turbine exit guide vanes
[ASME PAPER 78-GT-108] A79-10787
Wide range operation of advanced low NOx aircraft gas turbine combustors
[ASME PAPER 78-GT-128] A79-10792
Turbine engine automated trim balancing and vibration diagnostics
[ASME PAPER 78-GT-129] A79-10793
Demonstration of ceramic design methodology for a ceramic combustor liner
[ASME PAPER 78-GT-137] A79-10794
Computations of three-dimensional gas-turbine combustion chamber flows
[ASME PAPER 78-GT-142] A79-10797
Development of a compact gas turbine combuster to give extended life and acceptable exhaust emissions
[ASME PAPER 78-GT-146] A79-10799
Time-phased development methodology - The key for reliable engines in future military aircraft weapons systems
[ASME PAPER 78-GT-167] A79-10807
Propulsion test facilities technical capabilities and international use
[ASME PAPER 78-GT-184] A79-10813
Making turbofan engines more energy efficient
[ASME PAPER 78-GT-198] A79-10818
Turbine-driven refrigeration units in gas turbine engine cooling systems --- Russian book
A79-11441
On-line computer for transient turbine cascade instrumentation
A79-11488
Gas turbine jet exhaust noise prediction
[SAE ARP 876] A79-11623
Gas turbine engine inlet flow distortion guidelines
[SAE ARP 1420] A79-11624
Alternative aviation turbine fuels
A79-12378
Gas turbine analysis and design using interactive computer graphics
A79-12459
Current problems in the development and production of small gas turbine engines
A79-12529
Control system requirements for aircraft gas turbine engines
A79-12530
Control systems and problems of their development from the viewpoint of technological and operational requirements --- for aircraft gas turbine engines
A79-12531
New construction materials for gas turbine engines and technology for processing these materials
A79-12533
Optimal designing of gas-turbine engine thermogasdynamics on the basis of prototype elements. I
A79-12951
Study of T53 engine vibration
[NASA-CR-135449] N79-10061
Seal Technology in Gas Turbine Engines
[AGARD-CP-237] N79-11056
Gas path sealing in turbine engines
N79-11057
Oil sealing of aero engine bearing compartments
N79-11062
The contribution of dynamic X-ray to gas turbine air sealed technology
N79-11065

Factors associated with rub tolerance of compressor tip seals --- self sustained combustion of titanium
N79-11069
Self-acting shaft seals --- gas turbine engines
N79-11070
Self active pad seal application for high pressure engines
N79-11071
Gas turbine disc sealing system design
N79-11072
Thermal-structural mission analyses of air-cooled gas turbine blades
[NASA-TM-78963] N79-11433

GAS TURBINES
Aerodynamic force and moment on oscillating airfoils in cascade
[ASME PAPER 78-GT-181] A79-10812
Numerical solution of the direct problem of ideal gas flow in three-dimensional turbine cascades
A79-12194
Icing test facilities at the National Gas Turbine Establishment
N79-10006
Icing tests of a small gas turbine with inertial separation anti-icing system
N79-10015
Apparatus and method for reducing thermal stress in a turbine rotor
[NASA-CASE-LEW-12232-1] N79-10057
Principles of jet engine operation
[AD-A056158] N79-11050
Determining and improving labyrinth seal performance in current and advanced high performance gas turbines
N79-11068
Preliminary evaluation of several nondestructive-evaluation techniques for silicon nitride gas-turbine rotors
[ANL-77-89] N79-11414

GENERAL AVIATION AIRCRAFT
National Conference on Energy Conservation in General Aviation, 1st, Kalamazoo, Mich., October 10, 11, 1977, Proceedings
A79-12376
Turbine engines in light aircraft
A79-12380
Energy conservation in general aviation and operation and maintenance of Avco Lycoming piston engines
A79-12381
Energy conservation in general aviation piston powered aircraft
A79-12382
Economy in flight operations
A79-12383
Flying angle of attack
A79-12384
Pilot program to develop operating time emission degradation factors for general aviation piston engines
[AD-A058158] N79-11562

GRADIENTS
Application of gradient methods to the optimal design of components of load-bearing structures --- for aircraft minimum weight design
A79-12144

GRAPHITE-EPOXY COMPOSITE MATERIALS
Advanced technology helicopter landing gear
A79-10918

GROUND EFFECT (AERODYNAMICS)
Measurement of flow fields around an airfoil section with separation
A79-10868
Skirt components of the aerodynamic characteristics of an air-cushion vehicle using the oncoming flow to generate lift
A79-12949

GROUND SUPPORT EQUIPMENT
Potential applications of acoustic emission technology as a nondestructive evaluation method for naval aviation ground support
[AD-A056650] N79-10439

GROUND TESTS
Certification-compliance demonstration by flight or simulation
[SAE PAPER 780549] A79-10408

GUIDANCE (MOTION)
Flight experience with advanced controls and displays during piloted curved decelerating approaches in a powered-lift STOL aircraft
[NASA-TM-78527] N79-10054

GUIDE VANES
Application of nonseries airfoil design technology to highly loaded turbine exit guide vanes
[ASME PAPER 78-GT-108] A79-10787

GUST LOADS
Method for determining maximum allowable stress for preliminary aircraft wing design
A79-11370
Load and dynamic assessment of B-52B-008 carrier aircraft for finned configuration 1 space shuttle solid rocket booster decelerator subsystem drop test vehicle. Volume 2: Airplane flutter and load analysis results
[NASA-CR-150834] N79-10049

H

H-53 HELICOPTER
The effect of operations on the ground noise footprints associated with a large multibladed, nonbanging helicopter
N79-10851

HARMONIC OSCILLATION
Harmonic vibrations of an annular wing in the steady flow of an ideal fluid
A79-12963

HEAT EXCHANGERS
The F-16 environmental control system
[ASME PAPER 78-ENAS-11] A79-12560
The utilization of data relating to fin geometry and manufacturing processes of ceramic matrix systems to the design of ceramic heat exchangers
A79-12824

HEAT RESISTANT ALLOYS
Superalloy knife edge seal repair
[AD-A057269] N79-11055

HELICAL INDUCERS
An experimental study of three-dimensional turbulent boundary layer and turbulence characteristics inside a turbomachinery rotor passage
[ASME PAPER 78-GT-114] A79-10266

HELICOPTER DESIGN
Rotorcraft for transport use - European requirements
[SAE PAPER 780535] A79-10404
Helicopter transport efficiency payoffs from advanced technology
[SAE PAPER 780536] A79-10405
Conference on Helicopter Structures Technology, Moffett Field, Calif., November 16-18, 1977, Proceedings
A79-10903
The effects of latest military criteria on the structural weight of the Hughes advanced attack helicopter - YAH-64
A79-10904
Structural design flight maneuver loads using PDP-10 flight dynamics model
A79-10905
Derivation of control loads for bearingless rotor systems --- in helicopter design
A79-10906
Impact of operational issues on design of advanced composite structures for Army helicopters
A79-10907
A study of structural concepts for low radar cross section /LRCS/ fuselage configurations
A79-10908
The use of 3-D finite element analysis in the design of helicopter mechanical components
A79-10909
A glance at Soviet helicopter design philosophy
A79-10910
Damage-tolerant design of the YUH-61A main rotor system
A79-10911
Improved ballistic damage tolerant design through laminated metal construction
A79-10912
The survivability of helicopters to rotor blade ballistic damage
A79-10913

Damage tolerant design of the YAH-64 main rotor blade
A79-10914
Survey of the application of reinforced composites in European helicopters
A79-10917
Advanced technology helicopter landing gear
A79-10918
Development of a multitubular spar composite main rotor blade
A79-10919
Boeing Vertol bearingless main rotor structural design approach using advanced composites
A79-10920
Moments on the hub of a lifting propeller with hinge-mounted blades
A79-12216
Helicopter noise - State-of-the-art
[AIAA PAPER 77-1337] A79-12395
Design of helicopter rotors to noise constraints
N79-10854
The cost of applying current helicopter external noise reduction methods while maintaining realistic vehicle performance
N79-10855
Helicopter internal noise control: Three case histories
N79-10858
An analytical method for designing low noise helicopter transmissions
N79-10859

HELICOPTER ENGINES
Simulation of helicopter powerplant performance
[ASME PAPER 78-GT-51] A79-10774
Engine/airframe/drive train dynamic interface documentation
[AD-A056956] N79-10064

HELICOPTER PERFORMANCE
Helicopter transport efficiency payoffs from advanced technology
[SAE PAPER 780536] A79-10405
The role of flight dynamic modeling in helicopter certification
[SAE PAPER 780550] A79-10409
Application of the lifting line concept to helicopter computation
[ONERA, TP NO. 1978-90] A79-11571
The cost of applying current helicopter external noise reduction methods while maintaining realistic vehicle performance
N79-10855

HELICOPTER TAIL ROTORS
Rating helicopter noise
N79-10845

HELICOPTERS
The dynamic ice detector for helicopters
N79-10010
Highly survivable truss type tail boom
[AD-A056430] N79-10052
Engine/airframe/drive train dynamic interface documentation
[AD-A056956] N79-10064
Finite element analysis of helicopter structures
N79-10453
Helicopter Acoustics, part 2 --- conferences
[NASA-CP-2052-PT-2] N79-10843
Subjective evaluation of helicopter blade slap noise
N79-10844
Helicopter cabin noise: Methods of source and path identification and characterization
N79-10856
A practical approach to helicopter internal noise prediction
N79-10857
The influence of the noise environment on crew communications
N79-10860
Helicopter internal noise reduction research and development application to the SA 360 and SA 365 Dauphin
N79-10861
The status of rotor noise technology: One man's opinion
N79-10862
Trends in Langley helicopter noise research
N79-10863
Aeroacoustic research: An Army perspective
N79-10864

HELMETS
An active noise reduction system for aircrew helmets
N79-10853

HIGH ALTITUDE ENVIRONMENTS
Planning the high elevation/high temperature airport
[SAE PAPER 780532] A79-10402

HIGH ASPECT RATIO
Theory of large-aspect ratio wings in transonic gas flow
A79-12226

HIGH PRESSURE
Self active pad seal application for high pressure engines
N79-11071

HIGH STRENGTH
Influence of thermomechanical treatment on microstructure and mechanical properties of high strength aluminum alloys
[DLR-FB-77-50] N79-11203

HIGH STRENGTH ALLOYS
Decreasing stress concentrations in structures made of high-strength materials
A79-12145

HIGH TEMPERATURE
Planning the high elevation/high temperature airport
[SAE PAPER 780532] A79-10402

HIGH TEMPERATURE RESEARCH
A high temperature turbine research module
[ASME PAPER 78-GT-73] A79-10769

HINGES
Moments on the hub of a lifting propeller with hinge-mounted blades
A79-12216

HOOKS
Arresting hook installation, land based aircraft, emergency
[SAE ARP 1538] A79-11625

HOT-WIRE FLOWMETERS
Flying hot-wire study of two-dimensional turbulent separation on an NACA 4412 airfoil at maximum lift
N79-10019
The flying hot wire and related instrumentation
[NASA-CR-3066] N79-11352

HOVERING
A lifting surface performance analysis with circulation coupled wake for advanced configuration hovering rotors
N79-10017
Doppler Hover System (DHS) flight test report
[AD-A056777] N79-10053

HUBS
Composite rotor hub. I, II --- fatigue and load tests for CH-54B helicopter design
A79-10916
Moments on the hub of a lifting propeller with hinge-mounted blades
A79-12216

HUMAN FACTORS ENGINEERING
The electronic flight deck
A79-11175
Aircraft lighting equipment --- interior and exterior illumination
A79-11366
Passenger ride quality in transport aircraft
A79-12396

HUMIDITY
Investigation of the electrification of an aircraft model by a humid airstream in a wind tunnel
A79-12162

HYDRAULIC TEST TUNNELS
Longitudinal distribution of hydrodynamic load on a gliding flat-bottomed plate with keel
A79-12200

HYDROCARBON FUELS
Characteristics and combustion of future hydrocarbon fuels
A79-11599
Impact of future fuel properties on aircraft engines and fuel systems
A79-11600

HYDRODYNAMICS
Longitudinal distribution of hydrodynamic load on a gliding flat-bottomed plate with keel
A79-12200

HYDROPLANES (SURFACES)
Longitudinal distribution of hydrodynamic load on a gliding flat-bottomed plate with keel
A79-12200

HYPERSONIC FLOW
A numerical solution of supersonic and hypersonic viscous flow fields around thin planar delta wings
[AD-A056513] N79-11003

I

ICE FORMATION
Icing testing for aircraft engines
[AGARD-CP-236] N79-10002
Meteorological icing conditions
N79-10005
Icing test facilities at the National Gas Turbine Establishment
N79-10006
Installation of icing tests
N79-10007
Engine icing measurement capabilities at the AEDC
N79-10008
The dynamic ice detector for helicopters
N79-10010
Aircraft engine icing, technical summary
N79-10011
Experimental and theoretical study of the influence of various parameters on an icing section
N79-10012
Icing tests on turbojet and turbofan engines using the NGTE engine test facility
N79-10013
Tests under snow and icing conditions with the BO 105 engine installation
N79-10014
Icing tests of a small gas turbine with inertial separation anti-icing system
N79-10015

ICE PREVENTION
Vibratory ice protection for helicopter rotor blades
[AD-A057329] N79-11038

IDEAL FLUIDS
Harmonic vibrations of an annular wing in the steady flow of an ideal fluid
A79-12963

IDEAL GAS
Numerical solution of the direct problem of ideal gas flow in three-dimensional turbine cascades
A79-12194

IMAGE MOTION COMPENSATION
Antenna to IMU mounting for SAR motion compensation --- Inertial Measurement Unit
A79-11913

IMPACT DAMAGE
Improved ballistic damage tolerant design through laminated metal construction
A79-10912
The survivability of helicopters to rotor blade ballistic damage
A79-10913

IMPACT TOLERANCES
The effects of latest military criteria on the structural weight of the Hughes advanced attack helicopter - YAH-64
A79-10904
Damage-tolerant design of the YUH-61A main rotor system
A79-10911
Damage tolerant design of the YAH-64 main rotor blade
A79-10914
Damage tolerance in advanced composite materials
A79-10915

IMPELLERS
Small perturbation analysis of nonuniform rotating disturbances in a vaneless diffuser
[ASME PAPER 78-GT-154] A79-10270

IN-FLIGHT MONITORING
Processing a random loading process by computer to obtain life information --- in-flight critical stress measurements in aircraft wing structures
A79-12535

INCOMPRESSIBLE FLOW
Theory of lifting surface in fluids of high electrical conductivity
A79-12394

INCOMPRESSIBLE FLUIDS
Method of calculating potential flows of an incompressible fluid past a wing with a high-lift device
A79-12126

INDEPENDENT VARIABLES
Spare memory and timing parameters in avionics computer system requirements
[AD-A056521] N79-10055

INDUCTION
Numerical study of the induction of porous walls of the working section of a low-velocity wind tunnel
A79-12228

INEQUALITIES
Design of a multivariable controller for a high-order turbofan engine model by Zakian's method of inequalities
A79-12287

INERTIAL PLATFORMS
Antenna to IMU mounting for SAR motion compensation --- Inertial Measurement Unit
A79-11913

INFINITE SPAN WINGS
Axial flow in trailing line vortices
[AD-A057075] N79-10034

INFRARED INSTRUMENTS
Infrared suppressor effect on T63 turboshaft engine performance
[NASA-TM-78970] N79-11043

INFRARED TRACKING
Infrared landing system for a mini remotely-piloted vehicle
A79-12093

INJURIES
Listing of accidents/incidents by aircraft make and model, US Civil Aviation, 1976
[PB-283000/8] N79-11016

INLET FLOW
Asymmetric swirling flows in turbomachine annuli
[ASME PAPER 78-GT-109] A79-10260
Propeller unsteady thrust due to operation in turbulent inflows
[ASME PAPER 78-GT-94] A79-10762
Weak extinction limits of turbulent flowing mixtures --- flame stabilization
[ASME PAPER 78-GT-144] A79-10798
Gas turbine engine inlet flow distortion guidelines
[SAE ARP 1420] A79-11624

INSPECTION
Determination of inspection intervals for aircraft structures with allowance for the two-stage nature of fatigue damage
A79-12135

INSTRUMENT COMPENSATION
An instrumentation modeling technique used in the identification of aerodynamic coefficients from flight test data
[IAF PAPER 78-99] A79-11239

INSTRUMENT FLIGHT RULES
Single pilot IFR operating problems determined from accidental data analysis
[NASA-TM-78773] N79-11013

INTAKE SYSTEMS
Development of an inlet for a tilt nacelle subsonic V/STOL aircraft
[ASME PAPER 78-GT-121] A79-10789
An experimental study of a catalytic combustor for an expendable turbojet engine
[AD-A056512] N79-11048

INTEGRATED CIRCUITS
Development of a 10 KVA power conditioner unit, aircraft, 115/200 volt, 3-phase, 400 Hz
[AD-A056119] N79-11049

INTERFEROMETERS
Experimental design study of an airborne interferometer for terrain avoidance
A79-10381

INVISCID FLOW
Theory of lifting surface in fluids of high electrical conductivity
A79-12394

ITERATIVE SOLUTION
Quality index for an iterative process of optimizing long-range aircraft parameters
A79-12152
Iterative method of aircraft wing strength calculation taking into account the effect of deformations on distribution of aerodynamic forces
A79-12213

J

J-75 ENGINE
A gas path performance diagnostic system to reduce J75-P-17 engine overhaul costs
[ASME PAPER 78-GT-116] A79-10267
JET AIRCRAFT
Flying angle of attack
A79-12384
JET AIRCRAFT NOISE
A performance measure for evaluating aircraft landing trajectories
A79-11494
Gas turbine jet exhaust noise prediction
[SAE ARP 876] A79-11623
Qualitative analysis of the effect of jet aircraft acoustic characteristics on the optimal take-off program
A79-12233
Community noise exposure resulting from aircraft operations. Volume 6: Acoustic data on Navy aircraft
[AD-A056217] N79-11566
JET ENGINE FUELS
The need and impact of long-term advances in aircraft technology - The airlines' point of view
[SAE PAPER 780554] A79-10410
Alternative aircraft fuels
A79-10824
Some aspects of aircraft jet engine fuels
A79-11368
Alternative aviation turbine fuels
A79-12378
Aviation turbine fuels, 1977
[BERC/PPS-78/2] N79-11240
JET ENGINES
Significance of disk flexing in viscous-damped jet engine dynamics
[ASME PAPER 78-GT-107] A79-10263
Experimental method for investigating preintake vortex circulation --- in engine air intakes
A79-11367
Internal mixer investigation for JT8D engine jet noise reduction. Volume 1: Results
[AD-A057309] N79-10059
Internal mixer investigation for JT8D engine jet noise reduction. Volume 2: Appendices A, B, C, and D
[AD-A057310/5] N79-10065
End wall and corner flow improvements of the rectangular Alperin jet-diffuser ejector
[AD-A057663] N79-11051
An investigation of the performance of a J52-P-8A engine operating under the influence of high bleed flow extraction rates
[AD-A057325] N79-11054
Jet engine test cells: Emissions and control measures, phase 1
[PB-283470/3] N79-11580
JET EXHAUST
Gas turbine jet exhaust noise prediction
[SAE ARP 876] A79-11623
Jet engines test cells: Emissions and control measures, phase 2
[PB-282412/6] N79-10072
JET FLAPS
Flight and propulsion control integration for selected in-flight thrust vectoring modes
[ASME PAPER 78-GT-79] A79-10768
JET FLOW
Jet curtain flameholder for aircraft afterburners
[ASME PAPER 78-GT-95] A79-10761
JORDAN
Planning, design and construction of the Queen Alia International Airport
[SAE PAPER 780531] A79-10401
JP-4 JET FUEL
Aviation turbine fuels, 1977
[BERC/PPS-78/2] N79-11240
JP-5 JET FUEL
Aviation turbine fuels, 1977
[BERC/PPS-78/2] N79-11240

K

KALMAN FILTERS
Performance analysis of a particularly simple Kalman filter --- for strapdown inertial navigation system
A79-12610

L

LAMINATES
All weather cockpit canopies. I - The F16
A79-10619
Improved ballistic damage tolerant design through laminated metal construction
A79-10912
Damage tolerance in advanced composite materials
A79-10915
LAND USE
LAX airport/land use planning study. Phase 1 report: Short term noise abatement
[PB-281622/1] N79-10071
LANDING GEAR
Relative pavement bearing strength requirements of aircraft
[SAE PAPER 780568] A79-10415
Advanced technology helicopter landing gear
A79-10918
LANDING INSTRUMENTS
Description and preliminary studies of a computer drawn instrument landing approach display
[NASA-TM-78771] N79-11039
LARGE SCALE INTEGRATION
Advanced technology impact upon ATE self test --- by use of microprocessors and LSI
A79-12306
LASER APPLICATIONS
Present and potential capabilities of three-dimensional displays using sequential excitation of fluorescence
A79-12033
LASER DOPPLER VELOCIMETERS
Investigation of the profile drag and the mean and pulsation velocities in the wake of wings by means of a laser Doppler anemometer
A79-12151
Velocity measurement about a NACA 0012 airfoil with a laser velometer
[AD-A056447] N79-10029
LEADING EDGES
Dynamic stall of an airfoil with leading edge bubble separation involving time dependent re-attachment
[ASME PAPER 78-GT-194] A79-10817
Calculation of flow past conical bodies with supersonic leading edges
A79-12227
LEAKAGE
Transmission seal development
[NASA-CR-135372] N79-10423
LIFT
Lift and longitudinal moment of a small-aspect-ratio wing in the proximity of a body of revolution
A79-12168
LIFT AUGMENTATION
Method of calculating potential flows of an incompressible fluid past a wing with a high-lift device
A79-12126
Study of aerodynamic technology for VSTOL fighter/attack aircraft, volume 1
[NASA-CR-152128] N79-10025
LIFT DEVICES
A lifting surface performance analysis with circulation coupled wake for advanced configuration hovering rotors
N79-10017
Direct numerical solution of the transonic perturbation integral equation for lifting and nonlifting airfoils
[NASA-TM-78518] N79-10045
LIFTING BODIES
Problems in the method of discrete vortices for solving linear wing theory problems
A79-12224

Theory of lifting surface in fluids of high electrical conductivity
A79-12394
Application of an interactive graphics system for the design and optimization of aircraft lifting surfaces
A79-12436
A lifting surface performance analysis with circulation coupled wake for advanced configuration hovering rotors
N79-10017

LIFTING ROTORS
Application of the lifting line concept to helicopter computation
[ONERA, TP NO. 1978-90] A79-11571
Moments on the hub of a lifting propeller with hinge-mounted blades
A79-12216

LIGHT AIRCRAFT
Turbine engines in light aircraft
A79-12380

LIGHTING EQUIPMENT
Aircraft lighting equipment --- interior and exterior illumination
A79-11366

LINEAR SYSTEMS
Desensitizing constant gain feedback linear regulators
A79-12290

LININGS
Demonstration of ceramic design methodology for a ceramic combustor liner
[ASME PAPER 78-GT-137] A79-10794

LIQUID BEARINGS
Significance of disk flexing in viscous-damped jet engine dynamics
[ASME PAPER 78-GT-107] A79-10263

LOAD TESTS
Composite rotor hub. I, II --- fatigue and load tests for CH-54B helicopter design
A79-10916
Summation of defects in the case of nonisothermal programmed loads --- for supersonic transport propulsion system components
A79-12164

LOADING MOMENTS
Load and dynamic assessment of B-52B-008 carrier aircraft for finned configuration 1 space shuttle solid rocket booster decelerator subsystem drop test vehicle. Volume 3: Pylon load data method 1
[NASA-CR-150835] N79-10050
Load and dynamic assessment of B-52B-008 carrier aircraft for finned configuration 1 space shuttle solid rocket booster deceleration subsystem drop test vehicle. Volume 4: Pylon load data
[NASA-CR-150836] N79-10051

LOADS (FORCES)
Load and dynamic assessment of B-52B-008 carrier aircraft for finned configuration 1 space shuttle solid rocket booster decelerator subsystem drop test vehicle. Volume 2: Airplane flutter and load analysis results
[NASA-CR-150834] N79-10049

LOGIC DESIGN
Development of gas turbine performance seeking logic
[ASME PAPER 78-GT-13] A79-10257

LONG TERM EFFECTS
The need and impact of long-term advances in aircraft technology - The airlines' point of view
[SAE PAPER 780554] A79-10410

LOW ASPECT RATIO WINGS
Lift and longitudinal moment of a small-aspect-ratio wing in the proximity of a body of revolution
A79-12168

LOW COST
The application of low cost manufacturing technology to a turbine gas generator
[ASME PAPER 78-GT-202] A79-10822

LOW SPEED WIND TUNNELS
Numerical study of the induction of porous walls of the working section of a low-velocity wind tunnel
A79-12228

LOW THRUST
The RB211-535 - New member of the family
[SAE PAPER 780512] A79-10392

LUBRICATING OILS
Aircraft piston oils: Past - present - future
A79-12377

LUGS
Residual strength of a cracked lug --- stress corrosion cracking of aluminum alloy lugs
[ARL-STRUC-NOTE-442] N79-10445

M

MAGNETOHYDRODYNAMIC FLOW
Theory of lifting surface in fluids of high electrical conductivity
A79-12394

MAINTAINABILITY
Management of test program development for S-3A --- avionics, maintainability and automatic test equipment
A79-12319

MAN MACHINE SYSTEMS
Experimental design for real-time simulations of air traffic control concepts
A79-11481

MANAGEMENT INFORMATION SYSTEMS
Federal Energy Data System (FEDS) technical documentation
[PB-281815/1] N79-11542

MANUALS
An evaluation of a new format for ejection information in a NATOPS manual
[AD-A056910] N79-10037
Principles of jet engine operation
[AD-A056158] N79-11050

MANUFACTURING
The utilization of data relating to fin geometry and manufacturing processes of ceramic matrix systems to the design of ceramic heat exchangers
A79-12824

MATHEMATICAL MODELS
Cascade - Queue model of airport users
[SAE PAPER 780518] A79-10394
Computations of three-dimensional gas-turbine combustion chamber flows
[ASME PAPER 78-GT-142] A79-10797
Calculation of transonic flows around wings
A79-11132
An instrumentation modeling technique used in the identification of aerodynamic coefficients from flight test data
[IAF PAPER 78-99] A79-11239
Optimal designing of gas-turbine engine thermogasdynamics on the basis of prototype elements. I
A79-12951
Air traffic control simulation models, volume 1. A bibliography with abstracts
[NTIS/PS-78/0787/8] N79-10043
Air traffic control simulation models, volume2. A bibliography with abstracts
[NTIS/PS-78/0788/6] N79-10044

METAL SHEETS
Improved ballistic damage tolerant design through laminated metal construction
A79-10912

METAL WORKING
New construction materials for gas turbine engines and technology for processing these materials
A79-12533

METAL-METAL BONDING
Ultrasonic welding /solid state bonding/ of aircraft structure - Fact or fancy
A79-10921

METEOROLOGICAL PARAMETERS
Meteorological icing conditions
N79-10005

MICROPROCESSORS
Advanced technology impact upon ATE self test --- by use of microprocessors and LSI
A79-12306

MICROSTRUCTURE
Influence of thermomechanical treatment on microstructure and mechanical properties of high strength aluminum alloys
[DLR-FB-77-50] N79-11203

MICROWAVE ANTENNAS
Polish radar developments
A79-10283
A yaw stabilised S.A.R. aerial
A79-10364

MILITARY AIRCRAFT
Military engine usage monitoring developments in the United Kingdom
[ASME PAPER 78-GT-65] A79-10772
Time-phased development methodology - The key for reliable engines in future military aircraft weapons systems
[ASME PAPER 78-GT-167] A79-10807
Impact of operational issues on design of advanced composite structures for Army helicopters
A79-10907
Commercial test software development practices for military applications --- for avionics support equipment
A79-12320
Integrated Avionics Control System (IACS)
[AD-A056476] N79-10056

MILITARY AVIATION
Support systems for advanced military electronics --- ATE design trends
A79-12305

MILITARY HELICOPTERS
Aircraft RAM (MMH/FH) data comparative analysis
[AD-A056893] N79-10001
Intensive tropic function testing
[AD-A056416] N79-10440
The effective acoustic environment of helicopter crewmen
N79-10850
A static acoustic signature system for the analysis of dynamic flight information
N79-10852

MILITARY TECHNOLOGY
20 hp mini-RPV demonstrator engine programs
[ASME PAPER 78-GT-200] A79-10820

MISSILE CONFIGURATIONS
Improved transonic nose drag estimates for the NSWC missile aerodynamic computer program
[AD-A056795] N79-10030

MIXERS
Internal mixer investigation for JT8D engine jet noise reduction. Volume 2: Appendices A, B, C, and D
[AD-A057310/5] N79-10065

MODULES
A high temperature turbine research module
[ASME PAPER 78-GT-73] A79-10769

MOISTURE CONTENT
Installation of icing tests
N79-10007
Experimental and theoretical study of the influence of various parameters on an icing section
N79-10012

MOUNTING
Antenna to IMU mounting for SAR motion compensation --- Inertial Measurement Unit
A79-11913

MOVING TARGET INDICATORS
Moving target detector data utilization study
A79-10318
Multi-filter MTI system
A79-10320

MULTIPHASE FLOW
Emission sample probe investigation of a mixed flow JT8D-11 turbofan engine
[AD-A058038] N79-11561

N

NACELLES
Development of an inlet for a tilt nacelle subsonic V/STOL aircraft
[ASME PAPER 78-GT-121] A79-10789

NASTRAN
The use of 3-D finite element analysis in the design of helicopter mechanical components
A79-10909

NAVIER-STOKES EQUATION
Numerical aerodynamic simulation facility --- for flows about three-dimensional configurations
N79-10450

NAVIGATION AIDS
Experimental design study of an airborne interferometer for terrain avoidance
A79-10381

NAVIGATION INSTRUMENTS
Aircraft radio equipment --- Russian book
A79-11439

NAVSTAR SATELLITES
From Transit to Navstar - Development trends of satellite navigation
A79-12527

NAVY
Community noise exposure resulting from aircraft operations. Volume 6: Acoustic data on Navy aircraft
[AD-A056217] N79-11566

NETWORK ANALYSIS
Aircraft electric power networks - Structures. I
A79-11369

NETWORK SYNTHESIS
Network design
N79-11008

NITROGEN OXIDES
Wide range operation of advanced low NOx aircraft gas turbine combustors
[ASME PAPER 78-GT-128] A79-10792

NOISE GENERATORS
Helicopter noise - State-of-the-art
[AIAA PAPER 77-1337] A79-12395
Helicopter cabin noise: Methods of source and path identification and characterization
N79-10856

NOISE MEASUREMENT
A method for assessing turbine engine run-up noise impact on airport neighbors
[SAE PAPER 780522] A79-10397
The effective acoustic environment of helicopter crewmen
N79-10850
The effect of operations on the ground noise footprints associated with a large multibladed, nonbanging helicopter
N79-10851
A static acoustic signature system for the analysis of dynamic flight information
N79-10852

NOISE POLLUTION
A method for assessing turbine engine run-up noise impact on airport neighbors
[SAE PAPER 780522] A79-10397
Pollution sources caused by aviation
A79-10453
Community noise exposure resulting from aircraft operations. Volume 6: Acoustic data on Navy aircraft
[AD-A056217] N79-11566

NOISE REDUCTION
Qualitative analysis of the effect of jet aircraft acoustic characteristics on the optimal take-off program
A79-12233
Helicopter noise - State-of-the-art
[AIAA PAPER 77-1337] A79-12395
Internal mixer investigation for JT8D engine jet noise reduction. Volume 1: Results
[AD-A057309] N79-10059
Internal mixer investigation for JT8D engine jet noise reduction. Volume 2: Appendices A, B, C, and D
[AD-A057310/5] N79-10065
An active noise reduction system for aircrew helmets
N79-10853
Design of helicopter rotors to noise constraints
N79-10854
The cost of applying current helicopter external noise reduction methods while maintaining realistic vehicle performance
N79-10855
Helicopter internal noise control: Three case histories
N79-10858
An analytical method for designing low noise helicopter transmissions
N79-10859
Helicopter internal noise reduction research and development application to the SA 360 and SA 365 Dauphin
N79-10861
Trends in Langley helicopter noise research
N79-10863

NONDESTRUCTIVE TESTS
Nondestructive inspection of aircraft structures and materials via acoustic emission
A79-10991

Potential applications of acoustic emission technology as a nondestructive evaluation method for naval aviation ground support
[AD-A056650] N79-10439
Preliminary evaluation of several nondestructive-evaluation techniques for silicon nitride gas-turbine rotors
[ANL-77-89] N79-11414

NONLINEAR PROGRAMMING
Optimal designing of gas-turbine engine thermogasdynamics on the basis of prototype elements. I
A79-12951

NONLINEAR SYSTEMS
Time-frequency method of solving large problems in the dynamics of elastic structures with local nonlinearities --- for aircraft structures
A79-12155

NOSE CONES
Vortex system at the nose part of a fuselage model at supercritical angles of attack and different Reynolds numbers
A79-12199
Northrop F-5F shark nose development
[NASA-CR-158936] N79-10047

NOTCH STRENGTH
Damage tolerance in advanced composite materials
A79-10915

NOZZLE GEOMETRY
Investigation of an ejector thrust-augmentor with a perforated nozzle for the ejected gas
A79-12196

NUMERICAL ANALYSIS
Method of determining the stability and controllability characteristics of an aircraft from the transient processes
A79-12176
Numerical-analytical solution of the problem of the constrained torsion of a cantilever wing
A79-12195
Application of optimization techniques in engineering design --- computerized structural design
A79-12404
A lifting surface performance analysis with circulation coupled wake for advanced configuration hovering rotors
N79-10017
A numerical solution of supersonic and hypersonic viscous flow fields around thin planar delta wings
N79-10018
Numerical calculation of transonic flow past a swept wing by a finite volume method
[CONF-771204-3] N79-10036
Direct numerical solution of the transonic perturbation integral equation for lifting and nonlifting airfoils
[NASA-TM-78518] N79-10045

NUMERICAL FLOW VISUALIZATION
Numerical solution of the direct problem of ideal gas flow in three-dimensional turbine cascades
A79-12194

NUMERICAL INTEGRATION
Numerical solution of a linear integral equation of the first kind in the inverse problem of symmetric flow past a wing
A79-12138

O

OILS
Oil sealing of aero engine bearing compartments
N79-11062

OMEGA NAVIGATION SYSTEM
The Omega navigation system - An overview
A79-12525

OMNIDIRECTIONAL RADIO RANGES
Radio navigation and antenna technology, an area of study of many years' standing at the Institute for Communications Engineering of Braunschweig Technical University
A79-12526

ON-LINE PROGRAMMING
On-line computer for transient turbine cascade instrumentation
A79-11488

OPTIMAL CONTROL
Qualitative analysis of the effect of jet aircraft acoustic characteristics on the optimal take-off program
A79-12233
Desensitizing constant gain feedback linear regulators
A79-12290

OPTIMIZATION
Development of gas turbine performance seeking logic
[ASME PAPER 78-GT-13] A79-10257
Application of gradient methods to the optimal design of components of load-bearing structures --- for aircraft minimum weight design
A79-12144
A method of solving multicriterial optimization problems for load-bearing structures --- for large aspect ratio wings
A79-12163
Application of optimization techniques in engineering design --- computerized structural design
A79-12404
Program REV - A wing structural optimization computer program for preliminary design of fighter aircraft
A79-12460
Optimal designing of gas-turbine engine thermogasdynamics on the basis of prototype elements. I
A79-12951
Solution of the inverse problem of aerodynamics by a random search technique
A79-12956

OSCILLATIONS
Improved sonic-box computer program for calculating transonic aerodynamic loads on oscillating wings with thickness
[NASA-CR-158906] N79-10998

P

PARACHUTE DESCENT
Detached flow about an opening canopy
A79-11006
Parachute canopy opening dynamics
A79-11008
Free periodic oscillations of a parachute system in the longitudinal plane
A79-12971

PARAMETERIZATION
Choice of the main parameters in the design of aircraft engines
A79-12528

PASSENGER AIRCRAFT
Operational reliability of climate and pressure control equipment for passenger aircraft --- Russian book
A79-10850
Aspects of short-takeoff aircraft --- optimization of aircraft, airports and flight regimes
A79-11444
Passenger ride quality in transport aircraft
A79-12396
Determination of the geometrical parameters and position of the nose flap at the root section of a swept wing on the basis of wind tunnel data. I
A79-12953
Choice of a fuselage for a passenger aircraft
A79-12968

PAVEMENTS
Relative pavement bearing strength requirements of aircraft
[SAE PAPER 780568] A79-10415
Airfield pavement evaluation, volume 4. A bibliography with abstracts
[NTIS/PS-78/0685/4] N79-10070

PERFORMANCE PREDICTION
A gas path performance diagnostic system to reduce J75-P-17 engine overhaul costs
[ASME PAPER 78-GT-116] A79-10267
A new stage stacking technique for axial-flow compressor performance prediction
[ASME PAPER 78-GT-139] A79-10268
Performance and design of transpiration-cooled turbine blading
[ASME PAPER 78-GT-122] A79-10790

Computations of three-dimensional gas-turbine combustion chamber flows
[ASME PAPER 78-GT-142] A79-10797
Research of the XF3-1 turbofan engine
[ASME PAPER 78-GT-199] A79-10819
A performance measure for evaluating aircraft landing trajectories
A79-11494
Helicopter noise - State-of-the-art
[AIAA PAPER 77-1337] A79-12395
A lifting surface performance analysis with circulation coupled wake for advanced configuration hovering rotors
N79-10017

PERFORMANCE TESTS
Demonstration of ceramic design methodology for a ceramic combustor liner
[ASME PAPER 78-GT-137] A79-10794
Advanced technology helicopter landing gear
A79-10918
Analysis, design, fabrication and testing of the Mini-Brayton rotating unit (MINI-BRU). Volume 2: Figures and drawings
[NASA-CR-159441-VOL-2] N79-11409

PERIPHERAL JET FLOW
Skirt components of the aerodynamic characteristics of an air-cushion vehicle using the oncoming flow to generate lift
A79-12949

PHASED ARRAYS
The control of tolerances in an array antenna
A79-11934

PHOTOGRAPHIC MEASUREMENT
Turbine blade tip clearance measurement utilizing borescope photography
[ASME PAPER 78-GT-164] A79-10805

PILOT ERROR
Listing of accidents/incidents by aircraft make and model, US Civil Aviation, 1976
[PB-283000/8] N79-11016

PILOT PERFORMANCE
Aircraft lighting equipment --- interior and exterior illumination
A79-11366
Flight experience with advanced controls and displays during piloted curved decelerating approaches in a powered-lift STOL aircraft
[NASA-TM-78527] N79-10054

PISTON ENGINES
Aircraft piston oils: Past - present - future
A79-12377
Energy conservation in general aviation and operation and maintenance of Avco Lycoming piston engines
A79-12381
Energy conservation in general aviation piston powered aircraft
A79-12382
Pilot program to develop operating time emission degradation factors for general aviation piston engines
[AD-A058158] N79-11562

PITCHING MOMENTS
Lift and longitudinal moment of a small-aspect-ratio wing in the proximity of a body of revolution
A79-12168

PLASTIC AIRCRAFT STRUCTURES
All weather cockpit canopies. I - The F16
A79-10619

PLUMES
Exhaust plume thermodynamic effects on nonaxisymmetric nozzle afterbody performance in transonic flow
[AD-A057363] N79-11052

POLLUTION CONTROL
The effects of aircraft engine pollutant emission measurement variability on engine certification policy
[ASME PAPER 78-GT-86] A79-10261
The effects of ambient conditions on gas turbine emissions - Generalized correction factors
[ASME PAPER 78-GT-87] A79-10262
Pollution sources caused by aviation
A79-10453
Wide range operation of advanced low NOx aircraft gas turbine combustors
[ASME PAPER 78-GT-128] A79-10792
Jet engines test cells: Emissions and control measures, phase 2
[PB-282412/6] N79-10072
Jet engine test cells: Emissions and control measures, phase 1
[PB-283470/3] N79-11580

POLYCARBONATES
All weather cockpit canopies. I - The F16
A79-10619

POROUS WALLS
Numerical study of the induction of porous walls of the working section of a low-velocity wind tunnel
A79-12228

POTENTIAL FLOW
Method of calculating potential flows of an incompressible fluid past a wing with a high-lift device
A79-12126

POTENTIAL THEORY
Unsteady subsonic and supersonic potential aerodynamics for complex configurations
A79-12366

POWER CONDITIONING
Development of a 10 KVA power conditioner unit, aircraft, 115/200 volt, 3-phase, 400 Hz
[AD-A056119] N79-11049

POWER PLANTS
Powerplant integration - The application of current experience to future developments
[ASME PAPER 78-GT-113] A79-10788

POWER SUPPLY CIRCUITS
The solid state remote power controller - Its status, use and perspective --- for aircraft and spacecraft
A79-10896

PREDICTION ANALYSIS TECHNIQUES
Gas turbine jet exhaust noise prediction
[SAE ARP 876] A79-11623
A practical approach to helicopter internal noise prediction
N79-10857

PRESSURE DISTRIBUTION
Analysis of the flow field in a radial compressor
[ASME PAPER 78-GT-7] A79-10776
Solution of the inverse problem of aerodynamics by a random search technique
A79-12956
Aerodynamic performance of a 1.35-pressure-ratio axial-flow fan stage
[NASA-TP-1299] N79-10022

PRESSURE REDUCTION
An investigation of the performance of a J52-P-8A engine operating under the influence of high bleed flow extraction rates
[AD-A057325] N79-11054

PRESSURE SENSORS
Recent developments in sensors for the gas turbine engine
[ASME PAPER 78-GT-52] A79-10760

PRESSURIZED CABINS
Operational reliability of climate and pressure control equipment for passenger aircraft --- Russian book
A79-10850

PROBABILITY DENSITY FUNCTIONS
Probability that the propagation of an undetected fatigue crack will not cause a structural failure
[AD-A057335] N79-11439

PRODUCTION ENGINEERING
Certain problems which had to be solved between the prototype stage and mass production stage in the development of an engine --- turboprop engine tests
A79-12532

PROJECT MANAGEMENT
Management of test program development for S-3A --- avionics, maintainability and automatic test equipment
A79-12319

PROPELLER BLADES
Propeller unsteady thrust due to operation in turbulent inflows
[ASME PAPER 78-GT-94] A79-10762
Moments on the hub of a lifting propeller with hinge-mounted blades
A79-12216

PROPULSION SYSTEM CONFIGURATIONS
On the conventional definitions of thrust/drag of an aircraft equipped with a turbojet engine A79-10618
Propulsion cycle and configuration commonality considerations for subsonic V/STOL design [ASME PAPER 78-GT-88] A79-10764
Impact of future fuel properties on aircraft engines and fuel systems A79-11600

PROPULSION SYSTEM PERFORMANCE
Simulation of helicopter powerplant performance [ASME PAPER 78-GT-51] A79-10774
Propulsion test facilities technical capabilities and international use [ASME PAPER 78-GT-184] A79-10813
Gas turbine engine inlet flow distortion guidelines [SAE ARP 1420] A79-11624

PROPULSIVE EFFICIENCY
Helicopter transport efficiency payoffs from advanced technology [SAE PAPER 780536] A79-10405

PROTOTYPES
Optimal designing of gas-turbine engine thermogasdynamics on the basis of prototype elements. I A79-12951

PULSE DOPPLER RADAR
Moving target detector data utilization study A79-10318

PULSE DURATION MODULATION
Development of a 10 KVA power conditioner unit, aircraft, 115/200 volt, 3-phase, 400 Hz [AD-A056119] N79-11049

PULSES
Helicopter bearing failure detection utilizing shock pulse techniques [AD-A057308] N79-11410

PYLON MOUNTING
Load and dynamic assessment of B-52B-008 carrier aircraft for finned configuration 1 space shuttle solid rocket booster decelerator subsystem drop test vehicle. Volume 1: Summary [NASA-CR-150833] N79-10048
Load and dynamic assessment of B-52B-008 carrier aircraft for finned configuration 1 space shuttle solid rocket booster decelerator subsystem drop test vehicle. Volume 3: Pylon load data method 1 [NASA-CR-150835] N79-10050
Load and dynamic assessment of B-52B-008 carrier aircraft for finned configuration 1 space shuttle solid rocket booster deceleration subsystem drop test vehicle. Volume 4: Pylon load data [NASA-CR-150836] N79-10051

Q

QUEUEING THEORY
Cascade - Queue model of airport users [SAE PAPER 780518] A79-10394

R

RADAR ANTENNAS
A yaw stabilised S.A.R. aerial A79-10364
Antenna to IMU mounting for SAR motion compensation --- Inertial Measurement Unit A79-11913
E-3A antenna pedestal turntable A79-11923

RADAR CROSS SECTIONS
A study of structural concepts for low radar cross section /LRCS/ fuselage configurations A79-10908

RADAR DATA
Enhancements of radar data-handling networks A79-10299
A technical review of the radar systems implemented by Eurocontrol A79-10329
Developments in radar data processing at the London Air Traffic Control Centre A79-10330

RADAR EQUIPMENT
Polish radar developments A79-10283
Thermal design of airborne radars - Present and future A79-11919
The control of tolerances in an array antenna A79-11934
Intensive tropic function testing [AD-A056416] N79-10440

RADAR FILTERS
Multi-filter MTI system A79-10320

RADAR IMAGERY
Enhancements of radar data-handling networks A79-10299

RADAR NAVIGATION
Experimental design study of an airborne interferometer for terrain avoidance A79-10381

RADAR RECEIVERS
Giant image 2 reliability and maintainability B-52D [AD-A057938] N79-11291

RADAR SCANNING
Track-while-scan algorithm in a clutter environment A79-11492

RADAR TRACKING
Track-while-scan algorithm in a clutter environment A79-11492

RADIAL FLOW
Analysis of the flow field in a radial compressor [ASME PAPER 78-GT-7] A79-10776

RADIATIVE HEAT TRANSFER
Three-dimensional radiative heat-transfer problem with shading --- modeling aircraft compartments thermodynamics A79-12784

RADIO EQUIPMENT
Aircraft radio equipment --- Russian book A79-11439

RADIO NAVIGATION
The Omega navigation system - An overview A79-12525
Radio navigation and antenna technology, an area of study of many years' standing at the Institute for Communications Engineering of Braunschweig Technical University A79-12526

RADIOGRAPHY
The contribution of dynamic X-ray to gas turbine air sealed technology N79-11065

RANDOM LOADS
Processing a random loading process by computer to obtain life information --- in-flight critical stress measurements in aircraft wing structures A79-12535

RANDOM PROCESSES
Solution of the inverse problem of aerodynamics by a random search technique A79-12956

REAL TIME OPERATION
Experimental design for real-time simulations of air traffic control concepts A79-11481

REATTACHED FLOW
Dynamic stall of an airfoil with leading edge bubble separation involving time dependent re-attachment [ASME PAPER 78-GT-194] A79-10817

RECOMMENDATIONS
Planning for airport access: An analysis of the San Francisco Bay area. Introduction and conclusions N79-10943

RECTANGULAR PLANFORMS
Three-dimensional radiative heat-transfer problem with shading --- modeling aircraft compartments thermodynamics A79-12784

RECTANGULAR WINGS
Calculation of transonic flows around wings A79-11132

REFRIGERATORS
Turbine-driven refrigeration units in gas turbine engine cooling systems --- Russian book A79-11441

REGENERATIVE COOLING
Advanced environmental cooling concepts for supersonic aircraft [ASME PAPER 78-ENAS-21] A79-12570

REGULATORS
Desensitizing constant gain feedback linear regulators
A79-12290

REINFORCED PLASTICS
Survey of the application of reinforced composites in European helicopters
A79-10917

REINFORCED PLATES
Thermal stability of ribbed sheet systems
A79-12137

RELIABILITY ANALYSIS
Operational reliability of climate and pressure control equipment for passenger aircraft --- Russian book
A79-10850
Determination of inspection intervals for aircraft structures with allowance for the two-stage nature of fatigue damage
A79-12135
Statistical diagnostics of aircraft engines
A79-12950

RELIABILITY ENGINEERING
Hazard criticality analysis --- with emphasis on aircraft components
A79-10621
A high temperature turbine research module
[ASME PAPER 78-GT-73] A79-10769
Time-phased development methodology - The key for reliable engines in future military aircraft weapons systems
[ASME PAPER 78-GT-167] A79-10807
Thermal design of airborne radars - Present and future
A79-11919
Support systems for advanced military electronics --- ATE design trends
A79-12305

REMOTE CONTROL
The solid state remote power controller - Its status, use and perspective --- for aircraft and spacecraft
A79-10896

REMOTELY PILOTED VEHICLES
20 hp mini-RPV demonstrator engine programs
[ASME PAPER 78-GT-200] A79-10820
Infrared landing system for a mini remotely-piloted vehicle
A79-12093
Aerodynamic design and analysis of propellers for mini-remotely piloted air vehicles. Volume 2: Ducted propellers
[AD-A056948] N79-10062

RESEARCH AND DEVELOPMENT
Research of the XF3-1 turbofan engine
[ASME PAPER 78-GT-199] A79-10819

RESEARCH MANAGEMENT
Trends in Langley helicopter noise research
N79-10863
Aeroacoustic research: An Army perspective
N79-10864

RIBS (SUPPORTS)
Thermal stability of ribbed sheet systems
A79-12137

RIDING QUALITY
Passenger ride quality in transport aircraft
A79-12396

RING WINGS
Harmonic vibrations of an annular wing in the steady flow of an ideal fluid
A79-12963

ROCKET NOSE CONES
Improved transonic nose drag estimates for the NSWC missile aerodynamic computer program
[AD-A056795] N79-10030

ROTARY WINGS
Damage-tolerant design of the YUH-61A main rotor system
A79-10911
The survivability of helicopters to rotor blade ballistic damage
A79-10913
Damage tolerant design of the YAH-64 main rotor blade
A79-10914
Composite rotor hub. I, II --- fatigue and load tests for CH-54B helicopter design
A79-10916
Survey of the application of reinforced composites in European helicopters
A79-10917
Development of a multitubular spar composite main rotor blade
A79-10919
Boeing Vertol bearingless main rotor structural design approach using advanced composites
A79-10920
Helicopter noise - State-of-the-art
[AIAA PAPER 77-1337] A79-12395
Engine/airframe/drive train dynamic interface documentation
[AD-A056956] N79-10064
Subjective evaluation of helicopter blade slap noise
N79-10844
Design of helicopter rotors to noise constraints
N79-10854
The status of rotor noise technology: One man's opinion
N79-10862
Comparison of the effect of structural coupling parameters on flap-lag forced response and stability of a helicopter rotor blade in forward flight
[AD-A056485] N79-11037
Vibratory ice protection for helicopter rotor blades
[AD-A057329] N79-11038

ROTATING BODIES
An instrumentation modeling technique used in the identification of aerodynamic coefficients from flight test data
[IAF PAPER 78-99] A79-11239

ROTATING DISKS
Significance of disk flexing in viscous-damped jet engine dynamics
[ASME PAPER 78-GT-107] A79-10263
Gas turbine disc sealing system design
N79-11072

ROTATING FLUIDS
Small perturbation analysis of nonuniform rotating disturbances in a vaneless diffuser
[ASME PAPER 78-GT-154] A79-10270

ROTATING SHAFTS
Self-acting shaft seals --- gas turbine engines
N79-11070

ROTATING STALLS
A rotating stall control system for turbojet engines
[ASME PAPER 78-GT-115] A79-10757

ROTOR AERODYNAMICS
An experimental study of three-dimensional turbulent boundary layer and turbulence characteristics inside a turbomachinery rotor passage
[ASME PAPER 78-GT-114] A79-10266
Helicopter transport efficiency payoffs from advanced technology
[SAE PAPER 780536] A79-10405
A design point correlation for losses due to part-span dampers on transonic rotors
[ASME PAPER 78-GT-153] A79-10802
A lifting surface performance analysis with circulation coupled wake for advanced configuration hovering rotors
N79-10017
The status of rotor noise technology: One man's opinion
N79-10862

ROTOR BLADES
Derivation of control loads for bearingless rotor systems --- in helicopter design
A79-10906
Apparatus and method for reducing thermal stress in a turbine rotor
[NASA-CASE-LEW-12232-1] N79-10057

ROTOR LIFT
Application of the lifting line concept to helicopter computation
[ONERA, TP NO. 1978-90] A79-11571

ROTORS
Preliminary evaluation of several nondestructive-evaluation techniques for silicon nitride gas-turbine rotors
[ANL-77-89] N79-11414

RUNWAY CONDITIONS
Relative pavement bearing strength requirements of aircraft
[SAE PAPER 780568] A79-10415

Airfield pavement evaluation, volume 4. A bibliography with abstracts
[NTIS/PS-78/0685/4] N79-10070
RUNWAYS
Commercial STOL - The airplane, the airport
[SAE PAPER 780520] A79-10396
The airport capacity increasing potential of angled runway exit designs
[SAE PAPER 780567] A79-10414
Arresting hook installation, land based aircraft, emergency
[SAE ARP 1538] A79-11625

S

S-3 AIRCRAFT
Management of test program development for S-3A --- avionics, maintainability and automatic test equipment
A79-12319
SAN FRANCISCO BAY (CA)
Planning for airport access: An analysis of the San Francisco Bay area
[NASA-CP-2044] N79-10942
Planning for airport access: An analysis of the San Francisco Bay area. Introduction and conclusions
N79-10943
Planning for airport access: An analysis of the San Francisco Bay area. The setting
N79-10944
Components of the airport access system
N79-10945
Planning for airport access: An analysis of the San Francisco Bay area. Existing studies
N79-10946
Planning for airport access: An analysis of the San Francisco Bay area. Technological options
N79-10947
Planning for airport access: An analysis of the San Francisco Bay area. Three subsystem designs
N79-10948
SATELLITE NAVIGATION SYSTEMS
From Transit to Navstar - Development trends of satellite navigation
A79-12527
SEALERS
Gas path sealing in turbine engines
N79-11057
Use of coatings in turbomachinery gas path seals
N79-11058
SEALING
Oil sealing of aero engine bearing compartments
N79-11062
The contribution of dynamic X-ray to gas turbine air sealed technology
N79-11065
Gas turbine disc sealing system design
N79-11072
SEALS (STOPPERS)
A discussion of turbine and compressor sealing devices and systems
A79-12373
Transmission seal development
[NASA-CR-135372] N79-10423
Superalloy knife edge seal repair
[AD-A057269] N79-11055
Seal Technology in Gas Turbine Engines
[AGARD-CP-237] N79-11056
Gas path sealing in turbine engines
N79-11057
American Airlines' operational and maintenance experience with aerodynamic seals and oil seals in turbofan engines
N79-11061
Oil sealing of aero engine bearing compartments
N79-11062
The contribution of dynamic X-ray to gas turbine air sealed technology
N79-11065
Determining and improving labyrinth seal performance in current and advanced high performance gas turbines
N79-11068
Factors associated with rub tolerance of compressor tip seals --- self sustained combustion of titanium
N79-11069
Self-acting shaft seals --- gas turbine engines
N79-11070
Self active pad seal application for high pressure engines
N79-11071
SEAMS (JOINTS)
Superalloy knife edge seal repair
[AD-A057269] N79-11055
SECONDARY FLOW
An axial compressor end-wall boundary layer calculation method
[ASME PAPER 78-GT-81] A79-10767
SECONDARY RADAR
Stochastic Response Secondary Surveillance Radar /S.R.S.S.R./
A79-10341
SELF OSCILLATION
Free periodic oscillations of a parachute system in the longitudinal plane
A79-12971
SENSORS
Multisensor utilization investigation --- for automated ATC surveillance
A79-10332
SEPARATED FLOW
Detached flow about an opening canopy
A79-11006
Contribution to the asymptotic theory of flows at the trailing edge of a slender wing
A79-12127
Some types of separated flow past slotted wings
A79-12148
Flying hot-wire study of two-dimensional turbulent separation on an NACA 4412 airfoil at maximum lift
N79-10019
The flying hot wire and related instrumentation
[NASA-CR-3066] N79-11352
SERVICE LIFE
Military engine usage monitoring developments in the United Kingdom
[ASME PAPER 78-GT-65] A79-10772
Development of a compact gas turbine combuster to give extended life and acceptable exhaust emissions
[ASME PAPER 78-GT-146] A79-10799
Determination of inspection intervals for aircraft structures with allowance for the two-stage nature of fatigue damage
A79-12135
SH-3 HELICOPTER
Simulation of helicopter powerplant performance
[ASME PAPER 78-GT-51] A79-10774
SHADOWS
Three-dimensional radiative heat-transfer problem with shading --- modeling aircraft compartments thermodynamics
A79-12784
SHALE OIL
Alternative aircraft fuels
A79-10824
SHOCK ABSORBERS
Advanced technology helicopter landing gear
A79-10918
SHOCK WAVE PROPAGATION
Theory of large-aspect ratio wings in transonic gas flow
A79-12226
Helicopter bearing failure detection utilizing shock pulse techniques
[AD-A057308] N79-11410
SHORT TAKEOFF AIRCRAFT
Commercial STOL - The airplane, the airport
[SAE PAPER 780520] A79-10396
Aspects of short-takeoff aircraft --- optimization of aircraft, airports and flight regimes
A79-11444
Flight experience with advanced controls and displays during piloted curved decelerating approaches in a powered-lift STOL aircraft
[NASA-TM-78527] N79-10054
SHROUDED PROPELLERS
Aerodynamic design and analysis of propellers for mini-remotely piloted air vehicles. Volume 2: Ducted propellers
[AD-A056948] N79-10062
SIGNAL PROCESSING
Multi-filter MTI system
A79-10320

SIGNATURE ANALYSIS
A static acoustic signature system for the analysis of dynamic flight information
N79-10852

SKIN (STRUCTURAL MEMBER)
Ultrasonic welding /solid state bonding/ of aircraft structure - Fact or fancy
A79-10921

SLENDER BODIES
Lift and longitudinal moment of a small-aspect-ratio wing in the proximity of a body of revolution
A79-12168

SLENDER WINGS
Contribution to the asymptotic theory of flows at the trailing edge of a slender wing
A79-12127
Theory of large-aspect ratio wings in transonic gas flow
A79-12226

SMALL PERTURBATION FLOW
Small perturbation analysis of nonuniform rotating disturbances in a vaneless diffuser
[ASME PAPER 78-GT-154] A79-10270

SNOW
Tests under snow and icing conditions with the BO 105 engine installation
N79-10014

SOLID STATE DEVICES
The solid state remote power controller - Its status, use and perspective --- for aircraft and spacecraft
A79-10896

SOUND PROPAGATION
Helicopter cabin noise: Methods of source and path identification and characterization
N79-10856

SPACECRAFT POWER SUPPLIES
The solid state remote power controller - Its status, use and perspective --- for aircraft and spacecraft
A79-10896

SPEED INDICATORS
Recent developments in sensors for the gas turbine engine
[ASME PAPER 78-GT-52] A79-10760

SPIN DYNAMICS
SPINEQ: A program for determining aircraft equilibrium spin characteristics including stability
[NASA-TM-78759] N79-11074

SPIN STABILIZATION
SPINEQ: A program for determining aircraft equilibrium spin characteristics including stability
[NASA-TM-78759] N79-11074

SPLITTING
Transonic 3-D flow analysis of compressor cascade with splinter vanes
[AD-A057504] N79-11004

SPOILER SLOT AILERONS
Wind tunnel tests of the GA(W)-2 airfoil with 20% aileron, 25% slotted flap, 30% Fowler flap and 10% slot-lip spoiler
[NASA-CR-145139] N79-10021

STABILITY AUGMENTATION
Active control --- aircraft systems
A79-12534

STABILITY DERIVATIVES
Aerodynamic force and moment on oscillating airfoils in cascade
[ASME PAPER 78-GT-181] A79-10812
Flight-determined stability and control derivatives for the F-111 Tact research aircraft
[NASA-TP-1350] N79-10068

STABILIZATION
Investigations for the calculation of robust control systems --- aircraft control, sensor failure
[ESA-TT-488] N79-11076

STABILIZED PLATFORMS
E-3A antenna pedestal turntable
A79-11923

STATISTICAL ANALYSIS
Statistical diagnostics of aircraft engines
A79-12950

STOCHASTIC PROCESSES
Stochastic Response Secondary Surveillance Radar /S.R.S.S.R./
A79-10341

STRAPDOWN INERTIAL GUIDANCE
Performance analysis of a particularly simple Kalman filter --- for strapdown inertial navigation system
A79-12610

STREAMLINING
Numerical solution of a linear integral equation of the first kind in the inverse problem of symmetric flow past a wing
A79-12138
Effect of viscosity on nonseparated transonic flow past a profile
A79-12205

STRESS ANALYSIS
Method for determining maximum allowable stress for preliminary aircraft wing design
A79-11370

STRESS CORROSION CRACKING
Residual strength of a cracked lug --- stress corrosion cracking of aluminum alloy lugs
[ARL-STRUC-NOTE-442] N79-10445

STRESS MEASUREMENT
Processing a random loading process by computer to obtain life information --- in-flight critical stress measurements in aircraft wing structures
A79-12535

STRESS RELIEVING
Decreasing stress concentrations in structures made of high-strength materials
A79-12145

STRUCTURAL ANALYSIS
Cyclic linkage of finite elements with application --- to aircraft structural analysis
[IAF PAPER 78-213] A79-11294
Thermal-structural mission analyses of air-cooled gas turbine blades
[NASA-TM-78963] N79-11433

STRUCTURAL DESIGN
Conference on Helicopter Structures Technology, Moffett Field, Calif., November 16-18, 1977, Proceedings
A79-10903
Structural design flight maneuver loads using PDP-10 flight dynamics model
A79-10905
A study of structural concepts for low radar cross section /LRCS/ fuselage configurations
A79-10908
The use of 3-D finite element analysis in the design of helicopter mechanical components
A79-10909
Boeing Vertol bearingless main rotor structural design approach using advanced composites
A79-10920
Decreasing stress concentrations in structures made of high-strength materials
A79-12145
Application of optimization techniques in engineering design --- computerized structural design
A79-12404

STRUCTURAL DESIGN CRITERIA
The effects of latest military criteria on the structural weight of the Hughes advanced attack helicopter - YAH-64
A79-10904
Impact of operational issues on design of advanced composite structures for Army helicopters
A79-10907
A glance at Soviet helicopter design philosophy
A79-10910
Thermal design of airborne radars - Present and future
A79-11919
Quality index for an iterative process of optimizing long-range aircraft parameters
A79-12152
A method of solving multicriterial optimization problems for load-bearing structures --- for large aspect ratio wings
A79-12163

STRUCTURAL FAILURE
Probability that the propagation of an undetected fatigue crack will not cause a structural failure
[AD-A057335] N79-11439

STRUCTURAL RELIABILITY
Damage-tolerant design of the YUH-61A main rotor system
A79-10911
STRUCTURAL STABILITY
Relative pavement bearing strength requirements of aircraft
[SAE PAPER 780568] A79-10415
Thermal stability of ribbed sheet systems
A79-12137
Approximate solution of some boundary value problems on aircraft structural integrity
A79-12234
STRUCTURAL WEIGHT
The effects of latest military criteria on the structural weight of the Hughes advanced attack helicopter - YAH-64
A79-10904
Application of gradient methods to the optimal design of components of load-bearing structures --- for aircraft minimum weight design
A79-12144
SUBSONIC AIRCRAFT
Propulsion cycle and configuration commonality considerations for subsonic V/STOL design
[ASME PAPER 78-GT-88] A79-10764
Development of an inlet for a tilt nacelle subsonic V/STOL aircraft
[ASME PAPER 78-GT-121] A79-10789
SUBSONIC FLOW
Calculation of effect of viscosity on nonseparated subsonic flow past a wing with flap
A79-12240
Unsteady subsonic and supersonic potential aerodynamics for complex configurations
A79-12366
SUBSONIC WIND TUNNELS
A general correction method of the interference in 2-dimensional wind tunnels with ventilated walls
A79-10867
SUPERCRITICAL FLOW
Vortex system at the nose part of a fuselage model at supercritical angles of attack and different Reynolds numbers
A79-12199
SUPERSONIC AIRCRAFT
Calculation of the transient aerodynamic characteristics of a supersonic flight vehicle
A79-12182
SUPERSONIC COMPRESSORS
Supersonic unstalled flutter
A79-12599
SUPERSONIC FLIGHT
Overall aerodynamic characteristics of conical and delta wings at supersonic speeds
A79-12966
SUPERSONIC FLOW
Regimes of supersonic flow past thin wings
A79-12188
Calculation of flow past conical bodies with supersonic leading edges
A79-12227
Unsteady subsonic and supersonic potential aerodynamics for complex configurations
A79-12366
SUPERSONIC FLUTTER
Supersonic unstalled flutter
A79-12599
Supersonic unstalled flutter --- aerodynamic loading of thin airfoils induced by cascade motion
[NASA-TM-79001] N79-11000
SUPERSONIC INLETS
A computer program for the calculation of the flow field in supersonic mixed-compression inlets at angle of attack wing the three-dimensional method of characteristics with discrete shock wave fitting
[NASA-TM-78947] N79-10023
SUPERSONIC TRANSPORTS
Summation of defects in the case of nonisothermal programmed loads --- for supersonic transport propulsion system components
A79-12164
Advanced environmental cooling concepts for supersonic aircraft
[ASME PAPER 78-ENAS-21] A79-12570
SUPPORT SYSTEMS
Support systems for advanced military electronics --- ATE design trends
A79-12305
SUPPRESSORS
Infrared suppressor effect on T63 turboshaft engine performance
[NASA-TM-78970] N79-11043
SURFACE FINISHING
Use of coatings in turbomachinery gas path seals
N79-11058
SURFACE GEOMETRY
Application of an interactive graphics system for the design and optimization of aircraft lifting surfaces
A79-12436
SURVEILLANCE RADAR
Polish radar developments
A79-10283
Multisensor utilization investigation --- for automated ATC surveillance
A79-10332
Stochastic Response Secondary Surveillance Radar /S.R.S.S.R./
A79-10341
SWEPT WINGS
Numerical calculation of transonic flow past a swept wing by a finite volume method
[CONF-771204-3] N79-10036
SYNTHETIC APERTURE RADAR
A yaw stabilised S.A.R. aerial
A79-10364
Antenna to IMU mounting for SAR motion compensation --- Inertial Measurement Unit
A79-11913
SYNTHETIC FUELS
Characteristics and combustion of future hydrocarbon fuels
A79-11599
SYSTEM EFFECTIVENESS
An evaluation technique for determining the cost effectiveness of condition monitoring systems
[ASME PAPER 78-GT-166] A79-10806
SYSTEMS ANALYSIS
Issues in the design and analysis of airport ground transport systems
[SAE PAPER 780519] A79-10395
Rotorcraft for transport use - European requirements
[SAE PAPER 780535] A79-10404
Directions for developing an air cargo system planning model
[SAE PAPER 780556] A79-10411
SYSTEMS ENGINEERING
Powerplant integration - The application of current experience to future developments
[ASME PAPER 78-GT-113] A79-10788
Aircraft air conditioning systems --- Russian book
A79-11442
F-16 LRU test programs - A systems approach --- Line Replaceable Units
A79-12321
Planning for airport access: An analysis of the San Francisco Bay area. Three subsystem designs
N79-10948
Network design
N79-11008
Self active pad seal application for high pressure engines
N79-11071
Gas turbine disc sealing system design
N79-11072

T

T-53 ENGINE
Study of T53 engine vibration
[NASA-CR-135449] N79-10061
T-63 ENGINE
Infrared suppressor effect on T63 turboshaft engine performance
[NASA-TM-78970] N79-11043
TAIL ASSEMBLIES
Highly survivable truss type tail boom
[AD-A056430] N79-10052
TAIL ROTORS
Vibratory ice protection for helicopter rotor blades
[AD-A057329] N79-11038

TAKEOFF
Arresting hook installation, land based aircraft, emergency
[SAE ARP 1538] A79-11625
TAKEOFF RUNS
Qualitative analysis of the effect of jet aircraft acoustic characteristics on the optimal take-off program
A79-12233
TARGET RECOGNITION
Track-while-scan algorithm in a clutter environment
A79-11492
The control of tolerances in an array antenna
A79-11934
TECHNOLOGICAL FORECASTING
The need and impact of long-term advances in aircraft technology - The airlines' point of view
[SAE PAPER 780554] A79-10410
Advanced turbofan engines for low fuel consumption
[ASME PAPER 78-GT-192] A79-10816
TECHNOLOGY ASSESSMENT
Polish radar developments
A79-10283
Helicopter transport efficiency payoffs from advanced technology
[SAE PAPER 780536] A79-10405
Aircraft lighting equipment --- interior and exterior illumination
A79-11366
Energy conservation aircraft design and operational procedures
[ONERA, TP NO. 1978-107] A79-11572
Aircraft piston oils: Past - present - future
A79-12377
New construction materials for gas turbine engines and technology for processing these materials
A79-12533
The status of rotor noise technology: One man's opinion
N79-10862
Planning for airport access: An analysis of the San Francisco Bay area. Technological options
N79-10947
TECHNOLOGY TRANSFER
Commercial test software development practices for military applications --- for avionics support equipment
A79-12320
TELEVISION SYSTEMS
Method of eliminating static and dynamic errors in the reproduction of motion of TV-simulator displays --- for aircraft flight
A79-12153
TEMPERATURE SENSORS
Recent developments in sensors for the gas turbine engine
[ASME PAPER 78-GT-52] A79-10760
TERMINAL CONFIGURED VEHICLE PROGRAM
Operational benefits from the Terminal Configured Vehicle --- aircraft equipment for air traffic improvement
A79-10390
TERMINAL FACILITIES
Planning the passenger terminal
[SAE PAPER 780517] A79-10393
Airport development in Micronesia
[SAE PAPER 780530] A79-10400
TEST FACILITIES
Propulsion test facilities technical capabilities and international use
[ASME PAPER 78-GT-184] A79-10813
Icing test facilities at the National Gas Turbine Establishment
N79-10006
Jet engines test cells: Emissions and control measures, phase 2
[PB-282412/6] N79-10072
TEST VEHICLES
Load and dynamic assessment of B-52B-008 carrier aircraft for finned configuration 1 space shuttle solid rocket booster decelerator subsystem drop test vehicle. Volume 1: Summary
[NASA-CR-150833] N79-10048
Load and dynamic assessment of B-52B-008 carrier aircraft for finned configuration 1 space shuttle solid rocket booster decelerator subsystem drop test vehicle. Volume 2: Airplane flutter and load analysis results
[NASA-CR-150834] N79-10049
Load and dynamic assessment of B-52B-008 carrier aircraft for finned configuration 1 space shuttle solid rocket booster decelerator subsystem drop test vehicle. Volume 3: Pylon load data method 1
[NASA-CR-150835] N79-10050
Load and dynamic assessment of B-52B-008 carrier aircraft for finned configuration 1 space shuttle solid rocket booster deceleration subsystem drop test vehicle. Volume 4: Pylon load data
[NASA-CR-150836] N79-10051
THERMAL CYCLING TESTS
Summation of defects in the case of nonisothermal programmed loads --- for supersonic transport propulsion system components
A79-12164
THERMAL STABILITY
Some aspects of aircraft jet engine fuels
A79-11368
Thermal design of airborne radars - Present and future
A79-11919
Thermal stability of ribbed sheet systems
A79-12137
THERMAL STRESSES
The utilization of data relating to fin geometry and manufacturing processes of ceramic matrix systems to the design of ceramic heat exchangers
A79-12824
Apparatus and method for reducing thermal stress in a turbine rotor
[NASA-CASE-LEW-12232-1] N79-10057
THERMOCOUPLES
Recent developments in sensors for the gas turbine engine
[ASME PAPER 78-GT-52] A79-10760
THERMODYNAMIC PROPERTIES
Alternative aviation turbine fuels
A79-12378
Exhaust plume thermodynamic effects on nonaxisymmetric nozzle afterbody performance in transonic flow
[AD-A057363] N79-11052
THERMODYNAMICS
Principles of jet engine operation
[AD-A056158] N79-11050
THERMOMECHANICAL TREATMENT
Influence of thermomechanical treatment on microstructure and mechanical properties of high strength aluminum alloys
[DLR-FB-77-50] N79-11203
THICKNESS RATIO
Inverse mixed problem for a profile with a prescribed velocity distribution on one of its sides and a known thickness distribution
A79-12970
THIN AIRFOILS
Dynamic stall of an airfoil with leading edge bubble separation involving time dependent re-attachment
[ASME PAPER 78-GT-194] A79-10817
Theory of lifting surface in fluids of high electrical conductivity
A79-12394
Supersonic unstalled flutter --- aerodynamic loading of thin airfoils induced by cascade motion
[NASA-TM-79001] N79-11000
THIN WINGS
A method of solving multicriterial optimization problems for load-bearing structures --- for large aspect ratio wings
A79-12163
Regimes of supersonic flow past thin wings
A79-12188
Theory of large-aspect ratio wings in transonic gas flow
A79-12226
A numerical solution of supersonic and hypersonic viscous flow fields around thin planar delta wings
N79-10018
THREE DIMENSIONAL BOUNDARY LAYER
An experimental study of three-dimensional turbulent boundary layer and turbulence characteristics inside a turbomachinery rotor passage
[ASME PAPER 78-GT-114] A79-10266

THREE DIMENSIONAL FLOW
Computations of three-dimensional gas-turbine combustion chamber flows
[ASME PAPER 78-GT-142] A79-10797
Numerical solution of the direct problem of ideal gas flow in three-dimensional turbine cascades
A79-12194
Numerical aerodynamic simulation facility --- for flows about three-dimensional configurations
N79-10450

THRUST
The CF6-32 as a derivative engine of the CF6-6
[SAE PAPER 780511] A79-10391
On the conventional definitions of thrust/drag of an aircraft equipped with a turbojet engine
A79-10618

THRUST AUGMENTATION
Investigation of an ejector thrust-augmentor with a perforated nozzle for the ejected gas
A79-12196
End wall and corner flow improvements of the rectangular Alperin jet-diffuser ejector
[AD-A057663] N79-11051
An investigation of the performance of a J52-P-8A engine operating under the influence of high bleed flow extraction rates
[AD-A057325] N79-11054

THRUST BEARINGS
High efficiency fluid film thrust bearings for turbomachinery
A79-12371
Self-acting shaft seals --- gas turbine engines
N79-11070

THRUST CONTROL
Design of a multivariable controller for a high-order turbofan engine model by Zakian's method of inequalities
A79-12287

THRUST VECTOR CONTROL
Flight and propulsion control integration for selected in-flight thrust vectoring modes
[ASME PAPER 78-GT-79] A79-10768

TILT ROTOR AIRCRAFT
Development of an inlet for a tilt nacelle subsonic V/STOL aircraft
[ASME PAPER 78-GT-121] A79-10789

TITANIUM
Factors associated with rub tolerance of compressor tip seals --- self sustained combustion of titanium
N79-11069

TOLERANCES (MECHANICS)
The control of tolerances in an array antenna
A79-11934

TORSIONAL STRESS
Derivation of control loads for bearingless rotor systems --- in helicopter design
A79-10906

TORSIONAL VIBRATION
Numerical-analytical solution of the problem of the constrained torsion of a cantilever wing
A79-12195

TOWING
Tow bar for aircraft
[NASA-CASE-FRC-11022-1] N79-10069

TRAFFIC
Planning for airport access: An analysis of the San Francisco Bay area
[NASA-CP-2044] N79-10942
Planning for airport access: An analysis of the San Francisco Bay area. Introduction and conclusions
N79-10943
Planning for airport access: An analysis of the San Francisco Bay area. The setting
N79-10944
Components of the airport access system
N79-10945

TRAILING EDGES
Contribution to the asymptotic theory of flows at the trailing edge of a slender wing
A79-12127

TRAJECTORY ANALYSIS
A performance measure for evaluating aircraft landing trajectories
A79-11494

TRANSIENT LOADS
Calculation of the transient aerodynamic characteristics of a supersonic flight vehicle
A79-12182

TRANSIENT RESPONSE
Method of determining the stability and controllability characteristics of an aircraft from the transient processes
A79-12176

TRANSIT SATELLITES
From Transit to Navstar - Development trends of satellite navigation
A79-12527

TRANSMISSIONS (MACHINE ELEMENTS)
Engine/airframe/drive train dynamic interface documentation
[AD-A056956] N79-10064
An analytical method for designing low noise helicopter transmissions
N79-10859

TRANSONIC FLOW
Calculation of transonic flows around wings
A79-11132
Effect of viscosity on nonseparated transonic flow past a profile
A79-12205
Theory of large-aspect ratio wings in transonic gas flow
A79-12226
Numerical calculation of transonic flow past a swept wing by a finite volume method
[CONF-771204-3] N79-10036
Direct numerical solution of the transonic perturbation integral equation for lifting and nonlifting airfoils
[NASA-TM-78518] N79-10045
Performance of single-stage axial-flow transonic compressor with rotor and stator aspect ratios of 1.19 and 1.26, respectively, and with design pressure ratio of 1.82
[NASA-TP-1338] N79-10060
Improved sonic-box computer program for calculating transonic aerodynamic loads on oscillating wings with thickness
[NASA-CR-158906] N79-10998
Sonic-box method employing local Mach number for oscillating wings with thickness
[NASA-CR-158907] N79-10999
Exhaust plume thermodynamic effects on nonaxisymmetric nozzle afterbody performance in transonic flow
[AD-A057363] N79-11052

TRANSONIC SPEED
A design point correlation for losses due to part-span dampers on transonic rotors
[ASME PAPER 78-GT-153] A79-10802

TRANSPIRATION
Performance and design of transpiration-cooled turbine blading
[ASME PAPER 78-GT-122] A79-10790

TRANSPORT AIRCRAFT
The CF6-32 as a derivative engine of the CF6-6
[SAE PAPER 780511] A79-10391
Aspects of short-takeoff aircraft --- optimization of aircraft, airports and flight regimes
A79-11444
Passenger ride quality in transport aircraft
A79-12396

TRANSPORTATION
Issues in the design and analysis of airport ground transport systems
[SAE PAPER 780519] A79-10395

TROPICAL REGIONS
Intensive tropic function testing
[AD-A056416] N79-10440

TRUSSES
Highly survivable truss type tail boom
[AD-A056430] N79-10052

TURBINE BLADES
Determination of the aerodynamic damping of turbine blade vibrations with allowance for the pitch, exit blade angle, and blade curvature
A79-10568
An axial compressor end-wall boundary layer calculation method
[ASME PAPER 78-GT-81] A79-10767
Performance and design of transpiration-cooled turbine blading
[ASME PAPER 78-GT-122] A79-10790

Turbine blade tip clearance measurement utilizing borescope photography
[ASME PAPER 78-GT-164] A79-10805
Influence of geometric effects on the aspect ratio optimization of axial turbine bladings
[ASME PAPER 78-GT-173] A79-10809
Aerodynamic force and moment on oscillating airfoils in cascade
[ASME PAPER 78-GT-181] A79-10812
Dynamic stall of an airfoil with leading edge bubble separation involving time dependent re-attachment
[ASME PAPER 78-GT-194] A79-10817
Evaluation of the cyclic behavior of aircraft turbine disk alloys
[NASA-CR-159409] N79-10058
Thermal-structural mission analyses of air-cooled gas turbine blades
[NASA-TM-78963] N79-11433

TURBINE ENGINES
A method for assessing turbine engine run-up noise impact on airport neighbors
[SAE PAPER 780522] A79-10397
Turbine engines in light aircraft
A79-12380

TURBINE INSTRUMENTS
A high temperature turbine research module
[ASME PAPER 78-GT-73] A79-10769
On-line computer for transient turbine cascade instrumentation
A79-11488

TURBINES
A discussion of turbine and compressor sealing devices and systems
A79-12373

TURBOCOMPRESSORS
A new stage stacking technique for axial-flow compressor performance prediction
[ASME PAPER 78-GT-139] A79-10268
An axial compressor end-wall boundary layer calculation method
[ASME PAPER 78-GT-81] A79-10767
Apparatus and method for reducing thermal stress in a turbine rotor
[NASA-CASE-LEW-12232-1] N79-10057
Performance of single-stage axial-flow transonic compressor with rotor and stator aspect ratios of 1.19 and 1.26, respectively, and with design pressure ratio of 1.82
[NASA-TP-1338] N79-10060
Analysis, design, fabrication and testing of the Mini-Brayton rotating unit (MINI-BRU). Volume 2: Figures and drawings
[NASA-CR-159441-VOL-2] N79-11409

TURBOFAN ENGINES
The CF6-32 as a derivative engine of the CF6-6
[SAE PAPER 780511] A79-10391
The RB211-535 - New member of the family
[SAE PAPER 780512] A79-10392
A design point correlation for losses due to part-span dampers on transonic rotors
[ASME PAPER 78-GT-153] A79-10802
Advanced turbofan engines for low fuel consumption
[ASME PAPER 78-GT-192] A79-10816
Making turbofan engines more energy efficient
[ASME PAPER 78-GT-198] A79-10818
Research of the XF3-1 turbofan engine
[ASME PAPER 78-GT-199] A79-10819
Design of a multivariable controller for a high-order turbofan engine model by Zakian's method of inequalities
A79-12287
Icing tests on turbojet and turbofan engines using the NGTE engine test facility
N79-10013
American Airlines' operational and maintenance experience with aerodynamic seals and oil seals in turbofan engines
N79-11061
Emission sample probe investigation of a mixed flow JT8D-11 turbofan engine
[AD-A058038] N79-11561

TURBOFANS
Aerodynamic performance of a 1.35-pressure-ratio axial-flow fan stage
[NASA-TP-1299] N79-10022
Aerodynamic and acoustic effects of eliminating core swirl from a full scale 1.6 stage pressure ratio fan (QF-5A)
[NASA-TM-78991] N79-11001

TURBOJET ENGINE CONTROL
Design of a multivariable controller for a high-order turbofan engine model by Zakian's method of inequalities
A79-12287
Control system requirements for aircraft gas turbine engines
A79-12530
Control systems and problems of their development from the viewpoint of technological and operational requirements --- for aircraft gas turbine engines
A79-12531

TURBOJET ENGINES
On the conventional definitions of thrust/drag of an aircraft equipped with a turbojet engine
A79-10618
A rotating stall control system for turbojet engines
[ASME PAPER 78-GT-115] A79-10757
The application of low cost manufacturing technology to a turbine gas generator
[ASME PAPER 78-GT-202] A79-10822
Icing tests on turbojet and turbofan engines using the NGTE engine test facility
N79-10013
An experimental study of a catalytic combustor for an expendable turbojet engine
[AD-A056512] N79-11048

TURBOMACHINERY
An experimental study of three-dimensional turbulent boundary layer and turbulence characteristics inside a turbomachinery rotor passage
[ASME PAPER 78-GT-114] A79-10266
High efficiency fluid film thrust bearings for turbomachinery
A79-12371
The application of foil air bearing turbomachinery in aircraft environmental control systems
[ASME PAPER 78-ENAS-18] A79-12567
Use of coatings in turbomachinery gas path seals
N79-11058

TURBOPROP ENGINES
Evolution of the turboprop for high speed air transportation
[ASME PAPER 78-GT-201] A79-10821
Certain problems which had to be solved between the prototype stage and mass production stage in the development of an engine --- turboprop engine tests
A79-12532

TURBOSHAFTS
Infrared suppressor effect on T63 turboshaft engine performance
[NASA-TM-78970] N79-11043

TURBULENT BOUNDARY LAYER
An experimental study of three-dimensional turbulent boundary layer and turbulence characteristics inside a turbomachinery rotor passage
[ASME PAPER 78-GT-114] A79-10266

TURBULENT FLOW
Propeller unsteady thrust due to operation in turbulent inflows
[ASME PAPER 78-GT-94] A79-10762
Weak extinction limits of turbulent flowing mixtures --- flame stabilization
[ASME PAPER 78-GT-144] A79-10798
Flying hot-wire study of two-dimensional turbulent separation on an NACA 4412 airfoil at maximum lift
N79-10019

TURBULENT WAKES
Harmonic vibrations of an annular wing in the steady flow of an ideal fluid
A79-12963
Axial flow in trailing line vortices
[AD-A057075] N79-10034

TWO DIMENSIONAL FLOW
Flying hot-wire study of two-dimensional turbulent separation on an NACA 4412 airfoil at maximum lift
N79-10019

U

UH-1 HELICOPTER
Helicopter bearing failure detection utilizing shock pulse techniques
[AD-A057308] N79-11410

UH-60A HELICOPTER
A study of structural concepts for low radar cross section /LRCS/ fuselage configurations
A79-10908

UH-61A HELICOPTER
Damage-tolerant design of the YUH-61A main rotor system
A79-10911

ULTRASONIC WELDING
Ultrasonic welding /solid state bonding/ of aircraft structure - Fact or fancy
A79-10921

UNSTEADY FLOW
Unsteady subsonic and supersonic potential aerodynamics for complex configurations
A79-12366
Improved sonic-box computer program for calculating transonic aerodynamic loads on oscillating wings with thickness
[NASA-CR-158906] N79-10998

URBAN TRANSPORTATION
Planning for airport access: An analysis of the San Francisco Bay area
[NASA-CP-2044] N79-10942
Planning for airport access: An analysis of the San Francisco Bay area. Introduction and conclusions
N79-10943
Planning for airport access: An analysis of the San Francisco Bay area. The setting
N79-10944
Components of the airport access system
N79-10945
Planning for airport access: An analysis of the San Francisco Bay area. Existing studies
N79-10946
Planning for airport access: An analysis of the San Francisco Bay area. Technological options
N79-10947
Planning for airport access: An analysis of the San Francisco Bay area. Three subsystem designs
N79-10948

V

V/STOL AIRCRAFT
Propulsion cycle and configuration commonality considerations for subsonic V/STOL design
[ASME PAPER 78-GT-88] A79-10764
Development of an inlet for a tilt nacelle subsonic V/STOL aircraft
[ASME PAPER 78-GT-121] A79-10789
Aspects of short-takeoff aircraft --- optimization of aircraft, airports and flight regimes
A79-11444
Study of aerodynamic technology for VSTOL fighter/attack aircraft: Horizontal attitude concept
[NASA-CR-152130] N79-10024
Study of aerodynamic technology for VSTOL fighter/attack aircraft, volume 1
[NASA-CR-152128] N79-10025
Study of aerodynamic technology for VSTOL fighter/attack aircraft: Vertical attitude concept
[NASA-CR-152131] N79-10026
Study of aerodynamic technology for VSTOL fighter attack aircraft
[NASA-CR-152129] N79-10027
Study of aerodynamic technology for VSTOL fighter/attack aircraft, phase 1
[NASA-CR-152132] N79-10028
Implementation of an optimum profile guidance system on STOLAND
[NASA-CR-152187] N79-10038

VANELESS DIFFUSERS
Small perturbation analysis of nonuniform rotating disturbances in a vaneless diffuser
[ASME PAPER 78-GT-154] A79-10270

VARIABLE GEOMETRY STRUCTURES
Development of gas turbine performance seeking logic
[ASME PAPER 78-GT-13] A79-10257

VARIABLE THRUST
Propeller unsteady thrust due to operation in turbulent inflows
[ASME PAPER 78-GT-94] A79-10762

VELOCITY MEASUREMENT
Velocity measurement about a NACA 0012 airfoil with a laser velometer
[AD-A056447] N79-10029

VENTILATION
The F-16 environmental control system
[ASME PAPER 78-ENAS-11] A79-12560

VERY HIGH FREQUENCY RADIO EQUIPMENT
Radio navigation and antenna technology, an area of study of many years' standing at the Institute for Communications Engineering of Braunschweig Technical University
A79-12526

VERY LOW FREQUENCIES
The Omega navigation system - An overview
A79-12525

VIBRATION
Study of T53 engine vibration
[NASA-CR-135449] N79-10061
Vibratory ice protection for helicopter rotor blades
[AD-A057329] N79-11038

VIBRATION DAMPING
Determination of the aerodynamic damping of turbine blade vibrations with allowance for the pitch, exit blade angle, and blade curvature
A79-10568
Synthesis and analysis of systems for active control and suppression of flutter of flying craft
A79-12755

VIBRATION TESTS
Turbine engine automated trim balancing and vibration diagnostics
[ASME PAPER 78-GT-129] A79-10793

VISCOUS DAMPING
Significance of disk flexing in viscous-damped jet engine dynamics
[ASME PAPER 78-GT-107] A79-10263

VISCOUS FLOW
Effect of viscosity on nonseparated transonic flow past a profile
A79-12205
Calculation of effect of viscosity on nonseparated subsonic flow past a wing with flap
A79-12240
A numerical solution of supersonic and hypersonic viscous flow fields around thin planar delta wings
N79-10018

VOICE COMMUNICATION
The influence of the noise environment on crew communications
N79-10860

VORTICES
Experimental method for investigating preintake vortex circulation --- in engine air intakes
A79-11367
Recent theoretical developments and experimental studies pertinent to vortex flow aerodynamics - With a view towards design
A79-11549
Approximate calculation of the velocity field and the motion of vortices in the wake of a low-flying biplane
A79-12198
Vortex system at the nose part of a fuselage model at supercritical angles of attack and different Reynolds numbers
A79-12199
Problems in the method of discrete vortices for solving linear wing theory problems
A79-12224
Axial flow in trailing line vortices
[AD-A057075] N79-10034

W

WAKES
Investigation of the profile drag and the mean and pulsation velocities in the wake of wings by means of a laser Doppler anemometer
A79-12151
Features of flow past slotted wings
A79-12236

WALL FLOW
A general correction method of the interference in 2-dimensional wind tunnels with ventilated walls A79-10867
WEAPON SYSTEMS
Time-phased development methodology - The key for reliable engines in future military aircraft weapons systems [ASME PAPER 78-GT-167] A79-10807
WEAR TESTS
Factors associated with rub tolerance of compressor tip seals --- self sustained combustion of titanium N79-11069
WEIGHT REDUCTION
A glance at Soviet helicopter design philosophy A79-10910
Application of gradient methods to the optimal design of components of load-bearing structures --- for aircraft minimum weight design A79-12144
WELDED STRUCTURES
Ultrasonic welding /solid state bonding/ of aircraft structure - Fact or fancy A79-10921
WIND EFFECTS
Better performance for aircraft tracking and holding under gust and shearwind influence by use of direct digital control [ESA-TT-506] N79-11033
A contribution to the increase of aircraft guidance precision under wind disturbance conditions by using direct digital control [DLR-FB-77-48] N79-11075
WIND SHEAR
Possible near-term solutions to the wind shear hazard [SAE PAPER 780572] A79-10416
WIND TUNNEL CALIBRATION
A general correction method of the interference in 2-dimensional wind tunnels with ventilated walls A79-10867
WIND TUNNEL MODELS
Investigation of the electrification of an aircraft model by a humid airstream in a wind tunnel A79-12162
WIND TUNNEL TESTS
Propulsion test facilities technical capabilities and international use [ASME PAPER 78-GT-184] A79-10813
Parachute canopy opening dynamics A79-11008
Determination of the geometrical parameters and position of the nose flap at the root section of a swept wing on the basis of wind tunnel data. I A79-12953
Wind tunnel tests of the GA(W)-2 airfoil with 20% aileron, 25% slotted flap, 30% Fowler flap and 10% slot-lip spoiler [NASA-CR-145139] N79-10021
Design and test of an annular sting support concept for aftbody nozzle wind tunnel testing [AD-A056945] N79-10063
The influence of aerodynamic interference on high angle of attack wind tunnel testing [AD-A056045] N79-11002
Aerodynamic characteristics of a 1/24-scale F-111 aircraft with various external stores at Mach numbers from 0.5 to 1.3 [AD-A057409] N79-11005
WIND TUNNEL WALLS
A general correction method of the interference in 2-dimensional wind tunnels with ventilated walls A79-10867
Numerical study of the induction of porous walls of the working section of a low-velocity wind tunnel A79-12228
WINDSHIELDS
All weather cockpit canopies. I - The F16 A79-10619
All weather cockpit canopies. II - 'The Challenger' A79-10620
WING FLAPS
Some types of separated flow past slotted wings A79-12148
Features of flow past slotted wings A79-12236
Calculation of effect of viscosity on nonseparated subsonic flow past a wing with flap A79-12240
Determination of the geometrical parameters and position of the nose flap at the root section of a swept wing on the basis of wind tunnel data. I A79-12953
WING FLOW METHOD TESTS
Method of calculating potential flows of an incompressible fluid past a wing with a high-lift device A79-12126
WING LOADING
Method for determining maximum allowable stress for preliminary aircraft wing design A79-11370
A method of solving multicriterial optimization problems for load-bearing structures --- for large aspect ratio wings A79-12163
Longitudinal distribution of hydrodynamic load on a gliding flat-bottomed plate with keel A79-12200
Iterative method of aircraft wing strength calculation taking into account the effect of deformations on distribution of aerodynamic forces A79-12213
Processing a random loading process by computer to obtain life information --- in-flight critical stress measurements in aircraft wing structures A79-12535
WING OSCILLATIONS
Numerical-analytical solution of the problem of the constrained torsion of a cantilever wing A79-12195
Approximate solution of some boundary value problems on aircraft structural integrity A79-12234
Harmonic vibrations of an annular wing in the steady flow of an ideal fluid A79-12963
Sonic-box method employing local Mach number for oscillating wings with thickness [NASA-CR-158907] N79-10999
WING PLANFORMS
Recent theoretical developments and experimental studies pertinent to vortex flow aerodynamics - With a view towards design A79-11549
Calculation of the transient aerodynamic characteristics of a supersonic flight vehicle A79-12182
WING PROFILES
Numerical solution of a linear integral equation of the first kind in the inverse problem of symmetric flow past a wing A79-12138
Investigation of the profile drag and the mean and pulsation velocities in the wake of wings by means of a laser Doppler anemometer A79-12151
Effect of viscosity on nonseparated transonic flow past a profile A79-12205
Solution of the inverse problem of aerodynamics by a random search technique A79-12956
WING SLOTS
Some types of separated flow past slotted wings A79-12148
Features of flow past slotted wings A79-12236
WINGS
Problems in the method of discrete vortices for solving linear wing theory problems A79-12224
Program REV - A wing structural optimization computer program for preliminary design of fighter aircraft A79-12460
The smooth approximation method and its application to the mathematical description of the aerodynamic characteristics of a wing A79-12955

X

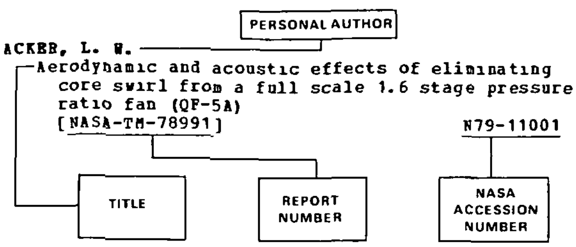
X RAY INSPECTION
The contribution of dynamic X-ray to gas turbine air sealed technology N79-11065

Y

YF-16 AIRCRAFT
Investigation of the YF-16 in high angle of attack asymmetric flight
[AD-A056511] N79-11036

PERSONAL AUTHOR INDEX

Typical Personal Author Index Listing



Listings in this index are arranged alphabetically by personal author The title of the document provides the user with a brief description of the subject matter The report number helps to indicate the type of document cited (e g NASA report translation NASA contractor report) The accession number is located beneath and to the right of the title e g N79 11001 Under any one author s name the accession numbers are arranged in sequence with the *IAA* accession numbers appearing first

A

ACKER, L. W.
Aerodynamic and acoustic effects of eliminating core swirl from a full scale 1.6 stage pressure ratio fan (QF-5A)
[NASA-TM-78991] N79-11001
ADAMCZYK, J. J.
Supersonic unstalled flutter
A79-12599
Supersonic unstalled flutter
[NASA-TM-79001] N79-11000
ADAMS, J. J.
Description and preliminary studies of a computer drawn instrument landing approach display
[NASA-TM-78771] N79-11039
ADAMS, W. M., JR.
SPINEQ: A program for determining aircraft equilibrium spin characteristics including stability
[NASA-TM-78759] N79-11074
AGLIULLIN, I. N.
Optimal designing of gas-turbine engine thermogasdynamics on the basis of prototype elements. I
A79-12951
AKAI, T. J.
Aerodynamic force and moment on oscillating airfoils in cascade
[ASME PAPER 78-GT-181] A79-10812
AKRUSHKIN, N. V.
Detached flow about an opening canopy
A79-11006
ALEXANDER, W. T., JR.
Advanced technology helicopter landing gear
A79-10918
ALLING, G. C., JR.
Survey of the application of reinforced composites in European helicopters
A79-10917
ALPERIN, M.
End wall and corner flow improvements of the rectangular Alperin jet-diffuser ejector
[AD-A057663] N79-11051
ALTOZ, F. E.
Thermal design of airborne radars - Present and future
A79-11919
ANAND, A. K.
An experimental study of three-dimensional turbulent boundary layer and turbulence characteristics inside a turbomachinery rotor passage
[ASME PAPER 78-GT-114] A79-10266
ANCTIL, A. A.
Improved ballistic damage tolerant design through laminated metal construction
A79-10912
ANDERSON, C. F.
Aerodynamic characteristics of a 1/24-scale F-111 aircraft with various external stores at Mach numbers from 0.5 to 1.3
[AD-A057409] N79-11005
ANDO, Y.
Aerodynamic response for the airfoil experiencing sudden change in angle of attack
A79-10869
ANTIPENKO, L. N.
Operational reliability of climate and pressure control equipment for passenger aircraft
A79-10850
ARCHIBALD, D. M.
Certification-compliance demonstration by flight or simulation
[SAE PAPER 780549] A79-10408
ARGUE, C. T.
Airport development in Micronesia
[SAE PAPER 780530] A79-10400
ATANACKOVIC, B.
Cyclic linkage of finite elements with application
[IAF PAPER 78-213] A79-11294
ATASSI, H.
Aerodynamic force and moment on oscillating airfoils in cascade
[ASME PAPER 78-GT-181] A79-10812

B

BAILEY, E. E.
Infrared suppressor effect on T63 turboshaft engine performance
[NASA-TM-78970] N79-11043
BAILEY, F. R.
Numerical aerodynamic simulation facility
N79-10450
BAILEY, P. G.
Superalloy knife edge seal repair
[AD-A057269] N79-11055
BAKER, P. D.
Recent developments in sensors for the gas turbine engine
[ASME PAPER 78-GT-52] A79-10760
BALALAEV, V. A.
Determination of the aerodynamic damping of turbine blade vibrations with allowance for the pitch, exit blade angle, and blade curvature
A79-10568
BALANTI, C. J.
Integrated Avionics Control System (IACS)
[AD-A056476] N79-10056
BALDRIDGE, P.
Tow bar for aircraft
[NASA-CASE-FRC-11022-1] N79-10069
BALL, R. G. J.
Icing tests on turbojet and turbofan engines using the NGTE engine test facility
N79-10013
BALLAL, D. R.
Weak extinction limits of turbulent flowing mixtures
[ASME PAPER 78-GT-144] A79-10798

BANERJEE, D.
Engine/airframe/drive train dynamic interface documentation
[AD-A056956] N79-10064
BARNEY, J.
Infrared landing system for a mini remotely-piloted vehicle
A79-12093
BAXENDALE, B. V.
Simulation of helicopter powerplant performance
[ASME PAPER 78-GT-51] A79-10774
BAYLEY, F. J.
Performance and design of transpiration-cooled turbine blading
[ASME PAPER 78-GT-122] A79-10790
BEATTY, J. P.
Planning the high elevation/high temperature airport
[SAE PAPER 780532] A79-10402
BEHM, H. D.
National Conference on Energy Conservation in General Aviation, 1st, Kalamazoo, Mich., October 10, 11, 1977, Proceedings
A79-12376
BEKIESINSKI, R.
Some aspects of aircraft jet engine fuels
A79-11368
BELLIERE, P.
Pivoting output unit control systems activated by jacks
[NASA-TM-75581] N79-10066
BELOTSERKOVSKII, S. M.
Synthesis and analysis of systems for active control and suppression of flutter of flying craft
A79-12755
BELOUS, V. A.
Application of gradient methods to the optimal design of components of load-bearing structures
A79-12144
BENDER, D.
Tests under snow and icing conditions with the BO 105 engine installation
N79-10014
BENDER, K.
Better performance for aircraft tracking and holding under gust and shearwind influence by use of direct digital control
[ESA-TT-506] N79-11033
A contribution to the increase of aircraft guidance precision under wind disturbance conditions by using direct digital control
[DLR-FB-77-48] N79-11075
BERRY, J. P.
Multisensor utilization investigation
A79-10332
BERTYN, V. R.
Investigation of the electrification of an aircraft model by a humid airstream in a wind tunnel
A79-12162
BIGLER, W. B., II
The effect of operations on the ground noise footprints associated with a large multibladed, nonbanging helicopter
N79-10851
BILLINGS, W. W.
The solid state remote power controller - Its status, use and perspective
A79-10896
BISHOP, A. R.
A computer program for the calculation of the flow field in supersonic mixed-compression inlets at angle of attack wing the three-dimensional method of characteristics with discrete shock wave fitting
[NASA-TM-78947] N79-10023
BLAKE, D. E.
Jet engine test cells: Emissions and control measures, phase 1
[PB-283470/3] N79-11580
BLUFORD, G. S., JR.
A numerical solution of supersonic and hypersonic viscous flow fields around thin planar delta wings
N79-10018
A numerical solution of supersonic and hypersonic viscous flow fields around thin planar delta wings
[AD-A056513] N79-11003
BOGOD, A. B.
Numerical solution of the direct problem of ideal gas flow in three-dimensional turbine cascades
A79-12194
BONGRAND, J.
Installation of icing tests
N79-10007
Experimental and theoretical study of the influence of various parameters on an icing section
N79-10012
BOROVIK, V. O.
Optimal designing of gas-turbine engine thermogasdynamics on the basis of prototype elements. I
A79-12951
BORST, H. V.
Aerodynamic design and analysis of propellers for mini-remotely piloted air vehicles. Volume 2: Ducted propellers
[AD-A056948] N79-10062
BOSSLER, R. B., JR.
An analytical method for designing low noise helicopter transmissions
N79-10859
BOWERS, D. L.
Design and test of an annular sting support concept for aftbody nozzle wind tunnel testing
[AD-A056945] N79-10063
BOWES, M. A.
The cost of applying current helicopter external noise reduction methods while maintaining realistic vehicle performance
N79-10855
An analytical method for designing low noise helicopter transmissions
N79-10859
BRASNETT, K. A.
The contribution of dynamic X-ray to gas turbine air sealed technology
N79-11065
BRIEN, M.
Transmission seal development
[NASA-CR-135372] N79-10423
BROWN, S. H.
Study of aerodynamic technology for VSTOL fighter/attack aircraft: Horizontal attitude concept
[NASA-CR-152130] N79-10024
BROWN, T. W.
Powerplant integration - The application of current experience to future developments
[ASME PAPER 78-GT-113] A79-10788
BRUTIAN, M. A.
Effect of viscosity on nonseparated transonic flow past a profile
A79-12205
Calculation of effect of viscosity on nonseparated subsonic flow past a wing with flap
A79-12240
BRYSOV, O. P.
Investigation of the profile drag and the mean and pulsation velocities in the wake of wings by means of a laser Doppler anemometer
A79-12151
BUCHANAN, E.
The application of low cost manufacturing technology to a turbine gas generator
[ASME PAPER 78-GT-202] A79-10822
BULAEVSKII, M. M.
Aircraft air conditioning systems
A79-11442
BUNK, W.
Influence of thermomechanical treatment on microstructure and mechanical properties of high strength aluminum alloys
[DLR-FB-77-50] N79-11203
BURHANS, W., JR.
Study of aerodynamic technology for VSTOL fighter attack aircraft
[NASA-CR-152129] N79-10027
BURNHAM, P.
All weather cockpit canopies. I - The F16
A79-10619
All weather cockpit canopies. II - 'The Challenger'
A79-10620

BURNS, J.
Application of an interactive graphics system for the design and optimization of aircraft lifting surfaces
A79-12436
BUTZE, H. F.
Wide range operation of advanced low NOx aircraft gas turbine combustors
[ASME PAPER 78-GT-128] A79-10792
BYRKIN, A. P.
Numerical study of the induction of porous walls of the working section of a low-velocity wind tunnel
A79-12228

C

CACKETTE, T.
The effects of ambient conditions on gas turbine emissions - Generalized correction factors
[ASME PAPER 78-GT-87] A79-10262
CADY, E. M.
Intensive tropic function testing
[AD-A056416] N79-10440
CALLINAN, R. J.
Residual strength of a cracked lug
[ARL-STRUC-NOTE-442] N79-10445
CALOPODAS, N. J.
Development of a multitubular spar composite main rotor blade
A79-10919
CALVERT, W. J.
A new stage stacking technique for axial-flow compressor performance prediction
[ASME PAPER 78-GT-139] A79-10268
CAMP, R. T., JR.
The effective acoustic environment of helicopter crewmen
N79-10850
CAMPBELL, D. A.
Gas turbine disc sealing system design
N79-11072
CANTWELL, B.
The flying hot wire and related instrumentation
[NASA-CR-3066] N79-11352
CARY, R. H. J.
Some novel techniques for avoiding antenna obscurations and E.M.C. effects
A79-10363
CASSETTI, M.
On the conventional definitions of thrust/drag of an aircraft equipped with a turbojet engine
A79-10618
CASTELLA, F. R.
Moving target detector data utilization study
A79-10318
CHAN, Y.
Overview of the small package air carrier industry - A study of the operations in Federal Express
[SAE PAPER 780540] A79-10406
CHANDLER, A. L.
Turbine blade tip clearance measurement utilizing borescope photography
[ASME PAPER 78-GT-164] A79-10805
CHATTOT, J.-J.
Calculation of transonic flows around wings
A79-11132
CHAUSSEE, D. S.
Improved transonic nose drag estimates for the NSWC missile aerodynamic computer program
[AD-A056795] N79-10030
CHEN, S. S.
Axial flow in trailing line vortices
[AD-A057075] N79-10034
CHEN, W. S.
Study of aerodynamic technology for VSTOL fighter/attack aircraft: Vertical attitude concept
[NASA-CR-152131] N79-10026
CHEREMUKHIN, G. A.
Determination of the geometrical parameters and position of the nose flap at the root section of a swept wing on the basis of wind tunnel data. I
A79-12953
CHIDANANDA, M. S.
Jet curtain flameholder for aircraft afterburners
[ASME PAPER 78-GT-95] A79-10761
CHINONE, H.
Research of the XF3-1 turbofan engine
[ASME PAPER 78-GT-199] A79-10819
CHU, E.
Jet engines test cells: Emissions and control measures, phase 2
[PB-282412/6] N79-10072
CHURKIN, V. M.
Free periodic oscillations of a parachute system in the longitudinal plane
A79-12971
CIVINSKAS, K. C.
Infrared suppressor effect on T63 turboshaft engine performance
[NASA-TM-78970] N79-11043
COGGINS, M. H.
The airport capacity increasing potential of angled runway exit designs
[SAE PAPER 780567] A79-10414
COLEBANK, J. M.
Management of test program development for S-3A
A79-12319
COLES, D.
The flying hot wire and related instrumentation
[NASA-CR-3066] N79-11352
COLLACOTT, R. A.
Hazard criticality analysis
A79-10621
COMPITELLO, F. E.
Propulsion test facilities technical capabilities and international use
[ASME PAPER 78-GT-184] A79-10813
CONDON, T. B.
Impact of operational issues on design of advanced composite structures for Army helicopters
A79-10907
CONNER, D. W.
Passenger ride quality in transport aircraft
A79-12396
COOK, G.
A performance measure for evaluating aircraft landing trajectories
A79-11494
COONS, F. G.
Possible near-term solutions to the wind shear hazard
[SAE PAPER 780572] A79-10416
COSTES, J.-J.
Application of the lifting line concept to helicopter computation
[ONERA, TP NO. 1978-90] A79-11571
COULOMBEIX, C.
Calculation of transonic flows around wings
A79-11132
COWLES, B. A.
Evaluation of the cyclic behavior of aircraft turbine disk alloys
[NASA-CR-159409] N79-10058
COX, C. R.
Helicopter internal noise control: Three case histories
N79-10858
CRAFTA, V. J., JR.
Study of aerodynamic technology for VSTOL fighter attack aircraft
[NASA-CR-152129] N79-10027
CUMPSTY, N. A.
Small perturbation analysis of nonuniform rotating disturbances in a vaneless diffuser
[ASME PAPER 78-GT-154] A79-10270
CURRY, R. E.
Utilization of the wing-body aerodynamic analysis program
[NASA-TM-72856] N79-10020
Flight-determined stability and control derivatives for the F-111 Tact research aircraft
[NASA-TP-1350] N79-10068

D

DA SILVA TOME, C.
Calculation of transonic flows around wings
A79-11132
DAJANI, J. S.
Planning for airport access: An analysis of the San Francisco Bay area
[NASA-CP-2044] N79-10942

DAMBRA, F.
Helicopter internal noise reduction research and development application to the SA 360 and SA 365 Dauphin
N79-10861
DANNENHOFFER, N.
Study of aerodynamic technology for VSTOL fighter attack aircraft
[NASA-CR-152129] N79-10027
DASKIN, M. S.
Issues in the design and analysis of airport ground transport systems
[SAE PAPER 780519] A79-10395
DAVY, M. C. W.
Commercial STOL - The airplane, the airport
[SAE PAPER 780520] A79-10396
DE RUYCK, J.
An axial compressor end-wall boundary layer calculation method
[ASME PAPER 78-GT-81] A79-10767
DEFELICE, J. J.
A practical approach to helicopter internal noise prediction
N79-10857
DEGNAN, W. G.
Improved ballistic damage tolerant design through laminated metal construction
A79-10912
DELLAMURA, F. A.
Study of aerodynamic technology for VSTOL fighter attack aircraft
[NASA-CR-152129] N79-10027
DEVINE, J.
Ultrasonic welding /solid state bonding/ of aircraft structure - Fact or fancy
A79-10921
DIBLIN, J. A.
Energy conservation in general aviation and operation and maintenance of Avco Lycoming piston engines
A79-12381
DICKERSON, J. W.
Testing of avionics display systems
A79-12309
DINGLE, G. K.
Ultrasonic welding /solid state bonding/ of aircraft structure - Fact or fancy
A79-10921
DINI, D.
Self active pad seal application for high pressure engines
N79-11071
DINYOVSZKY, P. P.
The use of 3-D finite element analysis in the design of helicopter mechanical components
A79-10909
DIXON, P. G. C.
Derivation of control loads for bearingless rotor systems
A79-10906
DOBLER, F. X.
Analysis, design, fabrication and testing of the Mini-Brayton rotating unit (MINI-BRU). Volume 2: Figures and drawings
[NASA-CR-159441-VOL-2] N79-11409
DODGE, P. R.
Transonic 3-D flow analysis of compressor cascade with splinter vanes
[AD-A057504] N79-11004
DONOVAN, P.
The effects of ambient conditions on gas turbine emissions - Generalized correction factors
[ASME PAPER 78-GT-87] A79-10262
DOREY, G.
Damage tolerance in advanced composite materials
A79-10915
DOREY, T. P.
An active noise reduction system for aircrew helmets
N79-10853
DRIGGERS, H. H.
Study of aerodynamic technology for VSTOL fighter/attack aircraft, phase 1
[NASA-CR-152132] N79-10028
DRON, B.
Application of an interactive graphics system for the design and optimization of aircraft lifting surfaces
A79-12436
DRYBURGH, D. C.
The effects of aircraft engine pollutant emission measurement variability on engine certification policy
[ASME PAPER 78-GT-86] A79-10261
DUE, H. F.
The application of low cost manufacturing technology to a turbine gas generator
[ASME PAPER 78-GT-202] A79-10822
DUNEGAN, H. L.
Nondestructive inspection of aircraft structures and materials via acoustic emission
A79-10991
DUNLAY, W. J., JR.
Cascade - Queue model of airport users
[SAE PAPER 780518] A79-10394

E

EDWARDS, B. D.
Helicopter internal noise control: Three case histories
N79-10858
EDWARDS, O. R.
Northrop F-5F shark nose development
[NASA-CR-158936] N79-10047
EGOROV, IU. N.
Choice of a fuselage for a passenger aircraft
A79-12968
EILER, D. C.
Internal mixer investigation for JT8D engine jet noise reduction. Volume 1: Results
[AD-A057309] N79-10059
Internal mixer investigation for JT8D engine jet noise reduction. Volume 2: Appendices A, B, C, and D
[AD-A057310/5] N79-10065
ELROD, C. W.
Factors associated with rub tolerance of compressor tip seals
N79-11069
EMERSON, T. P.
The application of foil air bearing turbomachinery in aircraft environmental control systems
[ASME PAPER 78-ENAS-18] A79-12567
EMIL, S.
Application of an interactive graphics system for the design and optimization of aircraft lifting surfaces
A79-12436
EMIN, O. N.
Turbine-driven refrigeration units in gas turbine engine cooling systems
A79-11441
ENDO, E.
Measurement of flow fields around an airfoil section with separation
A79-10868
ERLINE, T. F.
Highly survivable truss type tail boom
[AD-A056430] N79-10052
ERWIN, R. L., JR.
'Strategic' time-based ATC
A79-12473

F

FANCY, H.
Multi-filter MTI system
A79-10320
FANNING, W. R.
The control of tolerances in an array antenna
A79-11934
FARINA, A.
Track-while-scan algorithm in a clutter environment
A79-11492
FARR, D. A.
Management of test program development for S-3A
A79-12319
FEDOROV, E. IA.
The smooth approximation method and its application to the mathematical description of the aerodynamic characteristics of a wing
A79-12955
FERGUSON, J. G.
Use of coatings in turbomachinery gas path seals
N79-11058

FINKELSTEIN, A. R.
Turbine blade tip clearance measurement utilizing borescope photography
[ASME PAPER 78-GT-164] A79-10805
FIORE, N. F.
Preliminary evaluation of several nondestructive-evaluation techniques for silicon nitride gas-turbine rotors
[ANL-77-89] N79-11414
FIORITO, R. J.
Wide range operation of advanced low NOx aircraft gas turbine combustors
[ASME PAPER 78-GT-128] A79-10792
FLAKSMAN, IA. SH.
Approximate calculation of the velocity field and the motion of vortices in the wake of a low-flying biplane
A79-12198
FLANAGAN, P. F.
Implementation of an optimum profile guidance system on STOLAND
[NASA-CR-152187] N79-10038
FLEMING, P. J.
Desensitizing constant gain feedback linear regulators
A79-12290
FORSYTH, D. L.
Single pilot IFR operating problems determined from accidental data analysis
[NASA-TM-78773] N79-11013
FOSTER, R. P.
Aircraft piston oils: Past - present - future
A79-12377
FOXWELL, V. M.
Antenna to IMU mounting for SAR motion compensation
A79-11913
FRADIN, C.
Analysis of the flow field in a radial compressor
[ASME PAPER 78-GT-7] A79-10776
FRANCILLON, R. J.
Planning the high elevation/high temperature airport
[SAE PAPER 780532] A79-10402
FRICKE, H.
Radio navigation and antenna technology, an area of study of many years' standing at the Institute for Communications Engineering of Braunschweig Technical University
A79-12526
FRITZ, C. M.
E-3A antenna pedestal turntable
A79-11923
FROLOV, A. S.
Investigation of the electrification of an aircraft model by a humid airstream in a wind tunnel
A79-12162
FROLOV, V. M.
A method of solving multicriterial optimization problems for load-bearing structures
A79-12163
FUCINARI, C. A.
The utilization of data relating to fin geometry and manufacturing processes of ceramic matrix systems to the design of ceramic heat exchangers
A79-12824
FULLER, R. F.
Federal Energy Data System (FEDS) technical documentation
[PB-281815/1] N79-11542

G

GALKINA, N. S.
Decreasing stress concentrations in structures made of high-strength materials
A79-12145
GALLOWAY, W. J.
Subjective evaluation of helicopter blade slap noise
N79-10844
GAUGLER, R. E.
Thermal-structural mission analyses of air-cooled gas turbine blades
[NASA-TM-78963] N79-11433
GEBMAN, J. R.
Probability that the propagation of an undetected fatigue crack will not cause a structural failure
[AD-A057335] N79-11439
GEORGE, A. R.
Helicopter noise - State-of-the-art
[AIAA PAPER 77-1337] A79-12395
GEORGE, J. A.
Helicopter bearing failure detection utilizing shock pulse techniques
[AD-A057308] N79-11410
GEORGE, P. T.
An evaluation technique for determining the cost effectiveness of condition monitoring systems
[ASME PAPER 78-GT-166] A79-10806
GERHARDT, H. A.
Study of aerodynamic technology for VSTOL fighter/attack aircraft: Vertical attitude concept
[NASA-CR-152131] N79-10026
GERSHON, I. J.
Time-phased development methodology - The key for reliable engines in future military aircraft weapons systems
[ASME PAPER 78-GT-167] A79-10807
GOEHLER, D.
Cast Aluminum Structures Technology, phase 3 (CAST)
[AD-A057422] N79-11188
GOETZ, R. C.
Synthesis of aircraft structures using integrated design and analysis methods
N79-10454
GOLDSTEIN, M. E.
Supersonic unstalled flutter
A79-12599
Supersonic unstalled flutter
[NASA-TM-79001] N79-11000
GOLOVATIUK, G. I.
Vortex system at the nose part of a fuselage model at supercritical angles of attack and different Reynolds numbers
A79-12199
GOODALL, R. E.
Advanced technology helicopter landing gear
A79-10918
GRABE, W.
Icing tests of a small gas turbine with inertial separation anti-icing system
N79-10015
GREEN, A. T.
Nondestructive inspection of aircraft structures and materials via acoustic emission
A79-10991
GREITZER, E. M.
Asymmetric swirling flows in turbomachine annuli
[ASME PAPER 78-GT-109] A79-10260
GRISHIN, V. I.
Decreasing stress concentrations in structures made of high-strength materials
A79-12145
GROBMAN, J.
Alternative aircraft fuels
A79-10824
Alternative aviation turbine fuels
A79-12378
GROBMAN, J. S.
Characteristics and combustion of future hydrocarbon fuels
A79-11599
Impact of future fuel properties on aircraft engines and fuel systems
A79-11600
GRODZOVSKII, G. L.
Investigation of the profile drag and the mean and pulsation velocities in the wake of wings by means of a laser Doppler anemometer
A79-12151
GRONDAHL, C.
Demonstration of ceramic design methodology for a ceramic combustor liner
[ASME PAPER 78-GT-137] A79-10794
GUNKO, IU. P.
Overall aerodynamic characteristics of conical and delta wings at supersonic speeds
A79-12966
GURIANOV, N. A.
Skirt components of the aerodynamic characteristics of an air-cushion vehicle using the oncoming flow to generate lift
A79-12949

H

HABERCOM, G. E., JR.
Air traffic control simulation models, volume 1. A bibliography with abstracts
[NTIS/PS-78/0787/8] N79-10043
Air traffic control simulation models, volume2. A bibliography with abstracts
[NTIS/PS-78/0788/6] N79-10044
Airfield pavement evaluation, volume 4. A bibliography with abstracts
[NTIS/PS-78/0685/4] N79-10070
Clear air turbulence. A bibliography with abstracts
[NTIS/PS-78/0938/7] N79-11632
HANSEN, K. C.
The role of flight dynamic modeling in helicopter certification
[SAE PAPER 780550] A79-10409
Structural design flight maneuver loads using PDP-10 flight dynamics model
A79-10905
HARDY, G. H.
Flight experience with advanced controls and displays during piloted curved decelerating approaches in a powered-lift STOL aircraft
[NASA-TM-78527] N79-10054
HARRINGTON, J. H.
Giant image 2 reliability and maintainability B-52D
[AD-A057938] N79-11291
HARRINGTON, J. T.
Helicopter bearing failure detection utilizing shock pulse techniques
[AD-A057308] N79-11410
HARRISON, P. G.
A digital fuel control system for gas turbines
[ASME PAPER 78-GT-99] A79-10759
HARTMAN, W. F.
Potential applications of acoustic emission technology as a nondestructive evaluation method for naval aviation ground support
[AD-A056650] N79-10439
HARTMANN, M. J.
Supersonic unstalled flutter
A79-12599
Supersonic unstalled flutter
[NASA-TM-79001] N79-11000
HATHAWAY, A. W.
Numerical aerodynamic simulation facility
N79-10450
HAYASHI, M.
Measurement of flow fields around an airfoil section with separation
A79-10868
HEAD, R. E.
Development of a multitubular spar composite main rotor blade
A79-10919
HEIMBOLD, R. L.
Flight and propulsion control integration for selected in-flight thrust vectoring modes
[ASME PAPER 78-GT-79] A79-10768
HELLER, J. A.
Apparatus and method for reducing thermal stress in a turbine rotor
[NASA-CASE-LEW-12232-1] N79-10057
HEMMERLY, R. A.
An investigation of the performance of a J52-P-8A engine operating under the influence of high bleed flow extraction rates
[AD-A057325] N79-11054
HEMSWORTH, M. C.
Making turbofan engines more energy efficient
[ASME PAPER 78-GT-198] A79-10818
HENDERSON, H. R.
The effect of operations on the ground noise footprints associated with a large multibladed, nonbanging helicopter
N79-10851
HERBAGE, B. S.
High efficiency fluid film thrust bearings for turbomachinery
A79-12371
HICKEY, C. F., JR.
Improved ballistic damage tolerant design through laminated metal construction
A79-10912
HILTON, D. A.
The effect of operations on the ground noise footprints associated with a large multibladed, nonbanging helicopter
N79-10851
HINDSON, W. S.
Flight experience with advanced controls and displays during piloted curved decelerating approaches in a powered-lift STOL aircraft
[NASA-TM-78527] N79-10054
HIRSCH, C.
An axial compressor end-wall boundary layer calculation method
[ASME PAPER 78-GT-81] A79-10767
HOAD, D. R.
Velocity measurement about a NACA 0012 airfoil with a laser velometer
[AD-A056447] N79-10029
HODGE, R. J.
Planning, design and construction of the Queen Alia International Airport
[SAE PAPER 780531] A79-10401
HODOR, H.
Infrared landing system for a mini remotely-piloted vehicle
A79-12093
HOFFMAN, J. D.
A computer program for the calculation of the flow field in supersonic mixed-compression inlets at angle of attack wing the three-dimensional method of characteristics with discrete shock wave fitting
[NASA-TM-78947] N79-10023
HOFFRICHTER, J. S.
Damage-tolerant design of the YUH-61A main rotor system
A79-10911
HOLBROOK, G. E.
Evolution of the turboprop for high speed air transportation
[ASME PAPER 78-GT-201] A79-10821
HOLMES, M.
Military engine usage monitoring developments in the United Kingdom
[ASME PAPER 78-GT-65] A79-10772
HOMENTEOVSCHI, D.
Theory of lifting surface in fluids of high electrical conductivity
A79-12394
HOOVEN, F. J.
The Wright brothers' flight-control system
A79-11125
HOUSE, E. B., II
Investigation of the YF-16 in high angle of attack asymmetric flight
[AD-A056511] N79-11036
HOUSE, T. L.
Impact of operational issues on design of advanced composite structures for Army helicopters
A79-10907
HOWELL, A. R.
A new stage stacking technique for axial-flow compressor performance prediction
[ASME PAPER 78-GT-139] A79-10268
HUBBARD, H. H.
Trends in Langley helicopter noise research
N79-10863
HUGGETT, D. F.
Rotorcraft for transport use - European requirements
[SAE PAPER 780535] A79-10404
HUNT, J. D.
Engine icing measurement capabilities at the AEDC
N79-10008
HURRY, M. F.
Military engine usage monitoring developments in the United Kingdom
[ASME PAPER 78-GT-65] A79-10772
HURST, M.
The electronic flight deck
A79-11175
HUTCHINSON, C. E.
The Omega navigation system - An overview
A79-12525

I

IGNATEV, S. G.
Numerical solution of a linear integral equation of the first kind in the inverse problem of symmetric flow past a wing
A79-12138

ILICHEV, V. D.
Time-frequency method of solving large problems in the dynamics of elastic structures with local nonlinearities
A79-12155

INGLIS, M. E.
Simulation of helicopter powerplant performance
[ASME PAPER 78-GT-51] A79-10774

INOUE, M.
Small perturbation analysis of nonuniform rotating disturbances in a vaneless diffuser
[ASME PAPER 78-GT-154] A79-10270

ISAEV, V. V.
Determination of the geometrical parameters and position of the nose flap at the root section of a swept wing on the basis of wind tunnel data. I
A79-12953

ISELY, L. J.
F-16 Avionics Intermediate Shop self-test
A79-12302

ISHIGAKI, T.
Research of the XF3-1 turbofan engine
[ASME PAPER 78-GT-199] A79-10819

IUDIN, V. M.
Three-dimensional radiative heat-transfer problem with shading
A79-12784

IVANOV, M. IA.
Numerical solution of the direct problem of ideal gas flow in three-dimensional turbine cascades
A79-12194

IVANOV, V. S.
Optimal designing of gas-turbine engine thermogasdynamics on the basis of prototype elements. I
A79-12951

J

JACKSON, W. J., JR.
Structural design flight maneuver loads using PDP-10 flight dynamics model
A79-10905

JACOBSON, I. D.
Passenger ride quality in transport aircraft
A79-12396

JACOX, J. O.
A gas path performance diagnostic system to reduce J75-P-17 engine overhaul costs
[ASME PAPER 78-GT-116] A79-10267

JAMESON, A.
Numerical calculation of transonic flow past a swept wing by a finite volume method
[CONF-771204-3] N79-10036

JAROMINEK, W.
Aircraft electric power networks - Structures. I
A79-11369

JOHNSON, E. T.
20 hp mini-RPV demonstrator engine programs
[ASME PAPER 78-GT-200] A79-10820

JOHNSON, J.
The survivability of helicopters to rotor blade ballistic damage
A79-10913

JONES, J. L.
Planning for airport access: An analysis of the San Francisco Bay area
[NASA-CP-2044] N79-10942

JONES, R. G.
The F-16 environmental control system
[ASME PAPER 78-ENAS-11] A79-12560

JONES, T. V.
On-line computer for transient turbine cascade instrumentation
A79-11488

JORDAN, D.
Development of gas turbine performance seeking logic
[ASME PAPER 78-GT-13] A79-10257

JUCKER, J. V.
Planning for airport access: An analysis of the San Francisco Bay area
[NASA-CP-2044] N79-10942

K

KACHANOV, B. O.
Synthesis and analysis of systems for active control and suppression of flutter of flying craft
A79-12755

KALMAN, H.
Application of an interactive graphics system for the design and optimization of aircraft lifting surfaces
A79-12436

KAMCHI, J. S.
Propulsion test facilities technical capabilities and international use
[ASME PAPER 78-GT-184] A79-10813

KASPER, J. F.
The Omega navigation system - An overview
A79-12525

KAUFMAN, A.
Thermal-structural mission analyses of air-cooled gas turbine blades
[NASA-TM-78963] N79-11433

KAWASHIMA, S.
Aerodynamic response for the airfoil experiencing sudden change in angle of attack
A79-10869

KELDYSH, V. V.
Lift and longitudinal moment of a small-aspect-ratio wing in the proximity of a body of revolution
A79-12168

KELLY, J.
Jet engines test cells: Emissions and control measures, phase 2
[PB-282412/6] N79-10072

KENNEY, J. W.
Support systems for advanced military electronics
A79-12305

KERSHNER, R. L.
An evaluation of a new format for ejection information in a NATOPS manual
[AD-A056910] N79-10037

KESSLER, L.
Preliminary evaluation of several nondestructive-evaluation techniques for silicon nitride gas-turbine rotors
[ANL-77-89] N79-11414

KIVESTU, P. A.
Directions for developing an air cargo system planning model
[SAE PAPER 780556] A79-10411

KLOMPAS, N.
Significance of disk flexing in viscous-damped jet engine dynamics
[ASME PAPER 78-GT-107] A79-10263

KNAPP, L. G.
Helicopter transport efficiency payoffs from advanced technology
[SAE PAPER 780536] A79-10405

KOCUREK, J. D.
A lifting surface performance analysis with circulation coupled wake for advanced configuration hovering rotors
N79-10017

KOHZU, M.
Research of the XF3-1 turbofan engine
[ASME PAPER 78-GT-199] A79-10819

KOLCUM, E. H.
Near-net-shape engine methods emerge
A79-11449

KOLPAKCHIEV, I. N.
Aspects of short-takeoff aircraft
A79-11444

KOOL, P.
An axial compressor end-wall boundary layer calculation method
[ASME PAPER 78-GT-81] A79-10767

KOSARCHUK, N. A.
Free periodic oscillations of a parachute system in the longitudinal plane
A79-12971

KOSHEVOI, V. N.
Control and stabilization in aerodynamics
A79-11392

KOSTORNOI, S. D.
Inverse mixed problem for a profile with a prescribed velocity distribution on one of its sides and a known thickness distribution
A79-12970

KOVRIZHNYKH, L. D.
Longitudinal distribution of hydrodynamic load on a gliding flat-bottomed plate with keel
A79-12200

KOZHEVNIKOV, IU. V.
Statistical diagnostics of aircraft engines
A79-12950
Optimal designing of gas-turbine engine thermogasdynamics on the basis of prototype elements. I
A79-12951

KOZORNEZOV, M. A.
Method of calculating potential flows of an incompressible fluid past a wing with a high-lift device
A79-12126

KRASNOV, N. F.
Control and stabilization in aerodynamics
A79-11392

KRAVCHENKO, V. F.
Three-dimensional radiative heat-transfer problem with shading
A79-12784

KREPSKI, R. E.
Study of aerodynamic technology for VSTOL fighter attack aircraft
[NASA-CR-152129] N79-10027

KROPAC, O.
Processing a random loading process by computer to obtain life information
A79-12535

KROSZCZYNSKI, J. J.
Polish radar developments
A79-10283

KUCHUGURA, A. K.
Detached flow about an opening canopy
A79-11006

KUDRNA, J.
Active control
A79-12534

KUHLTHAU, A. R.
Passenger ride quality in transport aircraft
A79-12396

KUPPERMAN, D. S.
Preliminary evaluation of several nondestructive-evaluation techniques for silicon nitride gas-turbine rotors
[ANL-77-89] N79-11414

KUTCHERA, R. E.
Superalloy knife edge seal repair
[AD-A057269] N79-11055

KUZNETSOV, IU. E.
Investigation of the profile drag and the mean and pulsation velocities in the wake of wings by means of a laser Doppler anemometer
A79-12151
Approximate calculation of the velocity field and the motion of vortices in the wake of a low-flying biplane
A79-12198

KUZNETSOV, V. I.
Operational reliability of climate and pressure control equipment for passenger aircraft
A79-10850

L

LAKSHMINARAYANA, B.
An experimental study of three-dimensional turbulent boundary layer and turbulence characteristics inside a turbomachinery rotor passage
[ASME PAPER 78-GT-114] A79-10266

LALLMAN, F. J.
Description and preliminary studies of a computer drawn instrument landing approach display
[NASA-TM-78771] N79-11039

LAMAR, J. E.
Recent theoretical developments and experimental studies pertinent to vortex flow aerodynamics - With a view towards design
A79-11549

LANGE, D. E.
Flying angle of attack
A79-12384

LAPINSKI, N. P.
Preliminary evaluation of several nondestructive-evaluation techniques for silicon nitride gas-turbine rotors
[ANL-77-89] N79-11414

LAWRENCE, W. G.
Development of a 10 KVA power conditioner unit, aircraft, 115/200 volt, 3-phase, 400 Hz
[AD-A056119] N79-11049

LAYS, E.
Turbine engines in light aircraft
A79-12380

LAZALIER, G. R.
A gas path performance diagnostic system to reduce J75-P-17 engine overhaul costs
[ASME PAPER 78-GT-116] A79-10267

LEE, R. A.
Community noise exposure resulting from aircraft operations. Volume 6: Acoustic data on Navy aircraft
[AD-A056217] N79-11566

LEFEBVRE, A. H.
Weak extinction limits of turbulent flowing mixtures
[ASME PAPER 78-GT-144] A79-10798

LEMONT, H. E.
Vibratory ice protection for helicopter rotor blades
[AD-A057329] N79-11038

LENOIR, M.
Stochastic Response Secondary Surveillance Radar /S.R.S.S.R./
A79-10341

LEVERTON, J. W.
Rating helicopter noise
N79-10845
The influence of the noise environment on crew communications
N79-10860

LEVINE, L. S.
A practical approach to helicopter internal noise prediction
N79-10857

LIEBER, L. S.
Transonic 3-D flow analysis of compressor cascade with splinter vanes
[AD-A057504] N79-11004

LIPSHITS, IU. B.
Theory of large-aspect ratio wings in transonic gas flow
A79-12226

LITVINENKO, A. A.
Inverse mixed problem for a profile with a prescribed velocity distribution on one of its sides and a known thickness distribution
A79-12970

LOBANOVSKII, IU. I.
Calculation of flow past conical bodies with supersonic leading edges
A79-12227

LOBODINA, L. F.
Numerical solution of a linear integral equation of the first kind in the inverse problem of symmetric flow past a wing
A79-12138

LONGWELL, J. P.
Alternative aircraft fuels
A79-10824

LOUTHAN, J. D.
Propulsion cycle and configuration commonality considerations for subsonic V/STOL design
[ASME PAPER 78-GT-88] A79-10764

LOWRY, D. W.
A study of structural concepts for low radar cross section /LRCS/ fuselage configurations
A79-10908

LUCKRING, J. M.
Recent theoretical developments and experimental studies pertinent to vortex flow aerodynamics - With a view towards design
A79-11549

LUDWIG, G. R.
A rotating stall control system for turbojet engines
[ASME PAPER 78-GT-115] A79-10757

LUDWIG, L. P.
Gas path sealing in turbine engines
N79-11057

Self-acting shaft seals
N79-11070
LUETJERING, G.
Influence of thermomechanical treatment on microstructure and mechanical properties of high strength aluminum alloys
[DLR-FB-77-50] N79-11203
LUMMUS, J. R.
Study of aerodynamic technology for VSTOL fighter/attack aircraft, volume 1
[NASA-CR-152128] N79-10025

M

MAGLIERI, D. J.
The effect of operations on the ground noise footprints associated with a large multibladed, nonbanging helicopter
N79-10851
Trends in Langley helicopter noise research
N79-10863
MALEK, A.
Current problems in the development and production of small gas turbine engines
A79-12529
MANN, P. P.
LAX airport/land use planning study. Phase 1 report: Short term noise abatement
[PB-281622/1] N79-10071
MARSTILLER, J. K.
20 hp mini-RPV demonstrator engine programs
[ASME PAPER 78-GT-200] A79-10820
MARZE, H. J.
Helicopter internal noise reduction research and development application to the SA 360 and SA 365 Dauphin
N79-10861
MASON, R. A.
Recent developments in sensors for the gas turbine engine
[ASME PAPER 78-GT-52] A79-10760
MATHAISEL, D. F. X.
Directions for developing an air cargo system planning model
[SAE PAPER 780556] A79-10411
MATIAZH, A. I.
Determination of the geometrical parameters and position of the nose flap at the root section of a swept wing on the basis of wind tunnel data. I
A79-12953
MAYBECK, P. S.
Performance analysis of a particularly simple Kalman filter
A79-12610
MAYER, T. C.
Helicopter bearing failure detection utilizing shock pulse techniques
[AD-A057308] N79-11410
MAYERJAK, R. J.
Composite rotor hub. I, II
A79-10916
MAZHUL, I. I.
Overall aerodynamic characteristics of conical and delta wings at supersonic speeds
A79-12966
MAZUR, V. V.
Iterative method of aircraft wing strength calculation taking into account the effect of deformations on distribution of aerodynamic forces
A79-12213
MCCRACKEN, C. M.
Damage-tolerant design of the YUH-61A main rotor system
A79-10911
MCDERMOTT, J. M.
The effects of latest military criteria on the structural weight of the Hughes advanced attack helicopter - YAH-64
A79-10904
MCKELLIP, S. W.
The use of 3-D finite element analysis in the design of helicopter mechanical components
A79-10909
MCKENNY, L. D.
Time-phased development methodology - The key for reliable engines in future military aircraft weapons systems
[ASME PAPER 78-GT-167] A79-10807
MCKINZIE, G. A.
Economy in flight operations
A79-12383
MCKNIGHT, D.
Development of a compact gas turbine combuster to give extended life and acceptable exhaust emissions
[ASME PAPER 78-GT-146] A79-10799
MCLAUD, E. C.
Structural design flight maneuver loads using PDP-10 flight dynamics model
A79-10905
MCTASNEY, R.
Turbine engine automated trim balancing and vibration diagnostics
[ASME PAPER 78-GT-129] A79-10793
MEDVEDEV, M. M.
Method of determining the stability and controllability characteristics of an aircraft from the transient processes
A79-12176
MEECE, C. E., JR.
Time-phased development methodology - The key for reliable engines in future military aircraft weapons systems
[ASME PAPER 78-GT-167] A79-10807
MELUZOV, IU. V.
Optimal designing of gas-turbine engine thermogasdynamics on the basis of prototype elements. I
A79-12951
MENDELSON, I.
The CF6-32 as a derivative engine of the CF6-6
[SAE PAPER 780511] A79-10391
MERTES, B.
F-16 Avionics Intermediate Shop self-test
A79-12302
MEYERS, J. F.
Velocity measurement about a NACA 0012 airfoil with a laser velometer
[AD-A056447] N79-10029
MEZHIROV, I. I.
Numerical study of the induction of porous walls of the working section of a low-velocity wind tunnel
A79-12228
MICHAEL, G. J.
Development of gas turbine performance seeking logic
[ASME PAPER 78-GT-13] A79-10257
MIKHAILOV, IU. S.
Method of calculating potential flows of an incompressible fluid past a wing with a high-lift device
A79-12126
MILKIE, R. W.
Commercial test software development practices for military applications
A79-12320
MILLER, J. T., JR.
Moving target detector data utilization study
A79-10318
Multisensor utilization investigation
A79-10332
MILLER, L. C.
Antenna to IMU mounting for SAR motion compensation
A79-11913
MILLER, R. J.
Flight and propulsion control integration for selected in-flight thrust vectoring modes
[ASME PAPER 78-GT-79] A79-10768
MILLER, S. C.
The RB211-535 - New member of the family
[SAE PAPER 780512] A79-10392
MILOSEVIC, L.
Stochastic Response Secondary Surveillance Radar /S.R.S.S.R./
A79-10341
MIMAILOS, A. N.
Regimes of supersonic flow past thin wings
A79-12188
MITCHELL, W. S.
Application of nonseries airfoil design technology to highly loaded turbine exit guide vanes
[ASME PAPER 78-GT-108] A79-10787
MIYAKE, M.
Research of the XF3-1 turbofan engine
[ASME PAPER 78-GT-199] A79-10819

MONELLO, J. A.
Application of nonseries airfoil design technology to highly loaded turbine exit guide vanes
[ASME PAPER 78-GT-108] A79-10787
MONTS, F.
Energy conservation in general aviation piston powered aircraft
A79-12382
MOORE, R. D.
Aerodynamic performance of a 1.35-pressure-ratio axial-flow fan stage
[NASA-TP-1299] N79-10022
Performance of single-stage axial-flow transonic compressor with rotor and stator aspect ratios of 1.19 and 1.26, respectively, and with design pressure ratio of 1.82
[NASA-TP-1338] N79-10060
MORGAN, E.
A technical review of the radar systems implemented by Eurocontrol
A79-10329
MORINO, L.
Unsteady subsonic and supersonic potential aerodynamics for complex configurations
A79-12366
MORRIS, A. W. H.
A high temperature turbine research module
[ASME PAPER 78-GT-73] A79-10769
MORRISON, J. A.
Principles of jet engine operation
[AD-A056158] N79-11050
MORSE, H. A.
Aeroacoustic research: An Army perspective
N79-10864
MOUCH, T. N.
The influence of aerodynamic interference on high angle of attack wind tunnel testing
[AD-A056045] N79-11002
MOZO, B. T.
The effective acoustic environment of helicopter crewmen
N79-10850
MOZOLKOV, A. S.
Investigation of the profile drag and the mean and pulsation velocities in the wake of wings by means of a laser Doppler anemometer
A79-12151
MULCAHY, G.
The role of flight dynamic modeling in helicopter certification
[SAE PAPER 780550] A79-10409
MURASHIMA, K.
Research of the XF3-1 turbofan engine
[ASME PAPER 78-GT-199] A79-10819
MURRAY, B. S.
Helicopter cabin noise: Methods of source and path identification and characterization
N79-10856
MUSSBAUM, I.
Aircraft RAM (MMH/FH) data comparative analysis
[AD-A056893] N79-10001

N

NADER, M. A.
The control of tolerances in an array antenna
A79-11934
NEEDHAM, J. F.
Engine/airframe/drive train dynamic interface documentation
[AD-A056956] N79-10064
NELSON, R. C.
The influence of aerodynamic interference on high angle of attack wind tunnel testing
[AD-A056045] N79-11002
NENNI, J. P.
A rotating stall control system for turbojet engines
[ASME PAPER 78-GT-115] A79-10757
NESBITT, E. J.
Helicopter transport efficiency payoffs from advanced technology
[SAE PAPER 780536] A79-10405
NIXON, D.
Direct numerical solution of the transonic perturbation integral equation for lifting and nonlifting airfoils
[NASA-TM-78518] N79-10045
NOVITSKII, V. V.
Synthesis and analysis of systems for active control and suppression of flutter of flying craft
A79-12755
NOVOSELOV, IU. N.
Solution of the inverse problem of aerodynamics by a random search technique
A79-12956

O

OBRIEN, P. J.
Simulation study of the effect of fuel-conservative approaches on ATC procedures and terminal area capacity
[SAE PAPER 780523] A79-10398
OCONNOR, P. D.
F-16 LRU test programs - A systems approach
A79-12321
OLDFIELD, M. L. G.
On-line computer for transient turbine cascade instrumentation
A79-11488
OLKIN, S. I.
Summation of defects in the case of nonisothermal programmed loads
A79-12164
OMASSEY, R. C.
Relative pavement bearing strength requirements of aircraft
[SAE PAPER 780568] A79-10415
OSBORN, W. M.
Aerodynamic performance of a 1.35-pressure-ratio axial-flow fan stage
[NASA-TP-1299] N79-10022
OSORGIN, V. D.
The smooth approximation method and its application to the mathematical description of the aerodynamic characteristics of a wing
A79-12955
OVCHINNIKOV, V. A.
The smooth approximation method and its application to the mathematical description of the aerodynamic characteristics of a wing
A79-12955

P

PACKMAN, A. B.
Internal mixer investigation for JT8D engine jet noise reduction. Volume 1: Results
[AD-A057309] N79-10059
Internal mixer investigation for JT8D engine jet noise reduction. Volume 2: Appendices A, B, C, and D
[AD-A057310/5] N79-10065
PALMER, E. A.
Simulation study of the effect of fuel-conservative approaches on ATC procedures and terminal area capacity
[SAE PAPER 780523] A79-10398
PARANJPE, P. A.
Jet curtain flameholder for aircraft afterburners
[ASME PAPER 78-GT-95] A79-10761
PARDINI, S.
Track-while-scan algorithm in a clutter environment
A79-11492
PARIS, P. C.
Probability that the propagation of an undetected fatigue crack will not cause a structural failure
[AD-A057335] N79-11439
PARKER, A. T.
An evaluation technique for determining the cost effectiveness of condition monitoring systems
[ASME PAPER 78-GT-166] A79-10806
PARKHOMOVSKII, IA. M.
Numerical-analytical solution of the problem of the constrained torsion of a cantilever wing
A79-12195
Approximate solution of some boundary value problems on aircraft structural integrity
A79-12234
PASHINTSEV, V. T.
Quality index for an iterative process of optimizing long-range aircraft parameters
A79-12152

PAULSON, R.
Infrared landing system for a mini remotely-piloted vehicle
A79-12093

PAVLOV, V. G.
The smooth approximation method and its application to the mathematical description of the aerodynamic characteristics of a wing
A79-12955

PELC, S. P.
An active noise reduction system for aircrew helmets
N79-10853

PESHATOV, G. D.
Solution of the inverse problem of aerodynamics by a random search technique
A79-12956

PETERS, D. A.
Comparison of the effect of structural coupling parameters on flap-lag forced response and stability of a helicopter rotor blade in forward flight
[AD-A056485] N79-11037

PETERS, W. J.
The F-16 environmental control system
[ASME PAPER 78-ENAS-11] A79-12560

PETERSON, V. J.
Management of test program development for S-3A
A79-12319

PETROV, A. V.
Some types of separated flow past slotted wings
A79-12148
Features of flow past slotted wings
A79-12236

PETUNIN, A. N.
Investigation of the profile drag and the mean and pulsation velocities in the wake of wings by means of a laser Doppler anemometer
A79-12151

PFEIFER, G. D.
Aircraft engine icing, technical summary
N79-10011

PHOA, Y. T.
Program REV - A wing structural optimization computer program for preliminary design of fighter aircraft
A79-12460

PIKE, A. C.
Rating helicopter noise
N79-10845

PIOTTE, S. Y.
Pollution sources caused by aviation
A79-10453

PLECKAITIS, C. A.
Integrated Avionics Control System (IACS)
[AD-A056476] N79-10056

PODMAZOV, A. V.
Investigation of the electrification of an aircraft model by a humid airstream in a wind tunnel
A79-12162

POISSON-QUINTON, P.
Energy conservation aircraft design and operational procedures
[ONERA, TP NO. 1978-107] A79-11572

PONDER, R. J.
Overview of the small package air carrier industry - A study of the operations in Federal Express
[SAE PAPER 780540] A79-10406

POPOV, V. A.
Determination of the geometrical parameters and position of the nose flap at the root section of a swept wing on the basis of wind tunnel data. I
A79-12953

POPYTALOV, S. A.
Calculation of the transient aerodynamic characteristics of a supersonic flight vehicle
A79-12182

POST, T. J.
An evaluation of a new format for ejection information in a NATOPS manual
[AD-A056910] N79-10037

POTAPOV, IU. P.
Investigation of an ejector thrust-augmentor with a perforated nozzle for the ejected gas
A79-12196

POTONIDES, H. C.
Development of an inlet for a tilt nacelle subsonic V/STOL aircraft
[ASME PAPER 78-GT-121] A79-10789

POTTER, K. B.
Experimental design study of an airborne interferometer for terrain avoidance
A79-10381

POWELL, R. G.
Community noise exposure resulting from aircraft operations. Volume 6: Acoustic data on Navy aircraft
[AD-A056217] N79-11566

PREDTECHENSKII, A. N.
Method of eliminating static and dynamic errors in the reproduction of motion of TV-simulator displays
A79-12153

PRICE, R.
Infrared landing system for a mini remotely-piloted vehicle
A79-12093

PRICE, J. L.
Time-phased development methodology - The key for reliable engines in future military aircraft weapons systems
[ASME PAPER 78-GT-167] A79-10807

PRINCE, A. G.
Icing tests on turbojet and turbofan engines using the NGTE engine test facility
N79-10013

Q

QUADE, D. A.
Load and dynamic assessment of B-52B-008 carrier aircraft for finned configuration 1 space shuttle solid rocket booster decelerator subsystem drop test vehicle. Volume 1: Summary
[NASA-CR-150833] N79-10048
Load and dynamic assessment of B-52B-008 carrier aircraft for finned configuration 1 space shuttle solid rocket booster decelerator subsystem drop test vehicle. Volume 2: Airplane flutter and load analysis results
[NASA-CR-150834] N79-10049
Load and dynamic assessment of B-52B-008 carrier aircraft for finned configuration 1 space shuttle solid rocket booster decelerator subsystem drop test vehicle. Volume 3: Pylon load data method 1
[NASA-CR-150835] N79-10050
Load and dynamic assessment of B-52B-008 carrier aircraft for finned configuration 1 space shuttle solid rocket booster deceleration subsystem drop test vehicle. Volume 4: Pylon load data
[NASA-CR-150836] N79-10051

R

RACHOVITSKY, R.
Flight and propulsion control integration for selected in-flight thrust vectoring modes
[ASME PAPER 78-GT-79] A79-10768

RADA, J.
Choice of the main parameters in the design of aircraft engines
A79-12528

RAJPAUL, V. K.
Advanced environmental cooling concepts for supersonic aircraft
[ASME PAPER 78-ENAS-21] A79-12570

RAMER, D. J.
A static acoustic signature system for the analysis of dynamic flight information
N79-10852

RAWLINSON, D.
An active noise reduction system for aircrew helmets
N79-10853

REDDICK, H.
The survivability of helicopters to rotor blade ballistic damage
A79-10913

REDDICK, H. K.
Boeing Vertol bearingless main rotor structural design approach using advanced composites
A79-10920

REEDER, J. P.
Operational benefits from the Terminal Configured Vehicle
A79-10390

REID, L.
Performance of single-stage axial-flow transonic compressor with rotor and stator aspect ratios of 1.19 and 1.26, respectively, and with design pressure ratio of 1.82
[NASA-TP-1338] N79-10060

REYNOLDS, E. C., JR.
A gas path performance diagnostic system to reduce J75-P-17 engine overhaul costs
[ASME PAPER 78-GT-116] A79-10267

RICH, M. J.
Finite element analysis of helicopter structures
N79-10453

RICHARDS, L. G.
Passenger ride quality in transport aircraft
A79-12396

RIHA, B.
Control system requirements for aircraft gas turbine engines
A79-12530

RINGER, T. R.
The dynamic ice detector for helicopters
N79-10010

RIO, R. A.
Turbine engine automated trim balancing and vibration diagnostics
[ASME PAPER 78-GT-129] A79-10793

RIST, D.
Influence of geometric effects on the aspect ratio optimization of axial turbine bladings
[ASME PAPER 78-GT-173] A79-10809

ROBERTS, P. B.
Wide range operation of advanced low NOx aircraft gas turbine combustors
[ASME PAPER 78-GT-128] A79-10792

ROBERTS, W. B.
A design point correlation for losses due to part-span dampers on transonic rotors
[ASME PAPER 78-GT-153] A79-10802

ROBINSON, C. E.
Exhaust plume thermodynamic effects on nonaxisymmetric nozzle afterbody performance in transonic flow
[AD-A057363] N79-11052

RODCHENKO, V. V.
Method of eliminating static and dynamic errors in the reproduction of motion of TV-simulator displays
A79-12153

ROSEN, G.
Evolution of the turboprop for high speed air transportation
[ASME PAPER 78-GT-201] A79-10821

ROYAL, A. C.
An analytical method for designing low noise helicopter transmissions
N79-10859

RUBAN, A. I.
Contribution to the asymptotic theory of flows at the trailing edge of a slender wing
A79-12127

RUDEY, R. A.
Characteristics and combustion of future hydrocarbon fuels
A79-11599
Impact of future fuel properties on aircraft engines and fuel systems
A79-11600

RUNNELS, J. N.
Advanced environmental cooling concepts for supersonic aircraft
[ASME PAPER 78-ENAS-21] A79-12570

RUO, S. Y.
Improved sonic-box computer program for calculating transonic aerodynamic loads on oscillating wings with thickness
[NASA-CR-158906] N79-10998
Sonic-box method employing local Mach number for oscillating wings with thickness
[NASA-CR-158907] N79-10999

S

SALMON, R. F.
Pilot program to develop operating time emission degradation factors for general aviation piston engines
[AD-A058158] N79-11562

SAMSONOV, V. V.
Calculation of the transient aerodynamic characteristics of a supersonic flight vehicle
A79-12182

SANTANELLI, A. S.
Integrated Avionics Control System (IACS)
[AD-A056476] N79-10056

SATHER, A.
Preliminary evaluation of several nondestructive-evaluation techniques for silicon nitride gas-turbine rotors
[ANL-77-89] N79-11414

SAVITSKII, V. I.
Effect of viscosity on nonseparated transonic flow past a profile
A79-12205

SAWADA, H.
A general correction method of the interference in 2-dimensional wind tunnels with ventilated walls
A79-10867

SCHAEFFER, E. G.
Design of helicopter rotors to noise constraints
N79-10854

SCHIER, P.
New construction materials for gas turbine engines and technology for processing these materials
A79-12533

SCHLUETER, H. G.
Better performance for aircraft tracking and holding under gust and shearwind influence by use of direct digital control
[ESA-TT-506] N79-11033
A contribution to the increase of aircraft guidance precision under wind disturbance conditions by using direct digital control
[DLR-FB-77-48] N79-11075

SCHMAL, R. J.
A discussion of turbine and compressor sealing devices and systems
A79-12373

SCHMITZ, F. H.
Aeroacoustic research: An Army perspective
N79-10864

SCHMITZ, R. A.
Operational benefits from the Terminal Configured Vehicle
A79-10390

SCHRAGE, D. P.
Comparison of the effect of structural coupling parameters on flap-lag forced response and stability of a helicopter rotor blade in forward flight
[AD-A056485] N79-11037

SCHULTZ, D. L.
On-line computer for transient turbine cascade instrumentation
A79-11488

SCIAMMARELLA, C.
Preliminary evaluation of several nondestructive-evaluation techniques for silicon nitride gas-turbine rotors
[ANL-77-89] N79-11414

SCRUGGS, B. W., JR.
A study of structural concepts for low radar cross section /LRCS/ fuselage configurations
A79-10908

SENDER, P.
From Transit to Navstar - Development trends of satellite navigation
A79-12527

SENS, W.
Advanced turbofan engines for low fuel consumption
[ASME PAPER 78-GT-192] A79-10816

SERAG-ELDIN, M. A.
Computations of three-dimensional gas-turbine combustion chamber flows
[ASME PAPER 78-GT-142] A79-10797

SEREBRIISKII, IA. M.
Method of calculating potential flows of an incompressible fluid past a wing with a high-lift device
A79-12126

SHAUGHNESSY, J. D.
Single pilot IFR operating problems determined from accidental data analysis
[NASA-TM-78773] N79-11013

SHAW, R. R.
The need and impact of long-term advances in aircraft technology - The airlines' point of view
[SAE PAPER 780554] A79-10410
SHCHENNIKOVA, O. L.
Calculation of effect of viscosity on nonseparated subsonic flow past a wing with flap
A79-12240
SHEFFLER, M. W.
Boeing Vertol bearingless main rotor structural design approach using advanced composites
A79-10920
SHELTON, E. M.
Aviation turbine fuels, 1977
[BERC/PPS-78/2] N79-11240
SHESTERNINA, Z. N.
Harmonic vibrations of an annular wing in the steady flow of an ideal fluid
A79-12963
SHIVAMOGGI, B. K.
Axial flow in trailing line vortices
[AD-A057075] N79-10034
SHUMILKIN, V. G.
Investigation of the profile drag and the mean and pulsation velocities in the wake of wings by means of a laser Doppler anemometer
A79-12151
SHUSTOV, A. V.
Qualitative analysis of the effect of jet aircraft acoustic characteristics on the optimal take-off program
A79-12233
SHUSTROV, IU. M.
Aircraft air conditioning systems
A79-11442
SILHANEK, J.
Control systems and problems of their development from the viewpoint of technological and operational requirements
A79-12531
SIM, A. G.
Flight-determined stability and control derivatives for the F-111 Tact research aircraft
[NASA-TP-1350] N79-10068
SIMS, D. L.
Evaluation of the cyclic behavior of aircraft turbine disk alloys
[NASA-CR-159409] N79-10058
SINGLEY, G. T., III
Composite rotor hub. I, II
A79-10916
SISTO, F.
Dynamic stall of an airfoil with leading edge bubble separation involving time dependent re-attachment
[ASME PAPER 78-GT-194] A79-10817
SKINNER, R. C.
Program REV - A wing structural optimization computer program for preliminary design of fighter aircraft
A79-12460
SLUSHER, G. R.
Emission sample probe investigation of a mixed flow JT8D-11 turbofan engine
[AD-A058038] N79-11561
SMITH, C. R.
American Airlines' operational and maintenance experience with aerodynamic seals and oil seals in turbofan engines
N79-11061
SMITH, K. P.
20 hp mini-RPV demonstrator engine programs
[ASME PAPER 78-GT-200] A79-10820
SMITH, N. H. A.
Developments in radar data processing at the London Air Traffic Control Centre
A79-10330
SOBIESZCZANSKI-SOBIESKI, J.
Synthesis of aircraft structures using integrated design and analysis methods
N79-10454
SOPRONOV, N. A.
Aircraft radio equipment
A79-11439
SOUCEK, J.
Certain problems which had to be solved between the prototype stage and mass production stage in the development of an engine
A79-12532
SOUTHWOOD, B. J.
Rating helicopter noise
N79-10845
SPALDING, D. B.
Computations of three-dimensional gas-turbine combustion chamber flows
[ASME PAPER 78-GT-142] A79-10797
SPEAKMAN, J. D.
Community noise exposure resulting from aircraft operations. Volume 6: Acoustic data on Navy aircraft
[AD-A056217] N79-11566
SRIDHARA, K.
Jet curtain flameholder for aircraft afterburners
[ASME PAPER 78-GT-95] A79-10761
STAKOLICH, E. G.
Aerodynamic and acoustic effects of eliminating core swirl from a full scale 1.6 stage pressure ratio fan (QF-5A)
[NASA-TM-78991] N79-11001
STALLABRASS, J. R.
The dynamic ice detector for helicopters
N79-10010
STECH, G.
Integrated Avionics Control System (IACS)
[AD-A056476] N79-10056
STEINHAUSER, R.
Investigations for the calculation of robust control systems
[ESA-TT-488] N79-11076
STEINKE, R. J.
Aerodynamic performance of a 1.35-pressure-ratio axial-flow fan stage
[NASA-TP-1299] N79-10022
STEPHENS, D. G.
Trends in Langley helicopter noise research
N79-10863
STEPNIEWSKI, W. Z.
A glance at Soviet helicopter design philosophy
A79-10910
STERLIN, V. A.
Determination of the geometrical parameters and position of the nose flap at the root section of a swept wing on the basis of wind tunnel data. I
A79-12953
STERNFELD, H., JR.
Design of helicopter rotors to noise constraints
N79-10854
STEVENS, E. H.
Experimental design for real-time simulations of air traffic control concepts
A79-11481
STEWART, P. A. E.
The contribution of dynamic X-ray to gas turbine air sealed technology
N79-11065
STOCKER, H. L.
Determining and improving labyrinth seal performance in current and advanced high performance gas turbines
N79-11068
STRAND, T.
Asymmetric swirling flows in turbomachine annuli
[ASME PAPER 78-GT-109] A79-10260
STRANG, J. E.
F-18 air conditioning system
[ASME PAPER 78-ENAS-23] A79-12572
SUNDBERG, G. R.
The solid state remote power controller - Its status, use and perspective
A79-10896
SUTPHIN, H. W.
Helicopter bearing failure detection utilizing shock pulse techniques
[AD-A057308] N79-11410
SWIFT, R. D.
Icing test facilities at the National Gas Turbine Establishment
N79-10006
SYMONDS, M. F.
Damage tolerant design of the YAH-64 main rotor blade
A79-10914
SZCZECINSKI, S.
Experimental method for investigating preintake vortex circulation
A79-11367

SZCZEPANIK, R.
Experimental method for investigating preintake vortex circulation
A79-11367

T

TAGG, R. W.
A method for assessing turbine engine run-up noise impact on airport neighbors
[SAE PAPER 780522] A79-10397
TAIWO, O.
Design of a multivariable controller for a high-order turbofan engine model by Zakian's method of inequalities
A79-12287
TALBOT, J. E.
Powerplant integration - The application of current experience to future developments
[ASME PAPER 78-GT-113] A79-10788
TALL, W. A.
Application of nonseries airfoil design technology to highly loaded turbine exit guide vanes
[ASME PAPER 78-GT-108] A79-10787
TALYZIN, V. A.
Optimal designing of gas-turbine engine thermogasdynamics on the basis of prototype elements. I
A79-12951
TANEJA, N. K.
Directions for developing an air cargo system planning model
[SAE PAPER 780556] A79-10411
TAYLOR, L. E.
An experimental study of a catalytic combustor for an expendable turbojet engine
[AD-A056512] N79-11048
TEDSTONE, D.
Icing tests of a small gas turbine with inertial separation anti-icing system
N79-10015
TETELMAN, A. S.
Nondestructive inspection of aircraft structures and materials via acoustic emission
A79-10991
TETERIUKOV, IA. I.
Vortex system at the nose part of a fuselage model at supercritical angles of attack and different Reynolds numbers
A79-12199
THOMPSON, D. E.
Propeller unsteady thrust due to operation in turbulent inflows
[ASME PAPER 78-GT-94] A79-10762
THOMPSON, J. S.
Aircraft fuel pumps - Where we're at /A review of some problems and their current solutions/
[ASME PAPER 78-GT-10] A79-10777
THRAVES, J.
A yaw stabilised S.A.R. aerial
A79-10364
TIMOFEEV, I. IA.
Problems in the method of discrete vortices for solving linear wing theory problems
A79-12224
TINSLEY, H. G.
Possible near-term solutions to the wind shear hazard
[SAE PAPER 780572] A79-10416
TOBIAS, L.
Simulation study of the effect of fuel-conservative approaches on ATC procedures and terminal area capacity
[SAE PAPER 780523] A79-10398
TOKEL, H.
Dynamic stall of an airfoil with leading edge bubble separation involving time dependent re-attachment
[ASME PAPER 78-GT-194] A79-10817
TRANTINA, G.
Demonstration of ceramic design methodology for a ceramic combustor liner
[ASME PAPER 78-GT-137] A79-10794
TROHA, W. A.
Turbine engine automated trim balancing and vibration diagnostics
[ASME PAPER 78-GT-129] A79-10793
TSANDOULAS, G. N.
The control of tolerances in an array antenna
A79-11934
TSENG, K.
Unsteady subsonic and supersonic potential aerodynamics for complex configurations
A79-12366
TSOUBANOS, C. M.
Doppler Hover System (DHS) flight test report
[AD-A056777] N79-10053
TSYGANOV, N. K.
Detached flow about an opening canopy
A79-11006
Parachute canopy opening dynamics
A79-11008
TURCHANINIKOV, G. I.
Iterative method of aircraft wing strength calculation taking into account the effect of deformations on distribution of aerodynamic forces
A79-12213
TURNER, D.
Planning the passenger terminal
[SAE PAPER 780517] A79-10393

U

UBEROI, M. S.
Axial flow in trailing line vortices
[AD-A057075] N79-10034
UPTON, H.
Vibratory ice protection for helicopter rotor blades
[AD-A057329] N79-11038

V

VACHATA, F.
Certain problems which had to be solved between the prototype stage and mass production stage in the development of an engine
A79-12532
VADYAK, J.
A computer program for the calculation of the flow field in supersonic mixed-compression inlets at angle of attack wing the three-dimensional method of characteristics with discrete shock wave fitting
[NASA-TM-78947] N79-10023
VANDERPLAATS, G. N.
Application of optimization techniques in engineering design
A79-12404
VATH, K. A.
Meteorological icing conditions
N79-10005
VEGA, E.
The effects of latest military criteria on the structural weight of the Hughes advanced attack helicopter - YAH-64
A79-10904
VERBER, C. M.
Present and potential capabilities of three-dimensional displays using sequential excitation of fluorescence
A79-12033
VINOGRADOV, IU. A.
Method of determining the stability and controllability characteristics of an aircraft from the transient processes
A79-12176
VOLLMER, R. G.
Ultrasonic welding /solid state bonding/ of aircraft structure - Fact or fancy
A79-10921
VOLOBUEV, A. N.
Moments on the hub of a lifting propeller with hinge-mounted blades
A79-12216
VRONSKII, G. V.
Time-frequency method of solving large problems in the dynamics of elastic structures with local nonlinearities
A79-12155

W

WADCOCK, A.
The flying hot wire and related instrumentation
[NASA-CR-3066] N79-11352

WADCOCK, A. J.
Flying hot-wire study of two-dimensional turbulent separation on an NACA 4412 airfoil at maximum lift
N79-10019
WAGENER, L. E.
A Hub operator's view of small aircraft operations
[SAE PAPER 780562] A79-10412
WALDREN, N. E. P.
A high temperature turbine research module
[ASME PAPER 78-GT-73] A79-10769
WALKER, C. L.
Infrared suppressor effect on T63 turboshaft engine performance
[NASA-TM-78970] N79-11043
WALTER, T. J.
Study of T53 engine vibration
[NASA-CR-135449] N79-10061
WARREN, J. R.
Evaluation of the cyclic behavior of aircraft turbine disk alloys
[NASA-CR-159409] N79-10058
WASSELL, A. B.
The effects of aircraft engine pollutant emission measurement variability on engine certification policy
[ASME PAPER 78-GT-86] A79-10261
WEHNERT, G. J.
Boeing Vertol bearingless main rotor structural design approach using advanced composites
A79-10920
WELPMANN, K.
Influence of thermomechanical treatment on microstructure and mechanical properties of high strength aluminum alloys
[DLR-FB-77-50] N79-11203
WENTZ, W. H., JR.
Wind tunnel tests of the GA(W)-2 airfoil with 20% aileron, 25% slotted flap, 30% Fowler flap and 10% slot-lip spoiler
[NASA-CR-145139] N79-10021
WESTON, K. C.
Gas turbine analysis and design using interactive computer graphics
A79-12459
WHEELER, P. D.
An active noise reduction system for aircrew helmets
N79-10853
WHITE, R. P., JR.
The status of rotor noise technology: One man's opinion
N79-10862
WHITLOCK, D. C.
Oil sealing of aero engine bearing compartments
N79-11062
WIGLE, G. B.
Spare memory and timing parameters in avionics computer system requirements
[AD-A056521] N79-10055
WILBY, J. F.
Helicopter cabin noise: Methods of source and path identification and characterization
N79-10856
WILLIAMSON, W. E., JR.
An instrumentation modeling technique used in the identification of aerodynamic coefficients from flight test data
[IAF PAPER 78-99] A79-11239
WITT, R. M.
A performance measure for evaluating aircraft landing trajectories
A79-11494
WOOD, L. W.
Possible near-term solutions to the wind shear hazard
[SAE PAPER 780572] A79-10416
WOODWARD, R. P.
Aerodynamic and acoustic effects of eliminating core swirl from a full scale 1.6 stage pressure ratio fan (QF-5A)
[NASA-TM-78991] N79-11001
WU, T. J.
End wall and corner flow improvements of the rectangular Alperin jet-diffuser ejector
[AD-A057663] N79-11051

Y

YAMANAKA, K.
Research of the XF3-1 turbofan engine
[ASME PAPER 78-GT-199] A79-10819
YAMASAKI, M.
Aerodynamic response for the airfoil experiencing sudden change in angle of attack
A79-10869
YI, C. J.
Flight and propulsion control integration for selected in-flight thrust vectoring modes
[ASME PAPER 78-GT-79] A79-10768
YOUNG, A. P.
Enhancements of radar data-handling networks
A79-10299
YOUNG, W.
Advanced technology impact upon ATE self test
A79-12306
YOUNG, W. H., JR.
Velocity measurement about a NACA 0012 airfoil with a laser velometer
[AD-A056447] N79-10029
YUHAS, D.
Preliminary evaluation of several nondestructive-evaluation techniques for silicon nitride gas-turbine rotors
[ANL-77-89] N79-11414

Z

ZAMULA, G. N.
Thermal stability of ribbed sheet systems
A79-12137
ZHULEV, IU. G.
Investigation of an ejector thrust-augmentor with a perforated nozzle for the ejected gas
A79-12196
ZIMONT, E. L.
Determination of inspection intervals for aircraft structures with allowance for the two-stage nature of fatigue damage
A79-12135
ZINBERG, H.
The survivability of helicopters to rotor blade ballistic damage
A79-10913
ZIPKIN, M. A.
Making turbofan engines more energy efficient
[ASME PAPER 78-GT-198] A79-10818
ZMUDZINSKI, Z.
Aircraft electric power networks - Structures. I
A79-11369
ZUCHOWICZ, K.
Aircraft lighting equipment
A79-11366
ZURAEV, T. G.
A method of solving multicriterial optimization problems for load-bearing structures
A79-12163

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NAS2-9460 — CONTRACT NUMBER

N79-10038 — NASA ACCESSION NUMBER

Listings in this index are arranged alphanumerically by contract number Under each contract number the accession numbers denoting documents that have been produced as a result of research done under that contract are arranged in ascending order with the *IAA* accession numbers appearing first The accession number denotes the number by which the citation is identified in either the *IAA* or *STAR* section

AF PROJ. 486U
N79-11188
AF PROJ. 2307
N79-11002
N79-11004
AF PROJ. 2404
N79-11003
AF PROJ. 7351
N79-11055
AF-AFOSR-74-2675
A79-10812
AF-AFOSR-3299-77
N79-11002
DA PROJ. 1F2-62209-A-H76
N79-11038
DA PROJ. 1F2-62209-AH-76
N79-10062
DAAJ01-72-A-0027
N79-11410
DAAJ02-74-C-0039
N79-10859
DAAJ02-75-C-0013
A79-10916
DAAJ02-76-C-0031
N79-10062
DAAJ02-76-C-0051
N79-11038
DAAJ02-77-C-0035
N79-10064
DAHC04-75-6-0120
A79-12395
DOT-FA74WA-3423
A79-10318
A79-10332
DOT-FA76WA-3791
N79-10855
DOT-FA76WA-3809
N79-10059
N79-10065
DOT-FA76WA-3840
N79-10011
DOT-OS-50232 A79-10394
EPA-68-01-3158
N79-11580
EPA-68-01-4142
N79-10072
EPA-68-03-2159
A79-10262
EY-76-C-02-3077
N79-10036
F3615-73-C-2046
A79-10757
F33615-74-C-1040
A79-11913
F33615-76-C-2071
N79-11004
F33615-76-C-3111
N79-11188
F33615-76-C-5123
N79-11055
NASW-3199 N79-10066
NAS1-10210 A79-11494
NAS1-13613 N79-10998
N79-10999
NAS1-15159 N79-10047
NAS1-15226 N79-10854
NAS2-9460 N79-10038
NAS2-9769 N79-10025
NAS2-9770 N79-10027
NAS2-9771 N79-10024
N79-10026
NAS2-9772 N79-10028
NAS3-18517 N79-11409
NAS3-20045 N79-10423
NAS3-20056 N79-11068
NAS3-20367 N79-10058
NAS3-20609 N79-10061
NAS8-31805 N79-10048
N79-10049
N79-10050
N79-10051
NGL-05-002-229
N79-11352
NGL-39-009-007
A79-10266
NGR-05-020-409
N79-10942
NGR-15-005-191
N79-10023
NGR-22-004-030
A79-12366
NR PROJ. 207-068
N79-10037
NSF SER-76-05002
A79-10257
NSG-1101 A79-11494
NSG-1165 N79-10021
NSG-3133 A79-10802
N00014-75-C-1143
N79-10034
N00014-76-C-0540
A79-10817
N00014-77-C-0321
N79-10037
N00140-73-C-005
N79-11068
N00140-74-C-0759
N79-11068
N60921-77-C-A085
N79-10030
N62269-76-C-0076
N79-11049
N62269-77-C-0232
N79-11051
N68335-77-M-5735
N79-10439
PROJ. SQUID N79-10034
SRC-B/SR/89866
A79-11488
W-31-109-ENG-38
N79-11414
ZF41400001 N79-11054
505-03-13-15 N79-10843
505-04 N79-10022
N79-10060
505-06-11 N79-10045
505-06-33-10 N79-10021
505-06-54 N79-10020
505-07-13-02 N79-11039
505-07-33-04 N79-11074
505-10-31 N79-10024
N79-10025
N79-10027
N79-10028
505-11-24 N79-10068
505-53-09-01 N79-11013
505-10731 N79-10026
513-53-11 N79-10054
992-21-01 N79-10942

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