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Engineering A Continuing Bibliography with Indexes September 1979

National Aeronautics and Space Administration

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AERONAUTICAL ENGINEERING

1

A Continuing Bibliography

Supplement 113

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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 436 reports, journal articles, and other documents originally announced in August 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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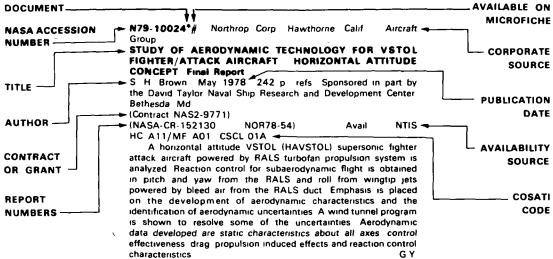
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TABLE OF CONTENTS

AA Entries	
STAR Entries	
Subject Index	A-1
Personal Author Index	B-1
Contract Number Index	C-1

TYPICAL CITATION AND ABSTRACT FROM STAR

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TYPICAL CITATION AND ABSTRACT FROM IAA

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AIAA ACCESSION	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	
TITLE OF PERIODICAL	78-GT-114) ASME, Transactions, Journal of Engineering for Power, vol 100, Oct 1978, p 676-687, Discussion, p 688-690 19 refs	AFFILIATION
	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, turbu- lence 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)	PUBLICATION DATE

AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 113)

SEPTEMBER 1979

IAA ENTRIES

A79-35927 # Second approximation in theory of a finitespan thin wing in a hypersonic gas flow (Vtoroe priblizhenie v teorii tonkogo kryla konechnogo razmakha, obtekaemogo giperzvukovym potokom gaza) V I Bogatko, A A Grib, and G A Kolton Leningradskii Universitet, Vestnik, Matematika, Astronomiia, Jan 1979, p 88-95 8 refs In Russian

The uniform hypersonic flow of an inviscid gas on the windward side of a thin wing of finite span is studied. Thin boundary layer theory is applied to obtain corrections to the main Newtonian flow. The shock is assumed to be attached to the leading edge at at least two points. The special case of a symmetric conical wing with rectilinear leading edge is considered. PTH.

A79-35928 # Construction of an initial approximation for the solution of the integral equation of a lifting surface (O postroenii nachal'nogo priblizheniia dha resheniia integral'nogo uravneniia nesushchei poverkhnosti) O F Mel'nikova and N N Poliakhov Leningradskii Universitet, Vestnik, Matematika, Astronomiia, Jan 1979, p 104-110 6 refs In Russian

Weissinger's hypothesis is used to obtain in a simple manner an analytic expression for an initial approximation to the solution of the integral equation for a lifting surface. It is proved that the abproximate solution obtained in this way satisfies the boundary conditions of the problem and the requirement for practical convergence of the iterations.

A79-36003 X-ray determination of internal stress states due to surface treatment of TiAl6V4 and TiAl6V6Sn2 (Rontgenographische Ermittlung der bei der Oberflachenbearbeitung von TiAl6V4 und TiAl6V6Sn2 entstehenden Eigenspannungszustande) H E Franz (Verein Deutscher Ingenieure, Internationale Konferenz über experimentelle Spannungsanalyse, 6th, Munich, West Germany, Sept 18-22, 1978) VDI-Berichte, no 313, 1978, p 453-462 14 refs in German

A report is given on the states of internal stress occurring near the surface on the surface finishing of two titanium alloys (TiAI6V4 and TiAI6V6Sn2). The finishing methods investigated comprise milling, grinding, milling plus grinding, turning plus grinding, rolling and shot peening. The results are compared with those relating to steel. It is pointed out that taking internal stresses due to finishing into account in aircraft construction may perhaps lead to reductions in weight and thus to lower costs of operation. (Author)

A79-36024 Application of advanced data reduction methods to gas turbine dynamic analysis P B Juhi (Verein Deutscher Ingenieure, Internationale Konferenz über experimentelle Spannungsanalyse, 6th, Munich, West Germany, Sept 18-22, 1978 VDI Berichte, no 313, 1978, p 637-642

This paper discusses the application of advanced data reduction methods to the evaluation of dynamic data from gas turbines and turbine components. The use of the Fast Fourier Transform and of real-time spectrum analyzers is discussed. The use of power spectral density and probability density functions for analyzing random data is discussed. Examples of the application of these modern techniques to gas turbine testing are presented. The use of the computer to automate the data reduction procedures is discussed. (Author) A79-36065 Evaluation of GPS performance for low-cost general aviation A N Joglekar (Mitre Corp , Metrek Div , McLean, Va) In PLANS 1978, Position Location and Navigation Symposium, San Diego, Calif, November 6-9, 1978, Record

New York, Institute of Electrical and Electronics Engineers, Inc, 1978, p 7-12

This paper presents preliminary results of a simulation effort to evaluate requirements and feasibility of GPS as a civil navigation system The paper focuses on evaluation of GPS requirements, from operational considerations, such as application to nonprecision approaches The conceptual low-cost GPS receiver simulated here does not correct for the ionospheric or tropospheric delay, is sequential in nature, tracks only four satellites, and is not mechanized to make independent range rate measurements based on the Doppler shift of the GPS carrier frequency The proposed GPS system has significantly different performance characteristics from the presently used VOR/DME system. The GPS is a low signal level system and may have a relatively slow data rate due to the low cost sequential receiver design. The results indicate that although the conceptual low-cost GPS receiver/navigator is potentially more accurate than a VOR, the accuracy may degrade during aircraft turns and satellite shielding periods (Author)

A79-36069 # Internationalization of OMEGA D T Haislip (U.S. Coast Guard, Washington, D.C.) In PLANS 1978, Position Location and Navigation Symposium, San Diego, Calif, November 6-9, 1978, Record New York, Institute of Electrical and Electronics Engineers, Inc., 1978, p. 37-39

The OMEGA system of radionavigation is a Very Low Frequency (VLF) system operating in the internationally allocated radio frequency band of 10 to 13 kHz Navigators using the OMEGA system will be able to obtain positional data on a worldwide and nearly continuous basis when the system is in full operation with eight transmitting stations Experimental stations commenced operating in 1966 in support of system evaluation and testing. These experimental stations provided coverage over most of the North Atlantic Ocean, North American Continent, and eastern portions of the North Pacific Ocean. This coverage provided the fundamental basis for initial operational evaluation and further development of the system intended to be available to the users of all nations, both ships and aircraft. This paper will review the growth, current status and future plans for management of this international radio-(Author) navigation system

A79-36070 Hyperbolic positioning per se is passe R R Hatch (Magnavox Government and Industrial Electronics Co, Ft Wayne, Ind) In PLANS 1978, Position Location and Navigation Symposium, San Diego, Calif, November 6-9, 1978, Record New York, Institute of Electrical and Electronics Engineers, Inc, 1978, p. 51-58, 7 refs

Hyperbolic navigation schemes, originally instituted to limit computational time, no longer have justification in positioning systems that use microprocessors. Instead of differencing raw measurements, the computational process for navigation systems should use raw, biased range measurements. The integrated Doppler count in the Transit navigation system is intrinsically hyperbolic, but results can still be obtained that are optimal in a batch sense. In this paper, a computationally efficient method capable of accounting for the measurement covariance in hyperbolic positioning systems is presented. J M B

A79-36071 Loran C - Its future in the shadow of Navstar GPS J P Van Etten (ITT, ITT Avionics Div, Nutley, NJ) In PLANS 1978, Position Location and Navigation Symposium, San Diego, Calif, November 6-9, 1978, Record New York, Institute of Electrical and Electronics Engineers, Inc, 1978, p 63-72 10 refs

The Navstar Global Positioning System, which may become available for civil use in 1990, has a projected development cost of 3.0 billion dollars. However, U.S. civil users, concentrated in the continental U.S. and its coastal zones, may be better served by the Loran-C. long-range regional radio navigation system Accuracy available to civil users of Navstar is expected to be somewhat poorer than that obtainable from Loran-C, furthermore, Navstar receivers are projected to be twice as costly as Loran-C receivers JMB

A79-36072 The MX 1105, an integrated Transit/Omega navigator J E Maenpa (Magnavox Government and Industrial Electronics Co, Fort Wayne, Ind) In PLANS 1978, Position Location and Navigation Symposium, San Diego, Calif, November 6-9, 1978, Record New York, Institute of Electrical and Electronics Engineers, Inc , 1978, p 73-88 20 refs

An integrated Transit/Omega navigation system based on a single, compact, microprocessor-controlled instrument has been developed. The integrated navigator combines the advantage of highly accurate position fixes in any weather (available through Transit) and the capability of nearly continuous position and velocity sensing over most of the globe (available through Omega). The integrated Transit/Omega system retains the bounded error characteristics and continuous navigation capability of Omega to limit error growth between Transit position fixes Transit position fix degradation due to Omega-derived velocity is minimized Testing of the integrated navigator over Atlantic, Pacific and Indian Ocean routes has been carried out.

A79-36077 Reliability, performance, and fault isolation considerations in the design of interconnected navigation systems J S H Liu and T J Murphy (Dynamics Research Corp , Wilmington, Mass) In PLANS 1978, Position Location and Navigation Symposium, San Diego, Calif, November 6-9, 1978, Record

New York, Institute of Electrical and Electronics Engineers, Inc., 1978, p. 114-121, 14 refs

The study demonstrates that decentralized approaches in the design of interconnected navigation systems are sometimes better than 'intuitively obvious' centralized approaches suggested by theory This means that although theory can show that centralized approaches will provide the best navigation accuracy under normal operating conditions, their performance can be adversely affected when conditions are not normal A good decentralized approach represents an acceptable engineering tradeoff between the issues of accuracy, cost, and reliability The focus is on interface design for a master-slave hierarchical interconnection. The issues of accuracy, cost, and reliability are developed on the basis of a specific example It is shown that the design of the decentralized interface is better than that of a centralized interface in terms of an engineering tradeoff between accuracy, cost, and reliability SD

A79-36082 The results of synthesizing and evaluating potential solutions for Multi-Function Inertial Reference Assembly /MIRA/ candidate configurations J M Perdzock (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio), R C Burns, and G C Jackson (McDonnell Aircraft Co, St Louis, Mo) In PLANS 1978, Position Location and Navigation Symposium, San Diego, Calif, November 6-9, 1978, Record New York, Institute of Electrical and Electronics Engineers, Inc., 1978, p 159-164

The development of the Multi-Function Inertial Reference Assembly (MIRA) satisfying the combined kinematic data requirements of flight control, navigation, weapon delivery, and terminal area control is reported to be a potential solution to increasing avionic costs on advanced Air Force fighter and transport aircraft of the 1980's A single line replaceable unit (LRU) of the selected MIRA configuration can replace eight LRUs on the F-15A and is characterized by improvements in velocity and attitude output accuracies while retaining position accuracy, safety and mission reliability, redundancy, maintainability, and survivability MIRA can accommodate either tuned rotor gyros (TRG) or ring laser gyros (RLG) With performance considerations favoring RLGs and weight projections favoring TRGs, it is found that RLGs are more adaptable for redundancy, afford rapid reaction from cold temperature, exhibit an inherent high dynamic capability, and offer potentially higher reliability and operational life

A79-36084 Drone formation control system /DFCS/ - A new generation test range system W A Rice (U S Army, White Sands Missile Range, White Sands, N Mex) and K D Rehm (IBM Corp, Federal Systems Div, Owego, N Y) In PLANS 1978, Position Location and Navigation Symposium, San Diego, Calif, November 6-9, 1978, Record New York, Institute of Electrical and Electronics Enginers, Inc, 1978, p 182-190

The Drone Formation Control System (DFCS) has been operating at the White Sands Missile range since September 1976 This paper briefly describes the DFCS and some of the missions performed by it A brief description of system hardware emphasizes the data link and display subsystems. The DFCS uses distancemeasuring equipment to locate a drone, then, the DFCS compares the present drone position to that desired and generates the commands necessary to bring the drone to the desired location. The paper highlights the various types of missions the DFCS can support and discusses missions that used BQM-34s and PQM-102s in single and multiple aircraft formations at all altitudes. Included are manual and automatic control, high 'g' maneuvers, and the takeoff and landing of GF102 and GF86 drones. The effects of multipath on DFCS data link performance over land and water are also presented (Author).

A79-36086 Evaluation of an FM/CW range measurement system for VTOL landing D G Krenz, D R Colvin (Cubic Corp, San Diego, Calif), S K Miyashiro, F E Morris, and W A Carlson (U S Naval Ocean Systems Center, Tactical Sensors and EW Div, San Diego, Calif) In PLANS 1978, Position Location and Navigation Symposium, San Diego, Calif, November 6-9, 1978, Record New York, Institute of Electrical and Electronics

Engineers, Inc , 1978, p 298-304

A Precision Ku-Band FM/CW Range Measurement System was designed and built by Cubic for the Naval Ocean Systems Center to test and evaluate its effectiveness as a landing/guidance system for VTOL aircraft Primary equipment consisted of an interrogator, transponder, control and display console, and government-furnished antennas and computer The system operated on the principle that a continuous-wave signal modulated onto a radio-frequency carrier and propagated through free space undergoes a phase shift that can be measured to provide slant range Test results conclusively indicate that the system provides more-than-adequate accuracy for the ranging requirements of a VTOL landing guidance system (Author)

A79-36087 A navigation filter for an integrated GPS/ JTIDS/INS system for a tactical aircraft B A Kriegsman and W M Stonestreet (Charles Stark Draper Laboratory, Inc, Cambridge, Mass) In PLANS 1978, Position Location and Navigation Symposium, San Diego, Calif, November 6-9, 1978, Record

New York, Institute of Electrical and Electronics Engineers, Inc., 1978, p 316-320 14 refs Contract No F33657-77-C-0672

An integrated dual-grid navigation system including the Global Positioning System (GPS), the Joint Tactical Information Distribution System (JTIDS), and an Inertial Navigation System (INS) is studied for use in a community of tactical fighter aircraft A 19-state minimum-variance filter on board each aircraft is designed to process most efficiently data from the different navaids. The integration of GPS with a JTIDS/INS system leads to better user overall navigation-system performance by providing more accurate geodetic position and velocity information, better estimates of absolute INS tilts and user clock errors, and more accurate estimation of baro-altimeter bias S D

A79-36090 Stability analysis of relative navigation systems M S Greenberg (Dynamics Research Corp., Wilmington, Mass) and H J Rome (Lowell University, Lowell, Mass) In PLANS 1978, Position Location and Navigation Symposium, San Diego, Calif, November 6-9, 1978, Record New York, Institute of Electrical and Electronics Enginers, Inc., 1978, p 335-344

Stability properties of relative navigation systems are investigated with regard to the level of inter-unit range measurement integration within a multi-member airborne community Each member is capable of processing relative range measurements and inertial dead-reckoning data. The analysis isolates and highlights the effects of various measurement weighting criteria and various measurement selection protocols and demonstrates a crossover from unstable to stable behavior for certain combinations and types of information hierarchies and rel nav filter mechanization choices A rel nav covariance analysis simulation is used for the evaluation of a four aircraft community, each unit equipped with an inertial dead reckoning system, a TDMA transceiver, and rel nav filtersoftware for the selection, weighting, and processing of inter-unit measurements (Author)

A79-36096 Recent results in navigation systems utilizing signal aiding from Navstar satellites J N Damoulakis, V Gylys, and T N Upadhyay (Texas Instruments, Inc., Dallas, Tex.) In PLANS 1978, Position Location and Navigation Symposium, San Diego, Calif, November 6-9, 1978, Record New York, Institute of Electrical and Electronics Engineers, Inc., 1978, p 388-395 11 refs Contract No F04701-75-C-0180

This paper describes some recent results and experience in designing navigation systems that use signals from GPS/Navstar satellites Three distinct navigation/system configurations are considered for applications to aircraft, missile, and man-vehicular user systems. The commonality in these three user equipment systems is the continuous use of range/range rate information transmitted from a set of navigation satellites. The basic engineering feature of these systems is their capability to process the range/range-rate measurements This is done by a real time combination of double-stage piecewise recursive filtering technique of Kalman's type for estimating the user's position and time. This technique consists of fast and slow filter loops. The received measurements are processed at a high rate in the fast loop while using the gains computed by the other loop. The slow loop also processes the system-error covariance matrix and other system statistics. Methods for resolving incompatibilities in the system statistics, resulting from the fast/slow loop processing combination are described (Author)

A79-36100 Industry seeks lighter aircraft weight D M North. Aviation Week and Space Technology, vol 110, May 21, 1979, p 77, 79, 80, 85

Future design of small general aviation aircraft will be based on fuel efficiency, safety performance, and reduced maintenance and will be influenced by advances in turbomachinery. composite materials, aerodynamics and avionics, with business and personal aircraft markets expected to grow Pressurization, anti-icing systems, weather radar and altimeters will be essential features in the 1990's with the use of composite materials for airframe structure, landing gear and propeller blades providing 25% reduction in empty weight Diesel, rotary and turbine engines will be used noting that turbo charged diesel engines in a four-place aircraft would run at 3500 rpm and would be attached to a composite material propeller by a helicopter type drive shaft. It will cruise at an altitude of 25,000 ft. with a 1600 mile range, and 26 mile/gal fuel consumption Wings will have higher aspect ratios, full span flaps with slot-lip roll and flight path spoilers, and pusher propeller technology will be utilized. It is expected that general aviation aircraft will provide about 25% more speed and 50-100% better fuel efficiency than aircraft available now A T

A79-36122 Profile of a nozzle shaping the free-molecule flow intended to investigate air-intakes and cascades lu E Kuz netsov and la Sh Flaksman (Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza, Sept-Oct 1978, p 171-174) Fluid Dynamics, vol 13, no 5, Mar 1979, p 776-778 Translation

A79-36248 Directionally solidified blades - Greater strength C A Lombard (USAF, Materials Laboratory, Wright-Patterson AFB, Ohio) *ManTech Journal*, vol 3, no 3, 1978, p 22-27

Superalloy turbine blades cast by the directional solidification process have higher stress rupture strength, resistance to thermal fatigue, and greater tensile strength than conventional castings, obtaining longer life and lower maintenance costs. Although blade cost is 1 5 to 2 times that of conventional blades, 300,000 airfoils made by this process are used in JT9D, F100, TF30 and PT6 Pratt and Whitney engines which accumulated more than 1.5 million hours of field use. The three basic directional solidification processes withdrawal, Rapid Automated Multistation-Directional Solidification, and exothermic are described, noting that the exothermic process was used for the F103, TF-41, T-55 engines, and the TFE731-3 engine which is under NASA contract Single crystal blades made by an extended directional solidification process are being developed to upgrade engine performance by allowing 125 F higher inlet temperatures, expected to reduce mission cost by 21%, save up to \$7 million in engine development, and increase overhaul life six to seven times AT

A79-36347 # Lectures on hydroaeromechanics (Lektsii po gidroaeromekhanike) S V Vallander Leningrad, Izdatel'stvo Leningradskogo Universiteta, 1978 296 p 5 refs In Russian

The book is a reproduction of Vallander's course on a branch of mechanics dealing with the laws of fluid motion and equilibrium and the laws of interaction between fluids and bodies situated in them. The concept of a fluid comprises both liquids and gases. The lectures deal with such issues as the derivation of the total system of hydrodynamics equations, the formulation of this system of equations for some representative fluid models, and with the fundamentals of hydrodynamics of ideal and viscous fluids VP

A79-36373 Making fluid flows visible W Merzkirch (Bochum, Ruhr-Universitat, Bochum, West Germany) American Scientist, vol 67, May-June 1979, p 330-336 7 refs.

Two principles of making a fluid flow visible are discussed in this paper. First, the internal edges or boundaries of the primary fluid can be made visible by introducing into it a secondary substance of a different phase. What actually can be seen is the movement of this foreign substance, which is assumed to have the same motion as the primary fluid, this requires that the particles of the foreign substance be as small as possible while still visible. The second principle applies to fluids having optical properties that change while the fluid is flowing. If the relationship between the state of the flow and the change in an optical parameter is known, optical methods could be applied to measure certain properties in the flow field without disturbing the fluid by introducing a measuring probe or a foreign material into it. Since the optical index of refraction of a gas is a function of a gas density, variations in the refractive index can be measured by means of optical interferometry VТ

A79-36374 Boeing 757/767 · On-the-spot report M Hirst Flight International, vol. 115, May 19, 1979, p. 1673-1678

The article reports on Boeing's new airliners, the medium haul 767, seating 221 and the short haul 757 seating 177 The 767's unique seven abreast seating results in a narrower profile, which in conjunction with the large wing area is responsible for the low seat/mile costs claimed by Boeing. The wing design and the decision to use a low tail versus a high tail is also discussed. The 757 is a variation of the 707,727,737 theme, and its commonality with the 767 is noted. Many systems, including the auxiliary power supply, the virtually all digital electronics of the avionics system, and the tail section surfaces will be shared A separate section notes a possible use of a 767-based nose on the 757 The use of a CRT display instead of a mechanical attitude indicator, and the use of a second CRT for horizontal-situation data is detailed. The use of lasers in the inertial reference system (IRS) is also covered, and full specifications. payload and fuel performance data are presented MEP

A79-36376 Producing light aircraft - Three viability case studies J M Robertson Aeronautical Journal, vol 83, Apr 1979, p 135-148 38 refs

The Piper PA-28-140 Cherokee, the Beagle B 121 Pup-100, and the Robin HR 200/100 light aircraft production studies are presented comparing their design details, rates of production envisaged and achieved, the attitudes towards light aviation in the U S, Great Britain and France, the sizes and previous history of the three manufacturers, and the success achieved The three aircraft dimensions and equipment are described, together with their performance, price and production quantities The production background of each aircraft is discussed, considering their respective companies' history, the relationship of manufacture to companies' facilities, and the product support that was being offered Designs of the wings, tail units and fuselage are analyzed, and markets and marketing practices in the countries of origin are considered Finally, an economic production management plan is outlined. A T

A79-36379 Model verification of force determination for measuring vibratory loads F D Bartlett, Jr (US Army, Structures Laboratory, Hampton, Va) and W G Flannelly (Kaman Aerospace Corp, Bloomfield, Conn) American Helicopter Society, Journal, vol 24, Apr 1979, p 10-18 11 refs Army-supported research

The method of force determination for measuring vibratory forces and moments experienced by helicopters is verified by means of laboratory tests of a dynamic helicopter model. The method was used to determine vibratory hub loads on a helicopter with the rotor removed from dynamic calibration data and fuselage accelerometer measurements. The mobility matrix is obtained by direct shaking at the hub and modal acceleration testing in order to calibrate the model. Errors of force determination predictions are found to lie within the accuracy limits of the instrumentation. Results of an application of the force determination method to the flight testing of a UH-1H helicopter fitted with a dynamic antiresonant vibration isolator indicate the potential of force determination for in-flight predictions.

A79-36380 Manufacturers developing fuel-efficient engines J Mayfield Aviation Week and Space Technology, vol 110, May 28, 1979, p 46, 47, 49 (3 ff)

The paper presents an analysis for both the General Electric and Pratt & Whitney fuel-efficient turbofans developed under NASA's Energy Efficient Engine (E3) project General Electric engine will produce 36,000 lb of thrust and have a bypass ratio of 6.8 during maximum climb power operation Specific fuel consumption (SFC) of 0.572 is predicted Pratt & Whitney turbofan will produce 41,000 lb of thrust on takeoff with a bypass ratio of 6.55 lts thrust SFC is predicted as 0.576 The engines use such advanced technologies as active clearance control, single-crystal turbine blades and vanes, new power metallurgy alloys, a 23.1 compressor, new combustor designs and digital electronic engine control systems, and may evolve into prototypes for the commercial transport powerplants of the 1990s V T

A79-36423 Velocity slip and temperature difference of gas mixtures in quasi-one-dimensional nozzle flows K Nanbu (Tohoku University, Sendar, Japan) *Physics of Fluids*, vol 22, May 1979, p 998, 999

The velocity slip and temperature difference are examined using two-temperature thirteen moment equations. It is shown that the velocity slip becomes maximum just beyond the throat and the temperature difference is appreciable in the supersonic flow regions (Author)

A79-36484 An optical-fiber multiterminal data system for aircraft J G Farrington and M Chown (Standard Telecommunication Laboratories, Ltd, Harlow, Essex, England) Fiber and Integrated Optics, vol 2, no 2, 1979, p 173-193 8 refs Research supported by the Ministry of Defence (Procurement Executive)

As a result of a study on the potential of optical-fiber multiterminal data systems for avionics, a design approach has been chosen that is expected to be a suitable basis for a wide range of applications. This is a time division multiplexing system, which has features of being highly immune to problems of optical loss and multipath effects in optical highways having redundant paths, and of avoiding the need for any master terminal. This system approach is tailored to characteristics of optical fibers, and should lead to good integrity and ruggedness. A breadboarded model of a terminal has been demonstrated, and the construction of functional models is currently under way. (Author)

A79-36582 # Calculation of a laminar wall jet in a wake (Raschet laminarnoi pristennoi strui v sputnom potoke) V N Zhuravlev Samoletostroenie - Tekhnika Vozdushnogo Flota, no 43, 1978, p 31-36 5 refs In Russian

An integral method is proposed for calculating the fundamental portion of a laminar wall jet propagating in a wake with a longitudinal pressure gradient. It is assumed that the velocity of the jet is greater than that of the wake VP

A79-36583 # Optimal selection of the geometrical characteristics of the reversing channel of a small-scale turbine with readmission of the gas (Ob optimal'nom vybore geometricheskikh kharakteristik povorotnogo kanala malorazmernoi turbiny s povtornym podvodom gaza) I P Goldaev, V V Ill'iunskii, and E A Skvorchevskii Samoletostroenie - Tekhnika Vozdushnogo Flota, no 43, 1978, p 37-43 In Russian

The paper deals with gasdynamics methods of profiling channels of auxiliary high-pressure-ratio small-scale aircraft turbines. The influence on the flow of the channel curvature in the radial plane of a small-scale axial-flow turbine is studied. Optimal channel designs for supersonic inlet flows are proposed. V P

A79-36584 # Effectiveness of readmission of the gas in high-pressure-ratio small-scale turbines (Effektivnosť povtornogo podvoda gaza v vysokoperepadnykh malorazmernykh turbinakh) I P Goldaev, V V Ilíunskii, and E A Skvorchevskii Samoletostroenie - Tekhnika Vozdushnogo Flota, no 43, 1978, p 44-48 6 refs In Russian

A comparative analysis is carried out of the energetic characteristics of a single-blade-ring turbine and a turbine with readmission of the gas. The gasdynamic parameters of the flow in high-pressure-ratio small-scale (auxiliary) aircraft gas turbines are evaluated. V.P.

A79-36585 # Influence of the flow angle on the characteristics of an elbow-shaped air intake (Vliianie ugla natekaniia potoka na kharakteristiki kolenoobraznogo vozdukhozabornika) A D Griga and N M Zubov Samoletostroenie - Tekhnika Vozdushnogo Flota, no 43, 1978, p 48-50 In Russian It is shown experimentally that an increase in inlet blade angle from 75 to 105 degrees leads to an increase in circumferential nonuniformity and a decrease in radial nonuniformity, whereas the total pressure losses are hardly affected. A satisfactory flow structure at the air-intake exit can be obtained by proper selection of the iometrical relations. V P

A79-36586 # Allowing for the wall boundary layer in an axial compressor stage (K voprosu ucheta pristenochnogo pogranichnogo sloia v stupeni osevogo kompressora) N S Berestneva, V A Koval', F G Kontsevich, and Iu G Otsechkin Samoletostroenie -Tekhnika Vozdushnogo Flota, no 43, 1978, p 51-54 In Russian

If an axial compressor blade is designed without allowance for the boundary layer in the flow area, the flow past the end sections is characterized by large positive angles of attack. This leads to an increase in boundary layer thickness at the blade back and possible boundary layer separation. In the present paper, a method of designing compressor blades with allowance for the boundary layer is proposed, and test data obtained with blades designed by this method are examined.

A79-36587 # Formation of water-fuel emulsions in tanks of grounded aircraft (K voprosu obrazovanila vodno-toplivnykh emul'sii v samoletnykh bakakh v nazemnykh uslovilakh) V T Vasilenko and A S Rasborshchuk Samoletostroenie - Tekhnika Vozdushnogo Flota, no 43, 1978, p 54-56 In Russian

The factors and conditions leading to the formation of water fuel emulsions in aircraft tanks after refueling are examined. The conditions for the formation of emulsion water depend on the temperatures and concentrations of moisture both in the remaining and added fuel and on the stability of water-fuel emulsions A nomogram for determining the mean temperature and mean water content in the fuel mixture after refueling is proposed.

A79-36588 # Informativeness and errectiveness of digital command-generating devices (Informativnost' i effektivnost' diskretnykh komandnykh priborov) N I Brekhin Samoletostroenie -Tekhnika Vozdushnogo Flota, no 43, 1978, p 57-61 In Russian

The speed of operation of modern onboard computers exceeds considerably that of analog command-generating devices. It is shown that the resulting impairments of device capacity and information transfer can be eliminated by using properly designed digital command-generating devices.

A79-36589 # Some possible applications of identification theory techniques in telemetry (O nekotorykh napravleniiakh primeneniia metodov teorii identifikatsii v telemetrii) lu N Sokolov, N M Podareva, and V I Uspalenko Samoletostroenie - Tekhnika Vozdushnogo Flota, no 43, 1978, p 61-70 24 refs In Russian

The basic principles of model representation of telemetry processes and the application of identification theory techniques to information problems are reviewed. Some aspects of the application of information theory techniques to the solution of problems of recording and analyzing telemetry data on the state of flight vehicles are discussed.

A79-36592 # Differential method of designing rational aircraft frames made of composite materials (Differentsial'nyi metod proektirovaniia ratsional'nykh korpusnykh aviakonstruktsii iz kompozitsionnykh materialov) V E Gaidachuk and Ia. S Karpov Samoletostroenie - Tekhnika Vozdushnogo Flota, no 43, 1978, p 81-92 6 refs In Russian

In the present paper, some rational structure diagrams for composite subsonic aircraft frames and fuselages are analyzed, and the advantages which accrue from the use of composite materials are pointed out A structure diagram with distinctly separated functions of the principal load carrying members is proposed and its effectiveness is evaluated V P

A79-36593 # Formulation of empirical formulas for calculating the hydraulic resistance of networks (Opredelenie vida empiricheskikh formul dlia rascheta gidraulicheskikh soprotivlenii v seti) N V Okolota, N A Skliarenko, N A Shelomov, and B D lalovkin Samoletostroenie - Tekhnika Vozdushnogo Flota, no 43, 1978, p 94-98 In Russian

Okolota et al (1976) have analyzed straight and curved networks of deicing systems and have formulated empirical formulas for calculating hydraulic resistances required for designing aircraft deicing and air-conditioning systems. In the present paper, a method is proposed for deriving empirical formulas for calculating the hydraulic resistance of any desired portion of a deicing network.

VΡ

A79-36644 The British Aerospace Harrier Case study in aircraft design J W Fozard (British Aerospace, Aircraft Group, Kingston-upon-Thames, Surrey, England) New York, American Institute of Aeronautics and Astronautics, Inc, 1978 190 p 100 refs

This work covers the history of the development of the jet V/STOL Harrier aircraft Fairly detailed information on the main engineering concepts of the aircraft are given, including the inlet, the Pegasus vectored thrust engine, nozzle bearing assemblies, engine installation, engine controls and cockpit throttle box, fuel system and its installation, air intake aerodynamic design, nozzle actuation system, wing aerodynamic design, stability and control qualities, flight control system, structural design, undercarriage design, and cockpit and escape system Attention is also given to the operational aspects of the aircraft on land and on ships PTH

A79-36645 # The Rockwell International Sabreliner-65 Case study in aircraft design G E Mathwig (Rockwell International Corp , St Louis, Mo) New York, American Institute of Aeronautics and Astronautics, Inc , 1978 80 p

The report summarizes the design and development process for the Sabreliner-65 executive jet aircraft, including the marketing and financial studies. The process was an experience in codevelopment involving several companies. The development schedule, test objectives and results, and design problems and solutions are summarized. Tables and graphs are given which summarize model study parameters, engines considered, study performance data, aircraft configuration, and basic aerodynamic characteristics.

A79-36646 # The Lockheed C-5 Case study in aircraft design W C J Garrard (Lockheed-Georgia Co, Marietta, Ga) New York, American Institute of Aeronautics and Astronautics, Inc, 1978 68 p

The paper reports on the activities during each of the four main phases in the design of the C-5 transport (1) preconcept formulation phase, (2) concept formulation phase, (3) project definition phase and proposal, and (4) acquisition phase with detailed design, manufacture, and qualification The initial requirements, configuration studies, airframe design studies, trade-off studies, engine and landing gear selection, cargo configurations, reliability and maintenance requirements, flying qualities and augmentation considerations, structural tests, and flight tests are summarized PTH

A79-36702 Bonding and durability A C Fehrle and R L McDougal (Lockheed-Georgia Co, Marietta, Ga) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan, Apr 3-6, 1979, Paper 790561 14 p

Bonding materials and processes and the increasing use of the adhesive bonded structures in all Lockheed cargo aircraft starting with the C-130 are evaluated By analyzing the application of bonding to structural durability, it is shown that more durable airframe structures can be built at little or no weight penalty while meeting the durability and damage tolerance criteria imposed by the new Military Standards and Specifications. An experiment conducted under NASA contract has shown that it may be economically feasible to use laminated sheet structures or bonded reinforcements throughout the aircraft, however, it may not only be feasible but mandatory in fatigue and fracture critical areas of future aircraft Further improvements can be achieved by combined advantages of laminated structures and cold working or interference-fit fasteners as well as by the use of the new generation adhesives and surface preparations.

A79-36704 Adhesive bonded structure of new pressurized piston twin aircraft A Nagao, T Nakao, and K Usuki (Fuji Heavy Industries, Ltd., Tokyo, Japan) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan, Apr 3-6, 1979, Paper 790563 7 p

Adhesively bonded structures, that is, metal to metal bonding of cabin and wing skin and honeycomb sandwich panel of pressure bulkhead, are used in newly developed general aviation pressurized piston twin aircraft, Rockwell/Fuji Model 700 This paper presents the design consideration of each bonded structure showing the advantages of bonding, and its quality control procedure used in subject aircraft (Author)

A79-36705 Effects of a spin chute installation on spin characteristics J D Patrick (Piper Aircraft Corp., Lock Haven, Pa.) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan., Apr. 3-6, 1979, Paper 790564.3 p

Data extracted from certification spin testing on a light general aviation training airplane was examined for differences in recovery characteristics that could be assigned to the spin chute installation Several center of gravity and rudder surface positions were tested Both normal spins and spins with aileron misuse were evaluated

(Author)

A79-36706 * Spin flight research summary J M Patton, Jr, H P Stough, III, and D J Dicarlo (NASA, Langley Research Center, Hampton, Va) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan, Apr 3-6, 1979, Paper 790565 11 p 8 refs

An extensive general aviation stall/spin research program is underway at the NASA Langley Research Center Flight tests have examined the effects of tail design, wing leading edge design, mass distribution, and minor airframe modifications on spin and recovery characteristics Results and observations on test techniques are presented for the first airplane in the program Configuration changes produced spins varying from easily recoverable slow, steep spins to unrecoverable, fast flat spins (Author)

A79-36707 Conversion of wing surface pressures into normalized lift coefficient A W Hoadley (Western Michigan University, Kalamazoo, Mich.) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan, Apr. 3-6, 1979, Paper 790567. 10 p

A normalized lift coefficient indicator has been developed for single-engine aircraft. The system developed incorporates a low-cost capacitance type pressure transducer and an electronic circuit to calculate the wing pressure coefficient. The system eliminates the need for probes protruding from the aircraft's wing by using two flush pressure taps on the wing surface and the aircraft's static pressures. The pressure taps have been located so as to produce a normalized lift coefficient display that is nearly linear, independent of flap setting, and independent of thrust. The system gives the aircraft's proximity to a stall condition regardless of its load factor, weight, or configuration. The preceding should reduce the fatal stall/spin accidents that are one of the foremost killers in general aviation. (Author) A79-36708 The effects of low-level wind shear on the approach and go-around performance of a landing jet aircraft R A Greene (Safe Flight Instrument Corp, White Plains, N Y) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan, Apr 3-6, 1979, Paper 790568 9 p 14 refs

The development and operation of the Wind Shear Monitor System which computes the thrust required to overcome horizontal wind shears and vertical downdrafts during jet landing is outlined The operation of the Wind Shear Computer which resolves the two orthogonal vectors of a wind shear encounter and provides meter output and threshold alert indications of the encounter are described Severe wind shear occurs when the additional thrust required to maintain desired glide path and airspeed exceed 15% of the aircraft's gross weight A 3-axis wind model has been developed for a Boeing 747 training simulator to repeat weather conditions at the time of an accident. Beyond signaling for the crew a severe reduction in performance, indication of positive shear conditions acts to guide the crew to anticipate a negative shear, thus preventing a reduction of thrust. The early rapid detection of a severe encounter will significantly improve the go-around profile and recovery opportunities AT

A79-36709 * A Demonstration Advanced Avionics System for general aviation D G Denery, G P Callas, C T Jackson, B K Berkstresser, and G H Hardy (NASA, Ames Research Center, Moffett Field, Calif) Society of Automotive Engineers, Business Aurcraft Meeting and Exposition, Wichita, Kan, Apr 3-6, 1979, Paper 790569 11 p

A program initiated within NASA has emphasized the use of a data bus, microprocessors, electronic displays and data entry devices for general aviation. A Demonstration Advanced Avionics System (DAAS) capable of evaluating critical and promising elements of an integrating system that will perform the functions of (1) automated guidance and navigation, (2) flight planning, (3) weight and balance performance computations, (4) monitoring and warning, and (5) storage of normal and emergency check lists and operational limitations is described. Consideration is given to two major parts of the DAAS instrument panel, the integrated data control center and an electronic horizontal situation indicator, and to the system architecture. The system is to be installed in the Ames Research Center's Cessna 402B in the latter part of 1980, engineering flight testing will begin in the first part of 1981.

A79-36710 Electronic system safety - Testing reality G L Neal (Collins Radio Group, Collins Avionics Div, Cedar Rapids, Iowa) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan, Apr 3-6, 1979, Paper 790570 7 p

Fundamentals of redundant avionics systems architecture are discussed, exposing some of the difficult and least understood redundancy defeating mechanisms. Such basic definitions as single, dual and triple concepts and the mean time between failures are given showing that simplistic thinking tends to give unreliable results because of the usually ignored problems of rare faults, common faults, tolerance propagation, hidden faults, unmonitored monitors, inoperative reconfiguration switches, and expediency of installation In order to achieve the reasonable low mission failure rates it is noted that at least dual and sometimes triple avionics are required. V T

A79-36711 The design and selection of optimum propellers for general aviation aircraft H V Borst (Henry V Borst and Associates, Wayne, Pa) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan, Apr 3-6, 1979, Paper 790575 15 p 11 refs

Using the latest available methods and data for designing propeller blades and determining performance, a study of the general aviation propellers installations is given. In this study four general aviation aircraft are considered covering the range of speed and power encountered in this field Propellers typical of those currently being used are considered and their performance is calculated and compared with the ideal to find the efficiency improvements that might be possible A study for the aircraft considered showed that new propellers can be designed that will have improved performance that approaches that of the ideal or optimum. The use of the new computer generated airfoils was also considered in the design of new propellers with promising results. (Author)

A79-36712 * The analysis of propellers including interaction effects B W McCormick, A S Aljabri, S J Jumper, and Z N Martinovic (Pennsylvania State University, University Park, Pa) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan, Apr 3-6, 1979, Paper 790576 14 p 11 refs Grant No NsG 1308

Analytical and experimental studies have been undertaken on propellers operating in the unsteady flow field produced by interaction effects due to the fuselage, wing, and nacelles. Methods have been developed and verified experimentally for determining the velocity field in which a propeller operates as well as its aerodynamic and dynamic response to this unsteady environment. Methods are presented for predicting the net thrust of a propeller wing-body combination as well as the unsteady thrust and torque acting on the propeller. Sample calculations as well as wind tunnel and flight test results are presented which illustrates the sensitivity of a propeller to flow field in which it is operating. (Author)

A79-36713 Composite applications at Bell Helicopter O K McCaskill, Jr (Bell Helicopter Textron, Fort Worth, Tex). Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan, Apr 3-6, 1979, Paper 790578 13 p

The past, present and future usage of fiber reinforced plastics in Bell helicopters is presented. In 1953 fiberglass composites were used in cabin structural areas of the 47H-1 which is still in active service Current production helicopters use composites as a facing material. sandwich panels, nose doors, fairings, passenger steps, and the cabin shell. In helicopters being developed, fiberglass main rotor blades are expected to achieve retirement life after more than 10,000 hours due to gradual failure modes, elimination of corrosion and improved fatigue life Blade manufacturing methods and certification tests are described. Other developmental applications are in control tubes of filament wound graphite epoxy and injection molded nylon/ fiberglass fittings producing 20% weight saving, bellcranks with 30% weight saving and cost reduction of 50%, boost cylinders for 3000 psi and 270 F service, and engine cowlings and fairings with fire resistance Other applications such as vertical fins, landing gear skid tubes, floats, horizontal stabilizers and taildoor driveshafts are discussed A flight evaluation program conducted under a NASA contract to obtain information on the durability of advanced composite components in field service is described AΤ

A79-36714 Development of an aircraft composite propeller W B Harlamert and R Edinger (Hartzell Propeller, Inc., Piqua, Ohio) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan., Apr. 3-6, 1979, Paper 790579, 7 p

The current aircraft noise regulations effected the design of propellers where tip speeds were reduced to meet these regulations Reduced tip speeds were accomplished by reducing propeller rpm and/or propeller diameter. To retain propeller performance, diameters were increased, or the number of blades increased, respectively. These changes effected the propeller weight drastically. A composite propeller blade has been developed that is significantly lighter than a blade fabricated from aluminum. Additional advantages of the composite blade is strength and maintenance characteristics. Considerable testing was accomplished to demonstrate the strength and fatigue characteristics of the blade. (Author)

A79-36715 Design description of a four-place business jet using two WR-19 engines J Roskam (Kansas, University, Lawrence, Kan) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan, Apr 3-6, 1979, Paper 790580 11 p

This paper describes the design of an advanced, four-place business jet airplane around two Williams-Research WR 19 engines In addition to the general layout, the performance, weight and balance characteristics of the airplane are described and illustrated by graphical examples. A detailed comparison in terms of fuel-used is made with the Learjet M35, the Cessna Citation I, the Foxjet and several other general aviation twins it is shown that the airplane described offers substantial advantages in terms of fuel economy over all these airplanes (Author)

A79-36716 The Learjet 'Longhorn' series - The first jets with winglets P T Reynolds (Gates Learjet Corp, Wichita, Kan) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan, Apr 3-6, 1979, Paper 790581 7 p

The Gates Learjet model 28/29 configuration with winglets offers performance increases over Model 25 which has similar configuration except for the wing, both during cruise and takeoff and landing Cruise fuel flows are up to 26% lower than Model 25 for the same playload/speed combination Such effects as an increase in aspect ratio, an end plate effect and a forward component of the winglet aerodynamic force are discussed, noting NASA's pioneering work in the field Consideration is also given to some details of stability and control and it is noted that Model 28/29 is certified for operations up to 51,000 feet Models 54/55/56 incorporating the same wing/winglet concept and utilizing high bypass turbofan engines and featuring a larger fuselage are currently under development, with the first flight expected early in 1979 V T

A79-36717 Improving business jet performance - The Mark Five Sabreliner L M Timmons (Raisbeck Group, Seattle, Wash) Society of Automotive Engineers, Business Aurcraft Meeting and Exposition, Wichita, Kan, Apr 3-6, 1979, Paper 790582 17 p 5 refs

By applying a unique combination of theoretical analysis, flight test development and advanced FAA certification methods, the Raisbeck Mark Five Sabreliner became a reality This configuration with advanced aerodynamics, systems and structure has been incorporated on both existing and new production versions of the aircraft it offers a minimum of 25% range increase while maintaining or reducing takeoff and landing field lengths. The development approach used for the Mark Five system is detailed, including the rationale for each of the improvements incorporated FAA certification plan procedures used on this program are discussed Performance improvements realized in actual operation of the Mark Five system are also detailed to demonstrate the advantages from a customer's viewpoint.

A79-36718 A general aviation flight test application of the on-board computer. P R Leckman (Rockwell International Corp, Bethany, Okla) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan, Apr 3-6, 1979, Paper 790583 7 p

The Digital Data Acquisition System (DDAS) which includes minicomputers both in on-board and in ground-based equipment has been used in flight test programs Functions performed are monitor critical parameters, alert to exceed limits, engine cooling development, cruise performance, climb performance, stall speed, stress surveys, engine detonation survey, and weight and center gravity Operating procedures and implementation problems are discussed and it is concluded that using a DDAS will reduce the post flight data analysis man-hours, but requires more thorough preparation prior to flight testing As computers become more compact and available at reduced costs, their more widespread use in the flight test programs of general aviation aircraft manufacturers is expected VT

A79-36719 * Design of quiet efficient propellers G P Succi (MIT, Cambridge, Mass) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan, Apr 3-6, 1979, Paper 790584 15 p 13 refs Research sponsored by the U S Environmental Protection Agency, Contract No NAS1-15154

A numerical computation scheme has been developed to determine the sound generated by propellers. A comparison of these calculations to the noise data taken in the flight test of a propeller driven aircraft shows good agreement. The method is then applied in a parametric study of fixed pitch propellers designed to reduce noise. All these techniques reduce noise while maintaining shaft speed so that the method presented here may be used in a retrofit option for the general aviation fleet. (Author)

A79-36720 Practical design of minimum induced loss propellers E E Larrabee (MIT, Cambridge, Mass) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan, Apr 3-6, 1979, Paper 790585 11 p 7 refs

An efficient procedure, which may be adapted to pocket calculators, has been developed to determine the geometry of minimum induced loss propellers matched to a specified operating point characterized by disc loading, advance ratio, and number of blades Consistent procedures are described to account for the effects of arbitrary geometry, off design point operation, and propeller-body interaction (Author)

A79-36721 Crashworthiness analysis of field investigation of business aircraft accidents R G Snyder and T J Armstrong (Michigan, University, Ann Arbor, Mich) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan, Apr 3-6, 1979, Paper 790587 15 p 17 refs Research supported by the University of Michigan

During the period 1964-1977 some 7,351 aircraft engaged in business flying, and 883 in corporate/executive operations, were involved in accidents reported by the NTSB. These accidents were reviewed utilizing the University of Michigan Computerized Accident Files to provide an overall view of the incidence and nature of business/executive aircraft accidents relative to occupant crash injuries. In addition more detailed case studies of selected accidents investigated including a Lear Jet 25B, Cessna 421, Beech Volpar Model 18, and Ted Smith Aerostar 601, are provided to illustrate specific types of crashworthiness, occupant protection, or post-crash emergency egress findings applicable to business/executive operations Post-crash fire was reported in 29 cases (16 3%) during the 3-year period (1975-1977) Emergency egress problems involving smoke and fire are discussed. Data from 1975-1977 indicate that the chances of being fatally injured in an accident is significantly greater than receiving serious injury, suggesting a lack of crashworthy performance which may be predicted to improve as more accidents occur in which crew shoulder harnesses are installed and worn

(Author)

A79-36722 * Nonlinear structural crash dynamics analyses R J Hayduk, R G Thomson (NASA, Langley Research Center, Hampton, Va), G Wittlin (Lockheed-California Co, Burbank, Calif), and M P Kamat (Virginia Polytechnic Institute and State University, Blacksburg, Va) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan, Apr 3-6, 1979, Paper 790588 14 p 12 refs

Presented in this paper are the results of three nonlinear computer programs, KRASH, ACTION and DYCAST used to analyze the dynamic response of a twin-engine, low-wing airplane section subjected to a 8 38 m/s (27 5 ft/s) vertical impact velocity crash condition. This impact condition simulates the vertical sink rate in a shallow aircraft landing or takeoff accident. The three distinct analysis techniques for nonlinear dynamic response of aircraft structures are briefly examined and compared versus each other and the experimental data.

tions of the three computer programs, the respective aircraft section mathematical models, pertinent data from the experimental test performed at NASA Langley, and a comparison of the analyses versus test results. Cost and accuracy comparisons between the three analyses are made to illustrate the possible uses of the different nonlinear programs and their future potential (Author)

A79-36723 Experimental verification of program KRASH - A mathematical model for general aviation structural crash dynamics G Wittlin (Lockheed-California Co, Burbank, Calif), D J Ahrens, and A W Bloedel (Cessna Aircraft Co, Wichita, Kan) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan, Apr 3-6, 1979, Paper 790589 14 p 8 refs US Department of Transportation Contract No FA75WA-3707

The results of four fully instrumented, full-scale crash tests involving a single-engine, high wing light airplane are described herein. The tests were performed under a contract sponsored by the Federal Aviation Administration. The range of impact conditions included initial airplane roll and/or yaw, a nose-down attitude, a flared nose-up attitude and impacts onto a rigid (concrete) and a flexible (soil) surface. Photographs are presented showing the impact conditions, as well as some typical postcrash damage. The crash test models, analyzed using digital computer program KRASH, are described. Typical analysis versus test correlation results as well as a summary correlation for all four crash tests are presented. The application of Program KRASH to assess structural design concepts with regard to crash dynamics characteristics is briefly described (Author).

A79-36724 Seat/Occupant crash dynamic analysis verification test program R F Chandler (FAA, Civil Aeromedical Institute, Oklahoma City, Okla) and D H Laananen (Pennsylvania State University, University Park, Pa) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan, Apr 3-6, 1979, Paper 790590 98 p 26 refs

The Federal Aviation Administration is developing a computer modeling program (SOMLA/Seat Occupant Model Light Aircraft) in an attempt to provide a practical engineering and design analysis tool for aircraft seat designers. To validate the model, two series of well-instrumented controlled tests have been completed by the FAA Civil Aeromedical Institute These tests used two basic seat configurations, two different impact vector orientations, and two different impact levels to produce both elastic and plastic seat deformations Measurements of seat reaction loads, seatbelt loads, and dummy accelerations were made, and the tests were documented by high-speed motion picture film Each test condition was repeated to obtain a statistical measure of test variability. The results of these tests, and their implications regarding the development of the model, are presented (Author)

A79-36725 * NASA general aviation crashworthiness seat development E L Fasanella (Vought Corp., Hampton, Va.) and E Alfaro-Bou (NASA, Langley Research Center, Hampton, Va.) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan., Apr. 3-6, 1979, Paper 790591. 13 p. 15 refs

Three load limiting seat concepts for general aviation aircraft designed to lower the deceleration of the occupant in the event of a crash were sled tested and evaluated with reference to a standard seat Dummy pelvis accelerations were reduced up to 50 percent with one of the concepts Computer program MSOMLA (Modified Seat Occupant Model for Light Aircraft) was used to simulate the behavior of a dummy passenger in a NASA full-scale crash test of a twin engine light aircraft A computer graphics package MANPLOT was developed to pictorially represent the occupant and seat motion (Author)

A79-36726 Crash-resistant fuel systems for general aviation aircraft. W T Edwards (FAA, National Aviation Facilities Experimental Center, Atlantic City, NJ) and W M Perrella, Jr (FAA, Seattle, Wash) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan, Apr 3-6, 1979, Paper 790592 13 p 6 refs

A significant percentage of general aviation aircraft accidents result in postcrash fires due to the ignition of spilled fuel. This condition often causes further injury or even death to the occupants Testing was undertaken to examine the performance of light weight, flexible, crash-resistant fuel cells with frangible fuel line couplings included in the experiments were four full-scale crash tests of a typical light twin-engined aircraft. In three of these tests, the crash-resistant fuel system performed satisfactorily. However, the fourth test, which used the lightest weight tanks, resulted in tank failures which indicated a possible lower strength limit to the tank material. (Author)

A79-36727 The impact of noise regulations on propeller design D G M Davis (Dowty Rotol, Ltd, Gloucester, Essex, England) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan, Apr 3-6, 1979, Paper 790593 11 p

Probeller noise is largely dependent upon tip speed and a reduction of this inevitably leads to either performance or weight penalty. A new aerofoil section has been developed which permits blade loading to be increased. Thus, slower revving propellers can be designed without degrading the performance or imposing a weight penalty. The paper introduces the characteristic differences in performance of the new section with more conventional ones and looks at the design of a range of propellers to illustrate the trade between noise, performance and weight with each type.

A79-36728 Propeller aircraft noise around general aviation airports F W J van Deventer (Delft, Technische Hogeschool, Delft, Netherlands) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan, Apr 3-6, 1979, Paper 790594 15 p 7 refs

In recent years systematic flyover noise measurements of propeller driven general aviation airplanes were performed This paper presents a brief description of the measurement and data reduction techniques together with some results Computation methods are given to estimate the effect of powersetting on the noise level and to approximate the shape of the noise field around these aircraft They are used to compute Leq-contours around general aviation airports Contour plots are used to compare the relative effects of several measures for noise reduction on the ground Noise reduction at the source is the most effective way to achieve this goal (Author)

A79-36729 * Preliminary OCGAT program test results R W Koenig and G K Sievers (NASA, Lewis Research Center, Cleveland, Ohio) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan, Apr 3-6, 1979, Paper 790596 11 p

The paper presents the NASA Lewis program to demonstrate that large engine technology can be applied to general aviation engines to reduce noise, emissions, and fuel consumption. After a Phase I study, two contractors, Garrett AiResearch and AVCO-Lycoming, were selected to design, manufacture, assemble, test, and deliver their Quiet, Clean, General Aviation Turbofan (QCGAT) engines to NASA. Noise, emission, and performance goals and how well they were met are discussed. Noise goals involve take off noise 3.5 n mi from runway threshold, sideline noise at 2.5 n mi and approach noise 1.n mi from the runway at an altitude of 370 ft. The AiResearch engines power a stretched Learjet 3.5 and the Lycoming a specially conceived Beech executive jet, resulting in differing power goals. Thus the thrust goal for the Lycoming was 1622 lb while the AiResearch goal was 3937 lb. Cruise thrust goals were 485 lb at

Mach 0 6 at 25,000 ft and 903 lb at Mach 0 8 at 40,000 ft respectively The design of both engines, based on existing cores, is studied, noting such special QCGAT features as new reduction gears, combustor and power turbine Test results are given, indicating that while the goals for noise and thrust were met those for emissions were only partially met MEP

A79-36730 Proper aircraft tire size selection - Optimum performance with minimum maintenance L J Gehrett (Goodyear Tire and Rubber Co, Akron, Ohio) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan, Apr 3-6, 1979, Paper 790598 7 p

A79-36731 Advanced braking controls for business aircraft D M Longyear and E. A Hirzel (Crane Co, Hydro-Aire Div, Burbank, Calif) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan, Apr 3-6, 1979, Paper 790599 14 p

Automatic braking capability is essential if a business aircraft is to compete with commercial ones in a Microwave Landing System (MLS) environment. The principles involved in braking an aircraft are discussed and it is concluded that an essential feature required to assure optimum performance of the braking system is the skid control or antiskid system. Consideration is given to some details of the brake/tire/runway theory, particularly to the tire friction phenomena. It is suggested for business aircraft that their skid control system should be coupled to such equipment as autobrakes and autoflaps which will increase the number of possible landing sights, and more importantly, will improve the pilot's safety margins V T

A79-36732 Auron electrically heated acrylic W Rothe (PPG Industries, Inc., Huntsville, Ala.) Society of Automotive Engineers, Business Aurcraft Meeting and Exposition, Wichita, Kan, Apr. 3-6, 1979, Paper 790600 5 p

A system for preventing the formation of ice on plastic aircraft transparencies by application of electric heat is described, and performance data for the system are presented. The system is based on resistance wire technology in use with glass laminates. It can be operated from any available voltage system, ac or dc, and is adaptable to a wide variety of aircraft. Positive static drain is provided to reduce the effect of static discharge of aircraft instruments and prevent damage to the heating system. C K D

A79-36734 Canadair Challenger flight test status R D Neal (Canadair, Ltd, Montreal, Canada) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan, Apr 3-6, 1979, Paper 790602 7 p

The initial flight of the Canadair Challenger, an all new aircraft designed for the business jet market of the 1980s and 1990s, occurred two years after program go-ahead and 21 months after release of the first engineering drawings. Three preproduction aircraft are assigned to the flight test program in Montreal and then at Mojave, California As part of the regular flight development effort, as well as assurance that a safe flight to Mojave could be accomplished, the general handling qualities and single-engine performance were evaluated in the Montreal test program. The tasks identified for the Mojave test program included change of engine from 6700 lb to 7500 lb production engines, change of horizontal tail to production elevator configuration, installation of flight flutter vane system, complete ground vibration test, complete instrumentation and calibration. The 5-1 by-pass ratio turbofan engine tested prior to the installation provides the lowest specific fuel consumption of any turbine engine now used on a business let aircraft VT.

A79-36735 A new light twin using bonded metal construction B McCullough and L W Bingham, Jr (Gulfstream American Corp., Savannah, Ga) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan, Apr 3-6, 1979, Paper 790603 15 p This paper describes the design and certification program for a new light twin-engine aircraft. The factors considered in the design of the aircraft, the flight testing, and the changes required for certification are described. Some of the problems encountered in flight testing, and the solutions to these problems, are also discussed (Author)

A79-36736 * Some theoretical considerations of a stall proof airplane H L Chevalier (Texas A&M University, College Station, Tex.) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan, Apr 3-6, 1979, Paper 790604 15 p Grant No NsG-1407

For the stall proof airplane there should be a stabilizing pitching moment below the stall angle of attack of sufficient amount to prevent the attainment of the stall angle of attack which cannot be over-ridden by control deflections. This paper presents (1) a development of the moment equations to show the theoretical considerations of a stall proof airplane and (2) the nonlinear moment characteristics that must be obtained to satisfy the stall proof requirements in addition, it is shown that an aerodynamic spoiler located on the under surface of the horizontal tail can be designed to meet these requirements of a stall proof airplane Wind tunnel results are shown to validate assumptions and predictions (Author)

A79-36737 * Concepts for reducing exhaust emissions and fuel consumption of the aircraft piston engine B J Rezy, K J Stuckas, J R Tucker, and J E Meyers (Teledyne Continental Motors, Mobile, Ala) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan, Apr 3-6, 1979, Paper 790605 35 p 23 refs Research supported by the Teledyne Continental Motors, Contract No NAS3-19755

A study was made to reduce exhaust emissions and fuel consumption of a general aviation aircraft piston engine by applying known technology Fourteen promising concepts such as stratified charge combustion chambers, cooling cylinder head improvements, and ignition system changes were evaluated for emission reduction and cost effectiveness. A combination of three concepts, improved fuel injection system, improved cylinder head with exhaust port liners and exhaust air injection was projected as the most cost effective and safe means of meeting the EPA standards for CO, HC and NO. The fuel economy improvement of 4.6% over a typical single engine aircraft flight profile does not though justify the added cost of the three concepts, and significant reductions in fuel consumption must be applied to the cruise mode where most of the fuel is used. The use of exhaust air injection in combination with exhaust port liners reduces exhaust valve stem temperatures which can result in longer valve guide life. The use of exhaust port liners alone can reduce engine cooling air requirements by 11% which is the equivalent of a 15% increase in propulsive power. The EPA standards for CO, HC and NO can be met in the IO-520 engine using air injection alone or the Simmonds improved fuel injection system AT

A79-36738 Dual breakerless aircraft magneto R S Cerny and J J Wycallis (Bendix Corp, Engine Products Div, Sidney, NY) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan, Apr 3-6, 1979, Paper 790606 6 p

Advantages of the dual breakerless aircraft magneto are presented The system eliminates mechanical switching and actuation, thus preventing wear induced timing shift and degraded performance inherent in conventional magnetos. The operation of both the conventional and the breakerless systems is detailed, showing that the latter provides more consistent performance while eliminating the regular maintenance required by the former A starting aid which has been developed to complement the breakerless magneto is also discussed. MEP

A79-36739 Selection of aircraft turbocharger systems N Richardson (Garrett Corp , AiResearch Industrial Div , Los Angeles, Calif) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan , Apr 3-6, 1979, Paper 790608 11 p

Selection of turbochargers and control systems is aided by analytical predictions of system performance and by comparisons of flight test data to the prediction model. Consideration is given to the turbocharger design optimization, while a design tailored to a specific application is possible, it is customary to choose the best components from a selection already available. Different control systems are evaluated and it is noted that the locations of the various operating limits in the control system operating ranges vary, depending on the desired manifold pressures and engine speeds, and the compressor and turbine used. Steady state mass flow continuity through the turbo/control and engine system, and power balance between the turbocharger compressor and turbine are considered as the main physical principles on which performance calculation are based, and a performance prediction calculation flow chart is presented. The inconsistencies between flight test data and predicted performance can be a basis for correcting the analytical model of the engine and turbo/control system νт

A79-36740 * Determination of cooling air mass flow for a horizontally-opposed aircraft engine installation S J Miley, E J Cross, Jr, N A Ghomi, and P D Bridges (Mississippi State University, State College, Miss) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan, Apr 3-6, 1979, Paper 790609 11 p 5 refs Grant No NsG 1083

The relationship between the amount of cooling air flow and the corresponding flow pressure difference across an aircraft engine was investigated in flight and on the ground. The flight test results were consistent with theory, but indicated a significant installation leakage problem. A ground test blower system was used to identify and reduce the leakage. The correlation between ground test cell determined engine orifice characteristics and flight measurements showed good agreement if the engine pressure difference was based on total pressure rather than static pressure (Author).

A79-36741 Fretting fatigue, with reference to aircraft structures J A Alic and A Kantimathi (Wichita State University, Wichita, Kan) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan, Apr 3-6, 1979, Paper 790612 15 p 43 refs Grant No AF-AFOSR-77-3422

Present knowledge concerning the mechanisms of fretting fatigue is reviewed, with particular attention to the following factors stresses at and near the contacting surfaces, location of crack initiation sites with respect to regions of highest surface stress and the slip-nonslip boundary, contributions of surface damage to crack initiation, propagation of microcracks initiated by fretting, the effects of mean stress, and fretting fatigue under variable amplitude loading. In the experimental program, a specially constructed apparatus was used to simulate conditions at the faying surface in a structural joint Fretting fatigue tests were carried out on 7075-T7351 aluminum alloy using stress ratios of +0 2, +0 5, and -0 2 (Author)

A79-36742 New technologies for general aviation aircraft K H Bergey (Oklahoma, University, Norman, Okla) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan, Apr 3-6, 1979, Paper 790613 18 p 16 refs FAA-supported research

An assessment of new technologies for use in general aviation aircraft is covered. The study presents 46 new or underused technologies including Wankel engines, crushed honeycomb sandwich panels, crash resistant fuel cells, that could be incorporated in general aviation aircraft with benefit to safety, performance, utility, and cost Social and political trends, such as statutory highway speed limits, and the need for improved fuel efficiency, as much as the technologies themselves, will affect the rate at which these technologies can be integrated into the fleet. Four proposals of aircraft are given which could capitalize on some of the trends the report considers significant to general aviation. The four consist of a high speed single engine aircraft, a single engine turbofan five seater, a single engine crashworthy aircraft, and a twin engine ducted propulsor commuter/cargo aircraft MEP

A79-36743 General aviation aircraft design for performance using small computers J C Narramore (Cessna Aircraft Co, Wichita, Kan) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan, Apr 3-6, 1979, Paper 790614 7 p 8 refs

A computerized preliminary design system for reciprocating engine aircraft has been developed which is applicable to a desk top mini-computer. This system integrates several performance, aerodynamics, and structural weight estimation routines into a procedure capable of investigating a wide variety of aircraft design problems. After the conceptual configuration and performance requirements are established, the mini-computer design system can be used to determine the aircraft and engine size which will satisfy the requirements and be the least expensive to build or operate Carpet plots can be used to overlay data showing performance relative to a baseline configuration for a hypothetical design case. (Author)

A79-36744 Recent results obtained with a new method for measuring aircraft power and drag in flight F W Smetana and S R Fox (North Carolina State University, Raleigh, N C) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan, Apr 3-6, 1979, Paper 790616 9 p

Progress is reported in the development of a method to extract thrust horsepower and drag simultaneously from accelerated flight maneuvers. Although the flight data still are not as self-compatible as desired, the extracted drag and power obtained from a pulluppushover agree reasonably well with the results from steady flight determinations for drag and wind tunnel tests for power. Further work is necessary to define the proper power model and to make the level flight acceleration data more self-compatible (Author)

A79-36745 Development of the Beechcraft Model 77 J I Elliott and M L Holcomb (Beech Aircraft Corp., Wichita, Kan.) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan., Apr. 3-6, 1979, Paper 790617, 17 p

The Model 77 Skipper is the result of an intensive development program to develop an economical and efficient two-place general aviation trainer. The program was initiated as a flying test bed program which allowed great freedom for engineering evaluation of various aerodynamic, structural and mechanical concepts. This included the evaluation of different types of tail surfaces, high lift and lateral control devices, engines, propellers, etc. Along with the test bed, other tests were run with radio-controlled free flight and spin tunnel models. The test bed program was followed by the production engineering, testing and certification of the chosen production configuration. (Author)

A79-36746 * Full-scale wind-tunnel investigation of an Ayres S2R-800 Thrush Agricultural Airplane J L Johnson, Jr, H C McLemore, R White, and F L Jordan, Jr (NASA, Langley Research Center, Hampton, Va) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan., Apr 3-6, 1979, Paper 790618 83 p 8 refs

This paper summarizes the significant results of recent full-scale wind tunnel tests at the NASA-Langley Research Center of the Ayres S2R 800 Thrush Agricultural Aircraft The purpose of the tests was to provide fundamental aerodynamic, performance, and stability and control information of the airplane and dispersal equipment, and to study near-field wake interaction characteristics behind the aircraft. The aerodynamic tests included the use of a propeller thrust-torque balance to measure the efficiency of the propeller in the presence of the engine and to provide data for determining slipstream interference effects and slip-stream drag A79-36747 * New opportunities for future small civil turbine engines - Overviewing the GATE studies W C Strack (NASA, Lewis Research Center, Cleveland, Ohio) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan, Apr 3-6, 1979, Paper 790619 14 p

This paper presents an overview of four independent studies that explore the opportunities for future General Aviation Turbine Engines (GATE) in the 150-1000 SHP class Detroit Diesel Allison, Garrett/AiResearch, Teledyne CAE, and Williams Research participated along with several airframers. These studies forecasted the potential impact of advanced technology turbine engines in the post-1988 market, identified important aircraft and missions, desirable engine sizes, engine performance and cost goals. Parametric evaluations of various engine cycles, configurations, design features, and advanced technology elements defined baseline conceptual engines for each of the important missions identified by the market analysis Both fixed-wing and helicopter aircraft, and turboshaft, turboprop, and turbofan engines were considered All four companies predicted sizable performance gains (e.g., 20% SFC decrease), and three predicted large engine cost reductions of sufficient magnitude to challenge the reciprocating engine in the 300-500 SHP class Key technology areas were recommended for NASA support in order to realize these improvements (Author)

A79-36748 Rolls-Royce RB 401-07 turbofan engine for business aircraft in the 1980's M A Wilson and R J Cant (Rolls-Royce, Ltd, London, England) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan, Apr 3-6, 1979, Paper 790620 17 p

Rolls-Royce has identified a potential market in the business aircraft of the 80's for more efficient, economical, quieter and cleaner engines in the 5000 lb to 6000 lb thrust class. The mechanical design of the engine is characterized by using the low aspect ratio, low hub tip ratio titanium fan blades, the high pressure compressor, the vaporising type of annular combustor, the conventional two-stage design in the low-pressure turbine and the hydromechanical fuel control system. A noise level test has shown that, even without any acoustic treatment in the intake or fan duct, a significant margin of noise level exists below the regulations. It is concluded that greater range with higher rates of climb and cruising speed will all become achievable by applying current big engine technology to the small engine in a simpler form.

A79-36749 * A review of Curtiss-Wright rotary engine developments with respect to general aviation potential C Jones (Curtiss-Wright Corp, Wood-Ridge, NJ) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan, Apr 3-6, 1979, Paper 790621 23 p 21 refs Contracts No NAS3-20030, No NAS3-20808

Aviation related rotary (Wankel-type) engine tests, possible growth directions and relevant developments at Curtiss-Wright have been reviewed Automotive rotary engines including stratified charge are described and flight test results of rotary aircraft engines are presented. The current 300 HP engine prototype shows basic durability and competitive performance potential. Recent parallel developments have separately confirmed the geometric advantages of the rotary engine for direct injected unthrottled stratified charge Specific fuel consumption equal to or better than pre- or swirlchamber disesls, low emission and multi-fuel capability have been shown by rig tests of similar rotary engine. A T

A79-36750 Electromechanical actuation for business aircraft D K Bird (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan, Apr 3-6, 1979, Paper 790622 13 p 12 refs

The Air Force Flight Dynamics Laboratory's (AFFDL) approach to the utilization of electric power is to use direct electromechanical (EM) actuation for critical flight control application as in the fly-by-wire concept. The integrated hinge concept, as

applied to any of the conventional trailing edge surfaces, i.e., elevators, ailerons, or rudders is considered as the best potential for EM actuation Two hardware units were built (one for NASA and one for AFFDL), each of them featuring inside-out motor design using rare earth samarium-cobalt permanent rotors with electronic commutation and powered with 270 V dc electrical power Attention is paid to motor selection, current limiting and gear ratio selection, and some opinions concerning the future development of EM actuation and its future application to military, commercial transport, and business aircraft are given V T

A79-36751 * A comparison of hydraulic, pneumatic, and electro-mechanical actuators for general aviation flight controls J Roskam, M Rice, and H Eysink (Kansas, University, Lawrence, Kan) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan, Apr 3-6, 1979, Paper 790623 13 p 8 refs Grant No NsG-1421

Mathematical models for electromechanical (EM), pneumatic and hydraulic actuations are discussed it is shown that EM and hydraulic actuators provide better and faster time responses than pneumatic actuators but EM actuators utilizing the recently developed samarium-cobalt technology have significant advantages in terms of size, weight and power requirements. In terms of ease and flexibility of installation EM actuators apparently have several advantages over hydraulic actuators, and cost is a primary reason for the popularity of EM actuation for secondary control function since no additional systems need to be added to the aircraft While new rare earth magnets are currently in developmental stage, costs are relatively high, but continued research should bring prices down

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A79-36752 A canister fuel pump for general aviation aircraft R R Goelz and R W Rothfusz (Airborne Manufacturing Co, Elyria, Ohio) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan, Apr 3-6, 1979, Paper 790624 9 p

A new family of canister-type fuel pumps for use on both rotary and fixed-wing aircraft in general aviation use will be described. The pump, which features a wet-brush DC motor, offers advantages on aircraft where ease of maintenance and minimum downtime is very important. Major features of the new design, pump performance, and maintenance cost savings will be discussed. (Author)

A79-36753 * An experimental study of propeller-induced structural vibration and interior noise J T Howlett and J A Schoenster (NASA, Langley Research Center, Hampton, Va) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan, Apr 3-6, 1979, Paper 790625 9 p 11 refs

This paper presents results of tests conducted to study fuselage sidewall dynamics and their effects on the cabin interior noise of a twin-engine, propeller-driven, light aircraft Data on the dynamic behavior were obtained by slowly sweeping the RPM of one of the engines while the aircraft was stationary on the ground This technique allowed frequency response plots of the sidewall structural accelerations to be obtained These accelerations are compared to similar results from a test using a mechanical shaker in order to evaluate the structural dynamic response caused by the harmonics of the propeller blade passage tone. The dynamic response of the fuselage sidewall is also discussed as a noise transmission mechanism A second mechanism for noise transmission through the fuselage sidewall was investigated by opening the copilot's window. The results illustrate the complex nature of the noise transmission mechanisms and the importance of correctly assessing noise paths

(Author)

A79-36754 * Engine induced structural-borne noise in a general aviation aircraft J F Unruh and D C Scheidt (Southwest

Research Institute, San Antonio, Tex.) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan, Apr 3-6, 1979, Paper 790626 15 p 8 refs Contract No NAS1-14861

This paper describes a study of engine induced structural-borne noise in a single engine light aircraft Cabin noise and fuselage vibration levels were recorded during ground tests for engineattached, engine-detached, interior-installed, and interior-removed configurations By comparisons of the data, engine induced structure-borne noise is shown to be a primary source of cabin noise Corresponding fuselage vibration levels were quite high with energy concentrated mainly in the lower frequencies A measure of the noise control effectiveness of the interior trim was also obtained (Author)

A79-36755 * Summary of noise reduction characteristics of typical general aviation materials J Roskam, F Grosveld, and J van Aken (Kansas, University, Lawrence, Kan) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan, Apr 3-6, 1979, Paper 790627 39 p 9 refs Grant No NsG-1301

The paper presents the results of a large number of systematic tests to determine noise reduction characteristics of general aviation materials. Effects of material type (metallic and composite), thickness, panel stiffening, vibration damping materials, sound absorption materials and pressurization on noise reduction are included Several promising methods for reducing cabin interior noise in light airplanes are discussed based on the results (Author)

A79-36756 Effects of extended oil changes on aircraft piston engine wear and oil characteristics W E Garrelts (Illinios, University, Savoy, III) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan, Apr 3-6, 1979, Paper 790629 13 p 6 refs

A79-36757 Detonation characteristics of Soviet GOST 1012-72 aviation gasoline J W Sibole, Jr (Avco Corp., Avco Lycoming Williamsport Div., Williamsport, Pa.) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan, Apr 3-6, 1979, Paper 790630. 11 p

Chemical analyses, CFR engine knock tests, and a full scale turbocharged aircraft engine detonation test were conducted to compare the detonation characteristics of Soviet Grade GOST 1012-72 fuel and a commercially available Grade 100 Low Lead Aviation Gasoline Chemical analysis indicated significant differences in the composition of the two fuels, particularly with respect to aromatic and tetraethyl lead contents CFR engine knock test data indicated that the GOST 1012-72 fuel clearly was lower in knock value than the 100 Low Lead fuel, and full scale engine detonation testing supported these results Modified detonation-imposed operating limitations were developed for the full scale aircraft engine model tested No conclusions have been made with respect to long-term effects by GOST 1012-72 fuel usage on engine condition and performance (Author)

A79-36758 Designing with damping materials to reduce noise and structural fatigue E O'Keefe (Speciality Composites Corp, Newark, Del) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan, Apr 3-6, 1979, Paper 790631 15 p 9 refs

The principal advantages of increased structural damping in aircraft components are design-cost and weight savings. The damping material is most conveniently presented, using the reduced temperature format which shows the loss factor and stiffness as a continuous function of both temperature and frequency. When the structural environment and damping properties are known, the composite panel behavior can be accurately determined from standard beam equations. In the present paper, some aspects of damping design for constrained layer dampers are discussed. Several case histories are examined, where damping was successfully used to minimize aircraft and helicopter vibration and resonant noise problems VΡ

A79.36759 * Wind tunnel performance of four energy efficient propellers designed for Mach 0.8 cruise R J Jeracki, D C Mikkelson, and B J Blaha (NASA, Lewis Research Center, Cleveland, Ohio) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan, Apr 3-6, 1979, Paper 790573 22 p 44 refs

For the advanced turboprop to be competitive with proposed advanced turbofan-powered aircraft, it must have high propulsive efficiency at Mach 0.8 cruise above 9.144-km altitude with an acceptable cabin noise environment Four 8-bladed propeller models are designed employing various concepts to reduce compressibility losses. Wind tunnel tests are conducted at zero model incidence to the free-stream flow Aerodynamic and acoustic test results are presented and discussed. It is shown that the aeroacoustically designed configuration (SR 3) with 45 deg of tip sweep and an area-ruled spinner yields the highest propulsive efficiency (78 7% at Mach 0 8, 3 06 advance ratio, and 1 7 power coefficient), with an improvement of about 3% over the straight bladed configuration (SR 2, with zero-degree sweep) The phase-interference concept for noise reduction used in SR-3 yields about 5-6 dB reduction as compared to SR-2

A79-36760 * Effects of air injection on a turbocharged Teledyne Continental Motors TSIO-360-C engine D V Cosgrove and E E Kempke (NASA, Lewis Research Center, Cleveland, Ohio) Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, Kan, Apr 3-6, 1979, Paper 790607 35 p 7 refs

Results are presented for tests performed to assess the effects of exhaust manifold injection air flow rate on emissions and on exhaust gas temperature and turbine inlet temperature for a range of engine operating conditions (speed, torque, and fuel-air ratios) of a fuel-injected turbocharged six-cylinder air-cooled Teledyne Continental Motors TSIO-360-C engine Air injection into the exhaust gas at 80 F resulted in a decrease in hydrocarbons and carbon monoxide while exceeding the maximum recommended turbine inlet temperature of 1650 F at the full rich mixture of the engine. The EPA standards could be met within present turbine inlet temperature limits using commercially available air pumps, provided that the fuel-air ratios were leaned in the taxi, climb, and approach modes

S D

A79-36773 The Fairchild can-opener - Shturmovik of the eighties. Air International, vol 16, June 1979, p 267-272, 287

The close air support (CAS) Fairchild A10 Thunderbolt II is examined Discussion centers on the essentially fair-weather aircraft's suitability to the adverse weather and other demanding conditions of a Central European scenario. Authorities contend that the aircraft is the best solution so far, to these problems. The A10's features such as high survivability resulting from heavy armor and triple redundant systems, and great firepower including a 30 mm Gatling type cannon and AGM-65 Maverick missiles are cited. The Tactical Air Command claims that attacking at an altitude of 100 ft or less at 350-370 knots the A10 will prove a difficult target Among the electronic equipment the aircraft carries are a ALQ-119 jamming systems pod, a ALR-46V radar warning receiver, and chaff and IR flare dispensers Modification of an A10 into a two seater for night and adverse weather duty is also discussed, as is a presentation of complete specifications MEP

A79-36774 Airbus picks up speed - and the junior A310 takes off Air International, vol 16, June 1979, p 278-286

The article details the commercial history and present situation of the Airbus, while presenting a cross section of the entire model array Features of the different models, such as the Krueger flaps, the Rolls Royce, Pratt and Whitney, and General Electric engines, are given in detail. Separate sections present the Airbus designations and list the number and model type which have been ordered by each customer airline Development of the A 300 B10 into the A 310, noting the joint wing development by German and British design teams, is also discussed. The A 310 will have a smaller tailplane and a digital automatic flight control system allowing Category II certification with provisions for upgrading to Category III Complete specifications of the A 310 are given and a comparison with the A 300 made Finally, projected Airbus sales are analyzed, since Great Britain has returned as a full risk sharing partner in the program

MEP

A79-36775 In Soviet service V · Backfire Air International, vol 16, June 1979, p 289-291, 308

The article discusses the Soviet Backfire bomber and the roles for which the aircraft may be used. While basically a tactical weapon, Arctic staging, in-flight refueling, and high altitude subsonic cruising would enable attacks on eastcoast US targets The Backfire's low-risk design, which makes little use of new technology, and similarity to the TU-28P Fiddler is examined. The 'Downbeat' bombing and terrain following navigation radar is analyzed Maximum take-off weight is about 260,000 lbs and length and width are 138 ft and 29 5 ft, respectively The engines are believed to be based on the TU-144 turbofan, and performance estimates such as maximum dash speed of close to Mach 2 at about 39.370 ft are presented Weapon load of the aircraft is about 21,000 lbs and use as a cruise missile launch platform is expected. It is concluded that at the present the Backfire, while a serious threat to Central Europe, possesses little strategic value in the intercontinental sense MEP

A79-36797 # A starter for gas turbine engines (Ustroistvo dlia zapuska gazoturbinnogo dvigatelia) V I Daineko Priborostroenie (Kiev), no 24, 1978, p 75-79 In Russian

The present analysis deals with some aspects of calculating and designing air-injection-type starters for gas turbine engines. The schematic arrangement of the starter is examined, and structural factors affecting the dimensioning of the device are discussed. It is shown that the number of channels depends on the dimensioning constraints, the design and dimensions of the compressor inlet, and the nozzle throat diameter of the nozzle of each channel V P

A79-36974 # Dassault-Breguet - The Mirage 2000 (Dassault-Brequet - Les Mirage 2000) J Morisset Air et Cosmos, vol 17, May 19, 1979, p 27, 28 In French

The performance and design characteristics of the Mirage 2000 are outlined. The aircraft, with an overall length of 15.3 m, is equipped with a SNECMA M 53-5 turbojet engine with a thrust of more than 10 tons at Mach 2,2 and 36,000 ft. Its range of operation with two pilon tanks (1700 Leach) is greater than 1500 km. It can be equipped with two MATRA Super 530 and two MATRA 550 'Magic' air-to-air missiles. Results of initial flight tests have been highly satisfactory CKD

A79-36975 # The Digibus multiplex at the heart of avionics (Le multiplex 'Digibus' au coeur de l'avionique) G Collin Air et Cosmos, vol 17, May 19, 1979, p 29, 30 In French

The Digibus digital bus developed for application in Mirage 2000, Mirage 4000, ANG, and F 1 is described. Two EMD-Sagem system management computers with memories of 32 and 64 k words form the core of the Digibus A high degree of component standardization will permit adaptation of the system for use in ballistic missiles and submarines. Schematic diagrams of the Digibus developed for the Mirage 2000 are provided CKD

A79-37044 # Changing requirements in aircraft design L M Nicolai (Defense Advanced Research Projects Agency, Arlington, Va) Astronautics and Aeronautics, vol 17, June 1979, p 22-31 10 refs

The evolution of paramount design requirements in the aircraft industry is outlined Particular attention is given to the technological, societal, environmental, and economic pressures responsible for the rapid changes in major design requirements during the 1970's The development of design requirements over the next 25 years is considered. It is concluded that future design requirements for commercial aircraft will include performance and long life, improved fuel efficiency and overall economy of operation, and compliance with noise and exhaust emission standards. Requirements for life-cycle costs, performance, and reliability in military aircraft will be expressed in higher kill rates and reduced cost for destruction of a given target Emphasis in general aviation design will be on fuel efficiency, safety, comfort and cost. CKD

A79-37045 # Impact of advanced technologies on aircraft design J McCracken (Vought Corp, Dallas, Tex) and M R Robinson (Rockwell International Corp, Pittsburgh, Pa) Astronautics and Aeronautics, vol 17, June 1979, p 32-38 23 refs

Advanced aircraft system technologies and design process technologies that will characterize the next generation of aircraft are examined Gross-weight reductions, increases in mission functions, and expected improvements in reliability and maintainability offered

A79-37046 # Computer graphics create the new wave of design A Feder (Northrop Corp., Hawthorne, Calif.) Astronautics and Aeronautics, vol. 17, June 1979, p. 42-47, 51

The application of interactive computer graphics in advanced aircraft design, engineering analysis and production design is discussed. Advantages of this technology in terms of increased productivity, cost reductions and flexibility at each step of the design process are examined. Two- and three-dimensional geometry projections are noted.

A79-37047 # Some main points about general-aviation design practice. M Newman (Douglas Aircraft Co, Long Beach, Calif) Astronautics and Aeronautics, vol 17, June 1979, p. 48-50

A brief overview of general-aviation design practice is presented Particular attention is given to the influence of model-year marketing pressures and the high-volume, low-cost production techniques characterizing this portion of the aerospace industry on the incorporation of product-improvement features Data on general aviation aircraft production for major manufacturers are presented C K D

A79-37048 # Design, meet production G L Michaelson (Boeing Commercial Airplane Co, Renton, Wash) Astronautics and Aeronautics, vol 17, June 1979, p 52, 53, 59

The paper discusses the importance of considering production costs as well as performance in designing aircraft. The potential for cost avoidance at different steps of the design, engineering and production sequence is considered. Attention is given to problems in developing producible designs for commercial aircraft interiors.

СКD

A79-37050 # A case study in design - The Gossamer Condor P MacCready (Aero Vironment, Inc., Pasadena, Calif) Astronautics and Aeronautics, vol. 17, June 1979, p. 60-63

The design strategy used in developing the Gossamer Condor, a man-powered light-weight wire-braced airplane, is discussed Low operating power was the major design consideration, high priority was also given to ease of construction, repair and modification Reflection on the performance of soaring birds and hang gliders contributed to the design concept, sophisticated design analysis techniques were used in moderation An unconventional design approach proved highly successful in developing an unconventional aircraft C K D

A79-37149 # Joint Airworthiness Requirements - Their history and progress A P Kennedy (Civil Aviation Authority, London, England) Aircraft Engineering, vol 51, May 1979, p 17-20

The formation process of Western European Joint Airworthiness Requirements (JAR) is examined The Association Européene des Constructeurs de Matériel Aérospatial (AECMA) consisting of Belgium, France, Germany, Italy, the Netherlands, Spain, Sweden, Switzerland and the United Kingdom began work on such codes in 1970 The aims, background and results of the work now attained are discussed Separate sections deal with the airworthiness codes, Import/Export difficulties, certification of joint projects, JAR structure and general policy, and amendment procedure. Under the Airworthiness Codes section the UK 's decision to write their own after World War Two is discussed, while the Import/Export section cites the case of the Fokker F-27 and F-28 certification. In addition, a list of published documents is given. Future JAR regulations for sailplanes with and without engines are also covered. It is concluded that while work has been satisfactory in conception, adoption of JARs has been sluggish, which could erode the support they now MEP have

A79-37150 # Inertial Referenced Flight Inspection System P R Vousden (Litton Systems, Ltd., Rexdale, Ontario, Canada) Aircraft Engineering, vol 51, May 1979, p 21-25

The development and features of the Inertial Referenced Flight Inspection System (IRFIS) which allows less costly and more accurate calibration of Category I, II, and III Aircraft Instrument Landing Systems, is presented IRFIS utilizes aircraft velocity data measured by an Inertial Navigation System, while incorporating two mathematical error estimaters, a sub-optimal Kalman filter and a Bryson-Frazier smoother The Aircraft Position Sensor (APS) consisting of two infrared detector arrays mounted at 90 deg to each other in the aircraft pitch plane, is detailed as well as the ground mounted retroreflector Design of the APS has met these criteria all weather operation, no hazardous features, no interference with radio communications and no ground personnel or ground installation of expensive equipment An onboard computer incorporating a CRT display and cassette magnetic tape storage is covered Calibration procedure which consists of a 50 ft altitude pass over the runway is detailed Other applications such as aerial surveying, photogrammatic operations, and airborne precision spraying can also be enhanced with IRFIS based equipment MEP

A79-37238 The estimation of induced-voltage peak magnitude and energy level under LTA/EMP excitation of low-loss aircraft cabling W S McCormick (Wright State University, Dayton, Ohio) *IEEE Transactions on Electromagnetic Compatibility*, vol EMC-21, May 1979, p 136-146 8 refs Contract No F33615-75-D-0090

The important vulnerability parameters of peak voltage transient magnitude and voltage transient energy are estimated for the LTA/EMP induction problem Using basic linear system theory, straightforward expressions are derived to estimate these two survivability parameters. The derived model is quite general including cable characteristics, varying terminating impedances, and varying points of cable excitation. Using the developed model, a comparison of the LTA and EMP cases is made. An illustrative example involving the yaw damper circuit of the USAF f 111 is also included. (Author)

A79-37294 The McDonnell Aircraft Company Lightning Simulation Laboratory E H Schulte (McDonnell Aircraft Co, St Louis, Mo) Journal of Environmental Sciences, vol 22, May-June 1979, p 22-27 6 refs

The McDonnell Aircraft Company (MCAIR) Lightning Simulation Laboratory is equipped to conduct developmental lightning simulation tests as well as qualification tests on aircraft or aircraft assemblies. This paper describes how these techniques are applied at MCAIR in some of the unique generators used for conducting high-voltage, high-current, swept stroke, and induced-transient simulated lightning tests. This paper lists the various equipment and facilities which are available at MCAIR for performing lightning simulation tests and gives examples of some of the tests performed (Author)

A79-37295 * # Control considerations for CCV fighters at high angles of attack. L T Nguyen, W P Gibert, and S B Grafton (NASA, Langley Research Center, Hampton, Va) NATO, AGARD, Symposium on Aerodynamic Characteristics of Controls, Naples, Italy, May 14-17, 1979, Paper 11 p

Wind tunnel and piloted simulation studies show that the use of the CCV concept of relaxed static pitch stability on fighter aircraft at high angles of attack can result in pitch departures caused by inertia and/or kinematic coupling and in deep stall trim. These problems can be avoided by sufficient nose-down pitch control at high attack angles, and effectiveness of several pitch control configurations such as aft-mounted stabilators, canard mounted flaps, and all-movable canards was investigated. A variable incidence canard with a large travel range was the most effective means of obtaining the required pitch control, although very large deflections may be required on highly unstable configurations. Control laws were developed for cases where the high angle of pitch control requirement is not met, but they can limit aircraft roll capability and thus compromise maneuver. A T

A79-37296 * # A unique facility for V/STOL aircraft hover testing R G Culpepper (NASA, Langley Research Center, Hamp ton, Va) and R D Murphy (US Navy, Naval Air Systems Command, Washington, D C) Workshop on V/STOL Aerodynamics, U S Naval Postgraduate School, Monterey, Calif, May 16-18, 1979, Paper 28 p

The paper discusses the Navy's XFV-12A tethered hover testing capabilities utilizing NASA's impact Dynamic Research Facility (IDRF) at Langley The facility allows for both static and dynamic tethered hover test operations to be undertaken with safety The installation which consists of the 'Z' system (tether), restraint system, static tiedowns and the control room and console, is presented in detail Among the capabilities demonstrated were the ability to recover the aircraft anytime during a test, to rapidly and safely define control limits, and to provide a realistic environment for pilot training and proficiency in VTOL flight MEP

A79.37468 # Vertical cutoff rigidity and the intensity distribution of cosmic rays near Cape Town P J Konig, A J v d Walt, P H Stoker, B C Raubenheimer (Potchefstroom University for Christian Higher Education, Potchefstroom, Republic of South Africa), M A Shea, and D F Smart (USAF, Geophysics Laboratory, Bedford, Mass) In International Cosmic Ray Conference, 15th, Plovdiv, Bulgaria, August 13-26, 1977, Conference Papers Volume 4 Sofia, B'lgarska Akademiia na Naukite, 1978, p 173-177 6 refs. Research supported by the South African Council for Scientific and Industrial Research

A fairly sharp increase of 2 3% in the intensity of the nucleonic component of cosmic rays was observed at 30,000 feet pressure altitude along a contour of constant calculated vertical cutoff rigidity on a research flight from Cape Town, South Africa, at 18 deg E longitude, to a point 2 deg W longitude The increase seems to be an inherent feature of this region near the South Atlantic geomagnetic anomaly Detailed cutoff rigidity calculations in vertical and inclined directions revealed that the observed increase may at least partly be ascribed to variation in effective cutoff rigidites along the route However, the increase could also be attributed, at least as far as morphology is concerned, to the continuous precipitation in a restricted area of those high energy inner radiation belt protons that have short lifetimes. (Author)

A79-37573 # Observation of atmospheric interactions at aeroplane altitude F Fumuro, R Ihara (Kwansei Gakuin University, Nishinomiya, Japan), T Ogato, H Sugimoto (Tokyo, University, Tokyo, Japan), and Y Sato (Waseda University, Tokyo, Japan) In International Cosmic Ray Conference, 15th, Plovdiv, Bulgaria, August 13-26, 1977, Conference Papers Volume 7

Sofia, B'Igarska Akademiia na Naukite, 1978, p 171-176

A large gamma-ray family is observed with a emulsion chamber exposed at aircraft altitude (260 g/sq cm) This gamma-ray family represents the feature of atmospheric nuclear interactions directly Experimental results are presented on the energy, transverse momentum, and angular distribution of secondary gamma rays The analysis of this family is made by use of calculated results of three dimensional cascade theory and of the kinematical method

(Author)

A79-37725 The 'cloud-in-cell' technique applied to the roll up of vortex sheets G R Baker (California Institute of Technology, Pasadena, Calif) Journal of Computational Physics, vol 31, Apr 1979, p 76-95 36 refs Contract No AT(04 3)-767, Grant No DAHC04-68-C-0006

The cloud-in-cell technique is used to calculate the time evolution of a vortex sheet generated by a wing in an ideal fluid. Two cases are considered for the initial distribution of circulation one corresponding to an elliptically loaded wing and the other simulating the wing with a flap deployed. Results indicate that small scale behavior plays an important role in the roll-up. Typically, small scale perturbations result in small structures which evolve into ever increasing larger structures by vortex amalgamation. B J

A79-37735 Application of parameter identification techniques to analysis of flight data A J Ross (Royal Aircraft Establishment, Farnborough, Hants, England) *Progress in Aerospace Sciences*, vol 18, no 4, 1979, p 325-349 35 refs

The paper presents an outline of the parameter identification techniques currently used to extract aerodynamic data from flight tests, the emphasis being on the determination of stability and control derivatives Consideration is given to the following techniques equation error methods, output error methods, generalized least squares method, and maximum likelihood methods Some advantages and difficulties of the methods are discussed, and some examples of results obtained from research and demonstration flying are examined B J

A79-37827 # The evaluation of the weight of engine installations on transport aircraft (Sulla valutazione del peso degli impianti motopropulsori dei velivoli da trasporto) G Gabrielli Ingegneria, Mar -Apr 1979, p 65-69 9 refs In Italian

Expressions for engine installation weight as a function of thrust developed at take off are derived for transport aircraft. Engine weight assessments are presented for both propeller and jet aircraft and are intended as an aid in the preliminary design of aircraft with externally mounted power plants. The engine weight expressions are empirical formulations based on statistical elements.

A79-37828 # Radial equilibrium in axial turbomachines (L'equilibrio radiale nelle turbomacchine assiali) G De Michele (Franco Tosi S p A, Legnano, Italy), G A Danieli, and G Florio (Calabria, Universita, Cosenza, Italy) Ingegneria, Mar Apr 1979, p 70-83 7 refs In Italian

A review is presented of the theoretical foundations of the radial equilibrium model, a mathematical approach for fluid dynamic calculations applicable to axial turbines. The radial equilibrium model is based on a consideration of nonviscous, axisymmetric, potential flow in the meridian plane of the turbomachine. The radial distribution of a free parameter in the flow treatment provides a design tool for optimizing the fluid dynamic output of the turbomachine. J M B A79-37852 Fossil fuel heat pumps for domestic, commercial and industrial space heating R E Critoph (Open University, Milton Keynes, Buck, England) In International Conference on Future Energy Concepts, London, England, January 30-February 1, 1979, Proceedings London, Institution of Electrical Engineers, 1979, p 61-64

It is noted that fossil fuel heat pumps are more efficient than electric ones. The present paper gives a description of the OUERG/ Lucas gas-fueled heat pump, presents a schematic diagram and photographs of the device, and discusses predicted performances B J

A79-38058 # Turbulent wake measurements with a laser velocimeter J F Meyers (US Army, Instrument Research Div, Hampton, Va) and D R Hoad (US Army, Structures Laboratory, Hampton, Va) American Institute of Aeronautics and Astronautics, Thermophysics Conference, 14th, Orlando, Fla, June 4-6, 1979, Paper 79-1087 9 p 12 refs

An investigation has been conducted in the Langley V/STOL tunnel with a laser velocimeter to demonstrate the capabilities of this technique through measurements of airflow velocities in the wake region of a NACA 0012 wing in stall and cruise angles of attack (19.4 deg and 4.75 deg). A direction-sensitive, two component, fringe-type laser velocimeter with a focal length of 3.86 m to reach center span was used with high speed burst counter and minicomputer data acquisition and processing. The size of the seeding particles was measured and the velocity lag error determined along with errors due to the instrumentation. The measured velocities were found to have a bias uncertainty of 1.33 percent to 0.91 percent and a random uncertainty of + or 0.47 percent.

A79-38090 Fuel on fire - Rapid response to a military problem D Boyle Interavia, vol 34, June 1979, p 554-556

Equipment developed by Graviner England for extinguishing fuel fires in aircraft is analyzed, considering that such a system has to operate in milliseconds if suppression is to be effective. Two methods of detection are presented (1) detection of the impact shock wave through the fuel tank, and (2) detection of flame radiation. The latter, by reacting only to a flame, eliminates the possibility of releasing extinguishant when no fire has occurred. The ultraviolet sensor which consists of a hydrogen and inert gas filled glass bulb containing two metal electrodes is discussed in detail. Its quick response time allows for several 'readings' per millisecond, thus reducing the chance of errant flashes or rays triggering the system An explosive charge releases the potassium cryolite extinguishant from the cone shaped suppressor unit. The results of a demonstration for the U.S. Army are presented, noting various contract possibilities M.E.P.

A79-38091 Survivability in aircraft fires - New standards are needed C Bulloch Interavia, vol 34, June 1979, p 557, 558

The fire resistance of aircraft cabin materials in respect to design and certification is discussed. Improved testing procedures are called for as materials that have passed current specifications as 'self extinguishing' have been proven to propagate flame, noting criticisms that laboratory tests involving small samples do not adequately reproduce the aircraft cabin environment. The FAA has modified a C 133 with a false floor and ceiling to create a widebody cabin with full instrumentation provided to record heat flux, smoke density, and gas concentration in various parts and levels of the cabin. The complete data capability will include 128 channels of computer acquired information, gas sample analyses, test animal responses and video coverage of the cabin Results to date include fairly precise analysis of the time required for dangerous heat levels to occur A mathematical model of a cabin fire under development, and possible use of additives to reduce spilt fuel flammability are covered. The lack of up-to-date FAA regulations is also discussed MEP

A79-38092 Westland unveils WG30 transport helicopter D Wood Interavia, vol 34, June 1979, p 575-577

The Westland WG-30 transport helicopter is previewed. The medium size, high performance helicopter is intended for military and civilian use. Complete specifications regarding capacity, dimensions, weights, and performance are given The WG-30 differs from the earlier Lynx in having increased rotor diameter, 'raft' mounted engine and rotor assembly, and a new automatic flight control system The use of a minimum number of cleat sizes is covered, noting, that as a result, the WG-30 has half the structural components of the Lynx with only a 30 lb weight penalty Lynx items retained in the newer model, include the nose and tail structure Twin Rolls Royce GEM 41-4 turboshaft engines with a maximum rating of 1,120 shp , allow a maximum cruise speed of 135 knots A duplex pitch, roll, and yaw system with computer based control and duplex heading hold is employed and a complete VOR, DME, ILS, and ADF package will be tested for IFR operation. In the military role the WG-30 is seen as a tactical transport and for battlefield support. With tropical performance modifications it is hoped the craft's market will extend to the Middle and Far East

MEP

A79-38118 # Rotor blade stability in turbulent flows I Y K Lin (Illinois, University, Urbana, III), Y Fujimori (National Aerospace Laboratory, Tokyo, Japan), and S T Ariaratnam AIAA Journal, vol 17, June 1979, p 545-552 25 refs Grant No DAAG29-78-G-0039

The effect of turbulence in the atmosphere on the motion stability of a helicopter blade is investigated. Modeling turbulence as a random field, statistically stationary in time and homogeneous in space, the method of stochastic average of Stratonovich (1967) is used to obtain equivalent Ito stochastic equations, from which the Fokker-Planck equation for the transition probability density and the equations for various stochastic moments can be derived. As an exploratory study, only flapping and torsional motions are considered Equations of motion are derived which are reducible to those obtained previously by Sissingh and Kuczynski when the turbulence terms are removed. The in-plane turbulence components appear in the coefficients of these equations, thus, they affect the stability of the flapping and torsional motions. On the other hand, the normal turbulence component appears in the inhomogeneous terms in the equations, its statistical properties, while affecting the level of system response, do not change a stable solution to an unstable solution (Author)

A79-38123 * # Transient ablation of Teflon in intense radiative and convective environments N Arai (NASA, Ames Research Center, Moffett Field, Calif) *AIAA Journal*, vol 17, June 1979, p 634-640 13 refs

On the basis of this investigation of the high-temperature behavior of polytetrafluoroethylene (PTFE), the transient onedimensional ablation of PTFE has been developed by taking into account the optical transmittance of both the amorphous zone and the crystalline zone of PTFE layer Results show that although the exposed surface receded at an apparently steady state, both the internal temperature and the thickness of the gel layer increase continuously due to the internal absorption of radiation (Author)

A79-38124 # Effect of forward acceleration on aerodynamic characteristics of wings S Ando (Nagoya University, Nagoya, Japan) and A Ichikawa AIAA Journal, vol 17, June 1979, p 653-655 7 refs

A new theoretical formulation is presented for a threedimensional wing flying with nonuniform speed in an incompressible inviscid fluid General formulations are presented and some applications for the lift problem are given including the cases of slender wings and two-dimensional airfoils B J A79-38131 F-18 - A special report. M Shohat and F C Berry, Jr Military Electronics/Countermeasures, vol 5, May 1979, p 29, 30, 32 (4 ff)

One of the concepts driving F-18 Hornet development is to produce a multimission aircraft designed for reliability and maintainability, and whose cost of ownership is reduced by comparison with present aircraft Medium and large scale integrated circuits, solid state electronics, switching, and computer memory are heavily used and derating of electronics equipment contributes directly to reliability from the outset. The aircraft has built-in tests not only in the avionic systems but in some of the mechanical systems as well with fighter and attack versions completely common in basic aircraft hardware and software. It is also noted that the maintainability and reliability standards are now requirements, not goals as in earlier aircraft The entire full scale development program is reportedly valued at around \$2 billion beginning in 1976, with 11 aircraft fully engaged in test flying by the year-end of 1979 and squadron service to begin in 1982 vт

A79-38132 The intercept of covert radar R G Siefker Military Electronics/Countermeasures, vol 5, May 1979, p 56, 94 The geometry of intercept falls into one of two general categories the interceptor either is or is not colocated with the target The definition of a new term called the 'radar advantage' establishing the edge that radar must hold in order to be undetected while tracking a target is given Two examples covering most typical cases are presented using a radar range vs intercept range chart. In the first, a radar operator is tasked with not letting an electronic intelligence collector get close enough to intercept his radar, in the second, the radar designer is tasked to design a radar that can track a target at 10 km without the target's own ship sensors becoming aware of the covert act Either example can be worked backwards to aid the interceptor designer in system specification and required ranges VΤ

A79-38135 * # Some observations on the mechanism of aircraft wing rock C Hwang and W S Pi (Northrop Corp., Aircraft Group, Hawthorne, Calif.) *Journal of Aircraft*, vol. 16, June 1979, p. 366-373.6 refs Contract No. NAS2-8734

A scale model of the Northrop F 5A was tested in NASA Ames Research Center Eleven-Foot Transonic Tunnel to simulate the wing rock oscillations in a transonic maneuver. For this purpose, a flexible model support device was designed and fabricated, which allowed the model to oscillate in roll at the scaled wing rock frequency. Two tunnel entries were performed to acquire the pressure (steady state and fluctuating) and response data when the model was held fixed and when it was excited by flow to oscillate in roll. Based on these data, a limit cycle mechanism was identified, which supplied energy to the aircraft model and caused the Dutch roll type oscillations, commonly called wing rock. The major origin of the fluctuating pressures that contributed to the limit cycle was traced to the wing surface leading edge stall and the subsequent lift recovery For typical wing rock oscillations, the energy balance between the pressure work input and the energy consumed by the model's aerodynamic and mechanical damping was formulated and numerical data presented (Author)

A79-38136 # Aeroelastic stability analysis of the AD-1 manned oblique-wing aircraft M J Rutkowski (US Army, Aero mechanics Laboratory, Moffett Éield, Calif) Journal of Aircraft, vol 16, June 1979, p 401-406 23 refs

The AD-1 manned flight test program being conducted jointly by the Ames and Dryden Flight Research Centers of NASA is entended to evaluate the stability, control, and handling characteristics of oblique wing aircraft The results of the aeroelastic stability analysis carried out at Ames in support of the AD-1 program are presented for the oblique wing, both with and without ailerons When the wing is swept, the significant mode of instability is low-frequency, oblique-wing flutter With the oblique unswept, however, the critical mode is bending-torsion alleron flutter. The latest version of the NASTRAN computer code, as well as the Ames PASS/FLUT program, was used in these studies (Author)

A79-38137 # A tire runway interface friction prediction model concept M K Wahi (Boeing Commerical Airplane Co, Seattle, Wash) Journal of Aircraft, vol 16, June 1979, p 407 416 39 refs Contract No F33657 74 C-0129

A thorough literature survey was conducted to establish the range of aircraft tires in use, types of runway surfaces in use, and a list of factors affecting tire runway interface phenomenon. Both commercial and military aircraft tires and runways were studied Subsequently, a prediction model has been developed that correlates with existing tire test data to within plus or minus 5%. The model consists of a prediction equation expressing the relationships between seven dimensionless groups (pi terms) needed to define the tire runway interface friction. Due to lack of availability of uniform test data, a tire test program has been recommended to validate the said model. (Author)

A79-38140 # Aircraft design and strength /2nd revised and enlarged edition/ (Konstruktsila i prochnost' samoletov /2nd revised and enlarged edition/) V N Zaitsev and V L Rudakov Kiev, Izdatel'stvo Vishcha Shkola, 1978 488 p 48 refs In Russian

This second edition of the textbook has been extended to include a number of issues and problems associated with the progress made in aircraft design over the past few years. Particular attention is given to new requirements concerning the strength, reliability, dynamic creep, and fatigue strength of an aircraft and its assemblies and components. The structure diagrams of various systems and mechanisms are examined.

A79-38145 # Theoretical fundamentals of radio altimetry (Teoreticheskie osnovy radiovysotometrii) A P Zhukovskii, E I Onoprienko, and V I Chizhov Moscow, Izdatel'stvo Sovetskoe Radio, 1979 320 p 133 refs In Russian

A theory of air and space-borne radio altimeters and vertical velocimeters is developed. The principles of designing such instruments and obtaining information on height and vertical speed are outlined. The operational characteristics of radio altimeters, associated with the random nature of a signal reflected from a statistically uneven surface are discussed. The accuracy of radio altimeters is studied by statistical analysis and synthesis methods. Techniques for calculating dynamic and other errors of radio altimeters are described.

A79-38168 # Profiling of two-dimensional and threedimensional nozzles and calculation of their flows (Profilirovanie dwumernykh i prostranstvennykh sopel i raschet techenia v nikh) M la livanov and A N Kraiko In Gasdynamic lasers and laser photochemistry Moscow, Izdatel'stvo Moskovskogo Universiteta, 1978, p 52-62 43 refs In Russian

The paper deals with some problems associated with designing plane, axisymmetric, and three-dimensional nozzles for a desired flow at the exit section or for optimum thrust. Some aspects of the calculation of nozzle flows for a given nozzle configuration, with allowance for nonequilibrium physicochemical processes, are dis cussed.

A79-38387 The effect of hydrogen addition on ignition delays and flame propagation in spark ignition engines M J Rauckis and W J McLean (Cornell University, Ithaca, N Y) Combustion Science and Technology, vol 19, no 5-6, 1979, p 207 216 21 refs

The results of an experimental investigation of the effect of supplemental hydrogen (up to 30 percent of the total fuel energy) on the combustion process in a CFR engine are reported. The hydrogen was added under otherwise constant conditions so that chemical

properties were varied under constant hydrodynamic conditions Calibrated cylinder pressure traces, averaged over many cycles, were incorporated into a two-zone thermodynamic analysis to determine the mass fraction burned as a function of crankangle. The techniques employed enabled changes in the induction period and combustion duration of the order of 0.1 ms to be resolved. The added hydrogen resulted in significant reductions in ignition delay or induction times, especially in lean mixtures. Reductions were greater with increased fractions of hydrogen. Once a turbulent flame was well established, the hydrogen had a relatively small effect on the burning rate. The results are consistent with a description of the combustion process which includes an induction period dominated by chemical dynamic effects and a turbulent burning period dominated by turbulent transport effects Added hydrogen also led to improved efficiency and less cycle-to-cycle pressure variations (Author)

A79-38393 * Effects of forward velocity on sound radiation from convecting monopole and dipole sources in jet flow R Dash (NASA, Ames Research Center, Moffett Field, Calif) Journal of Sound and Vibration, vol 64, May 22, 1979, p 187-207 26 refs

A theoretical model is presented of the effects of forward velocity of an aircraft at arbitrary subsonic speed on sound radiated from convecting monopole and dipole sources embedded in the jet flow. It is found that with increasing forward velocity there is a steadily increasing amplification (over the static case) of the sound radiated into the forward arc and a large reduction of the sound which is radiated into the rearward arc. The same trend is also shown to result when there is a reduction in the exhaust velocity, with, however, a further rise in amplification in the forward quadrant B J

A79-38399 Noise characteristics of heated high velocity rectangular jets R A Kantola (GE Mechanical Systems and Technology Laboratory, Schenectady, N Y) Journal of Sound and Vibration, vol 64, May 22, 1979, p 277 294 14 refs US Department of Transportation Contract No OS 30034

A comprehensive experimental investigation of the noise emission from a rectangular jet has been carried out. In order to provide information pertinent to the operating conditions of jet engines, this study was conducted with a wide range of jet velocities and temperatures A substantial effort has been made to present the information in this paper in such a fashion as to delineate the effects of turbulent mixing and acoustic shielding. To aid in this process, a round jet with an equal area nozzle was also tested over the same ranges of velocity and temperature. As a result of this study, it is concluded that an observed reduction in overall acoustic power of the rectangular jet, when compared to a round jet, is mainly the result of the shielding effects of the mean velocity and temperature fields rather than due to any turbulent mixing phenomenon Acoustic shielding predictions were found to be qualitatively valid in the vicinity of the peak intensity but were inadequate at shallow angles to the jet axis. In order for shielding theory to properly predict the noise of non-circular jets, at shallow angles, it appears that it will be necessary to include the effects of jet spreading and subsequent degeneration to a circular jet as well as the effects of off-axis source locations (Author)

A79-38476 Sidestick/Throttle Controller - An alternate approach F Gregory (USAF, Washington, D.C.) Society of Experimental Test Pilots, Technical Review, vol. 14, no. 3, 1979, p. 4-15

A simulation was made to determine if a pilot using a single hand Sidestick/Throttle Controller (SSTC) could provide precise and effective aircraft control comparable to that of a conventional center stick and left-hand throttle. The construction of the SSTC, the Visual Motion Simulator (VMS) and the Differential Maneuvering Simulator (DMS) used during the evaluation conducted at the NASA Langley Research Center, together with the test procedures are described. The VMS pilot comments were that the SSTC is an acceptable alternative to aircraft control and that preliminary data analysis indicates no significant difference between the conventional controller and the SSTC, that throttle manipulation appears as a subconscious act with the SSTC, and with the exception of roll sensitivity, the roll and pitch interface harmony and the mechanical characteristics of the SSTC were acceptable. The DMS conclusions rated the SSTC as acceptable and equal or better than the conventional controls for a majority of DMS tasks, that hand fatigue can be expected with rapid and large displacement throttle manipulations while significantly displacing the SSTC from lateral or longitudinal neutral, and that preliminary data analysis indicates no significant difference in performance between the SSTC and conventional controller.

A79-38477 A wind shear/downdraft drift angle warning system R A Greene Society of Experimental Test Pilots, Technical Review, vol 14, no 3, 1979, p 16-21 8 refs

This paper describes the development of an airborne system, which determines the reduction in excess thrust available during a landing approach. The system measures, with no appreciable lag, the effective loss in available excess thrust-to-weight ratio due to downdraft drift angle and horizontal wind shear. These signals are summed in terms of radians and acceleration g's and are presented to the flight crew in the form of a go-around alert. (Author)

A79-38478 The test pilot in the airline industry or 'My bags are packed and I'm ready to go' C Kizer (United Air Lines, Inc, Chicago, III) Society of Experimental Test Pilots, Technical Review, vol 14, no 3, 1979, p 22-26

The engineering functions, personnel qualifications and the organization of the Flight Test Section at United Airlines are described and types of test flights, flight test requirements, and details of maintenance operations are outlined A Flight Test Audit Program which randomly selects fleet aircraft for flight checks and helps determine system function and reliability in the operating fleet environment, and a program to allow Flight Test Section a greater impact on the existing maintenance plan are depicted A T

A79-38479 Night/Adverse Weather A-10 evaluator program W H Shawler (Fairchild Republic Co, Farmingdale, N Y) Society of Experimental Test Pilots, Technical Review, vol 14, no 3, 1979, p 27-30

The program to extend the A-10 mission capability to the Night/Adverse Weather (N/AW) regime by demonstrating aircraft operability and survivability with low altitude attack and integrating tactics and sensors to destroy the threat is described. The N/AW capability will increase the A-10 usable time to over 90% in the European environment with enhanced avionics such as Inertial Navigation System, Radar, Forward Looking Infrared, Radar Altimeter, and Laser Ranger. The mission analysis to determine the required avionic subsystems and equipment is discussed together with the major tasks required to accomplish the program, including modification into a two-place N/AW evaluator, integration of the N/AW avionics, and demonstration of the N/AW capability. The test program is described, noting that a crew of two is needed to accomplish the low altitude mission at night and/or adverse weather, at least two sensors should provide information at all times, and the cockpits should be designed with maximum flexibility with control provisions in both cockpits and capability to display sensor information both Heads Up and Heads Down AT

A79-38531 Identification of voltage transients on aircraft cabling under LTA excitation W S McCormick (Wright State University, Dayton, Ohio) and K J Maxwell (Technology Scientific Services, Inc., Dayton, Ohio) *IEEE Transactions on Aerospace and Electronic Systems*, vol AES-15, May 1979, p 372-377 Contract No F33615-75-D-0090 Lightning and electro-magnetic pulse-induced fuselage skin currents can magnetically or electrically flux couple onto aircraft cabling through dielectric 'holes' or apertures in the aircraft fuselage Using lightning transient analysis (LTA) input-output waveform records, frequency domain techniques are presented that locate the exact point of excitation. The techniques are demonstrated using an RG-58 cable simulation and are then applied to the yaw damper circuit of a USAF F-111 (Author).

A79-38532 A family of air traffic control radars E Giaccari and G Nucci (Selenia S p A , Rome, Italy) *IEEE Transactions on Aerospace and Electronic Systems*, vol AES-15, May 1979, p 378-396 9 refs

Some 20 years of activity in the field of air traffic control radars is described. The technical experience gained in evaluating the performance of ATC radars installed throughout the world is described in terms of target visibility in the clear, a ground clutter, and in adverse meteorological conditions. A criterion to determine the significance of a flight test is described. In the effort to establish a reliable method of measurement, the subclutter visibility over ground clutter is related to the linear dynamic range of the moving-target indicator (MTI) receiver and to the improvement factor. (Author)

A79-38533 Digital flight control research using microprocessor technology R F Stengel (Princeton University, Princeton, NJ) (Flight Control Systems Criteria Symposium, US Naval Postgraduate School, Monterey, Calif, July 1978) IEEE Transactions on Aerospace and Electronic Systems, vol AES-15, May 1979, p 397-404 12 refs Contract No N00014-78-C-0257

The Flight Research Laboratory at Princeton University is engaged in an experimental program to investigate a variety of approaches to digital control by actual flight test Experimentation is being conducted with Princeton's 6-DOF variable-response research aircraft (VRA), which is equipped for direct side-force control, direct-lift control, feedback of all motion variables, and multiplepilot command modes VRA avionics have been augmented by microprocessor digital flight control system (Micro-DFCS), which uses off-the-shelf computer components capable of operating in parallel or in series with the existing variable-response system. The digital control laws operate in conjunction either with the 'bare airframe' dynamics of the VRA or with the dynamics of a simulated aircraft, provided by the existing variable-response system. The initial flight control computer program CAS-1 provides three longitudinal control options direct (unaugmented) command, pitch rate command, and normal acceleration command (Author)

A79-38706 Air Force Space Laser Communications J R Roland and C E Whited (USAF, Space and Missile Systems Organization, Los Angeles Air Force Station, Calif) In ITC/ USA/78, Proceedings of the International Telemetering Conference, Los Angeles, Calif, November 14-16, 1978 Pittsburgh, Pa, Instrument Society of America, 1978, p 339-346

The background and status of the AF LASERCOM program are briefly reviewed The performance characteristics of the LASERCOM system make its potential application to certain satellite-satellite and satellite-aircraft links unique, while other potential LASERCOM links require a detailed cost analysis of the current investment in RF terminals and systems vs the cost of developing and deploying LASERCOM terminals and systems B J

A79-38814 # Model study of transient processes in a hydraulic power amplifier (Badania modelowe procesow przejsciowych hydraulicznego wzmacniacza siły) G Janowska and J Morawski Instytut Lotnictwa, Prace, no 72, 1978, p 3-24 In Polish

The paper deals with a hydraulic analog of a power amplifier incorporated in a helicopter control system. The results of the analysis are discussed, with particular reference to the influence of the principal functional and structural characteristics of the amplifier on its transient response. V P A79-38816 # Model study of aircraft disk brakes (Badanie modelowe lotniczych hamulcow tarczowych) A Derkaczew *Instytut Lotnictwa, Prace*, no 72, 1978, p 53 81 7 refs In Polish

The model test for aircraft disk brakes, proposed in the present paper, is based on the use of modern concepts of similarity theory and the theory of friction and wear A group of parameters which affect decisively the similarity aspects of the test are identified, along with the conditions which must be satisfied to provide a modeling accuracy adequate for designing aircraft disk brakes VP

A79-38817 # Tachystoscopic testing of onboard instruments (Badania tachistoskopowe przyrzadow pokladowych) Z Kazimierska *Instytut Lotnictwa, Prace,* no 73, 1978, p 3-25 18 refs In Polish

Some problems in the tachystoscopic testing of aircraft indicator instruments are addressed. The ergonomic optimization of some existing indicator instruments and proposed new ones is studied on the basis of some legibility tests, in which the minimum time necessary for correct reading was measured. Results of legibility tests performed in the design process for some fuel gages and gyrocompasses with integral lighting are discussed. PTH

A79-38819 # A method of reducing aircraft turbine blade vibrations (O pewnej metodzie zmniejszania drgan lopatek turbin lotniczych) W Klepacki *Instytut Lotnictwa, Prace,* no 74, 1978, p 11-40 In Polish

A vibration damper for aircraft turbine blades is described. The effectiveness of the device is evaluated by measuring the stress in the blade itself and the neck of the blade root before and after the vibration damper is installed. Stress amplitude reductions of up to around 70% are possible with the device. A mathematical model of the damper is proposed, and an analog method of analysis is described. These two methods give satisfactory results for predicting the effectiveness of the damper installation.

A79-38825 High level maintenance below sea level L M Kolsteeg (KLM - Royal Dutch Airlines, Engineering and Maintenance Div, Amsterdam, Netherlands) *Exxon Air World*, vol 31, no 2, 1979, p 22-26

The KLM Amsterdam Schiphol Airport engine overhaul shop is responsible for maintenance and overall engineering of about 200 CF6 engines Modular design and on condition maintenance philosophy, the two basic concepts of modern engine care, introduced new common industry terminology, Modules or Maintenance Units, Hospital and Hospital Visit, Shop and Shop Visit, Hospital Maintenance Unit and On Condition Maintenance which are defined Inspection methods including borescope, evaluation of magnetic slip detectors, Gamma-ray and oil sample checks are listed, noting that on condition maintenance philosophy, together with failure analysis. revealed the life-limited components which should be scheduled for replacement. The engine component inspection, repair and maintenance steps through the shop are detailed, noting the role of production control, engineering, quality assurance, finance and production experts. Finally, the repaired components and modules are rebuilt into a complete engine and given a test cell performance AT run

A79-38882 * Exploring team avionics systems by simulation G A Brent and T M McCalla, Jr (Southern Illinois University, Carbondale, III) In Annual Simulation Symposium, 11th, Tampa, Fla, March 15-17, 1978, Record of Proceedings

Tampa, Fla, Annual Simulation Symposium, Long Beach, Calif, IEEE Computer Society, 1978, p 155-170 12 refs Grant No NsG 2238

Configurations of software and hardware in a no-critical element team architecture are under study for future general aviation aircraft avionics. The team integrated avionics system, based on microprocessors, can monitor and partially interpret all flight instrument data, engine parameters, and navigation information faster than a human pilot. Simulation programs based on an event-oriented simulation language are being used to design team architectures. J M B

A79-38885 An aircraft simulation using a product of exponentials as matrizant K R Penrose (USAF, Ogden Air Logistics Center, Hill AFB, Utah) In Annual Simulation Symposium, 11th, Tampa, Fla, March 15-17, 1978, Record of Proceedings

Tampa, Fla, Annual Simulation Symposium, Long Beach, Calif, IEEE Computer Society, 1978, p. 253-269

An aircraft simulation is described wherein direction cosine matrices are updated by premultiplication with exponential matrices which represent rotations occurring during 50 millisecond intervals Equations and algorithms are presented which determine the aircraft state in inertial and other coordinate systems, based on aerodynamics and environmental factors. Techniques for fast, accurate real time execution are used throughout the simulation. Error estimates are given where known. (Author)

A79-38886 The dynamics of a general aviation pilot promotion campaign M A Duffy (Battelle Columbus Laboratories, Columbus, Ohio) In Annual Simulation Symposium, 11th, Tampa, Fla, March 15-17, 1978, Record of Proceedings

Tampa, Fla, Annual Simulation Symposium, Long Beach, Calif, IEEE Computer Society, 1978, p. 305-317

A dynamic simulation model has been developed to model causal connections between the supply of general aviation pilots, aircraft demand, and aircraft utilization Previous applications of the simulation model have included an assessment of the impact on general aviation activity of regulatory changes that would bring about increases in user costs. In this paper, the impact of the program initiated by the General Aviation Manufacturers' Association (GAMA) to double the private pilot population by 1980 is studied According to the simulation model, if the GAMA program is successful there will be approximately 50,000 additional active general aviation aircraft by 1985.

A79-38906 # A method for the calculation of 3D boundary layers on practical wing configurations J P F Lindhout, G Moek, E De Boer, B Van Den Berg (National Lucht en Ruimtevaartlaboratorium, Amsterdam, Netherlands) In Turbulent boundary layers Forced, incompressible, non-reacting, Proceedings of the Joint Applied Mechanics, Fluids Engineering and Bioengineering Conference, Niagara Falls, N Y, June 18-20, 1979 New York, American Society of Mechanical Engineers, 1979, p 35-46 13 refs

The paper describes a method for calculating three-dimensional turbulent and laminar boundary layers on nondevelopable surfaces A simple eddy viscosity model is incorporated in the method and consideration is given to the organization of computations with the aim of circumventing as much as possible stepsize limitations. As an example, the method is applied to laminar boundary layer flow over an aircraft wing B J

A79-38943 Experimental data on the dynamic properties of several propeller vanes W A A Monna and A G M Driedonks (Koninklijk Nederlands Meteorologisch Instituut, De Bilt, Netherlands) Journal of Applied Meteorology, vol 18, May 1979, p 699-702 8 refs

The dynamic properties of three types of commercially available propeller vanes were investigated in a wind tunnel. The same was done for the cup anemometer and wind vane as used on the 200-m mast at Cabauw, the Netherlands, as well as for the trivane, used for three-dimensional turbulence measurements. For these instruments the distance constant, damping ratio and damped wavelength were determined as well as the propeller response to a constant air speed as a function of the yaw angle. The results show differences from the manufacterer's specifications. Compared with the other instruments, the trivane appeared to be about twice as fast in response to variations of the wind vector Among the other instruments there were no large differences (Author)

A79-38951 # Damage-tolerant fan blade design L Cernoch and H Kaehler (Avco Corp, Avco Lycoming Stratford Div, Stratford, Conn) AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev, June 18-20, 1979, AIAA Paper 79-1119 11 p 11 refs

A method of predicting the extent of local damage to fan blades resulting from bird ingestion was evolved and used in the development of the ALF 502 turbofan engine Projectile and target parameters were related to the impact conditions producing damage to fan blades, acceptable damage levels were determined by full-scale engine ingestion tests to ensure survivability in a damaged state Engine survivability under different ingestion conditions or with different blade designs was then predicted by application of the damage criterion (Kaehler, 1977) CKD

A79-38952 # Propulsion system sensitivities for a strategic aircraft R M Tyson (Rockwell International Corp., Los Angeles, Calif.) AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev., June 18 20, 1979, AIAA Paper 79 1121 6 p

A study was conducted to identify advanced engine technologies which would have high payoffs for new strategic aircraft Technology candidates were assessed and their performance advantages identified using propulsion system performance sensitivities to component changes and vehicle takeoff gross weight sensitivities to propulsion system performance and weight changes. The propulsion technolo gies with the highest potential for reducing strategic aircraft weight are those which allow reduced turbine cooling flow and those which increase takeoff specific thrust. (Author)

A79-38953 # The multiple application core engine - Sizing and usage criteria E A Lehmann (United Technologies Corp., Pratt and Whitney Aircraft Group, West Palm Beach, Fla.) AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev., June 18-20, 1979, AIAA Paper 79-1123 9 p

Sizing and usage criteria for an advanced technology engine core (high pressure rotor) for multiple application in a variety of aircraft types are discussed. The multiple application core engine (MACE) considered consists of a high pressure compressor, combustor, and high pressure turbine designed for the composite fighter/bomber duty cycle. Data packages for a family of six study engines derived from a common core having a base corrected compressor exit flow of about 5.6 lb/sec, scalable to 150%, were compared with optimum engine parameters for several advanced airframe types currently under study to determine what applications could be grouped with a single core size and what penalties in take-off gross weight or other mission parameters are necessary to accommodate core commonality Take-off gross weight appeared to be relatively insensitive to core size over a wide size range if the bypass ratio was varied to maintain the thrust requirement CKD

A79-38961 * # Evaluation of methods for prediction of propulsion system drag G D Kuhn, O J McMillan, S C Perkins, Jr (Nielsen Engineering and Research, Inc, Mountain View, Calif), and E W Perkins AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev, June 18-20, 1979, AIAA Paper 79-1148 13 p 40 refs Contract No NAS2 9513

The results of a study directed toward compilation of a theoretical and experimental data base covering inlet/airframe and nozzle/afterbody integration are described, with the major emphasis on the evaluation of the adequacy for preliminary design purposes of the data base for afterbody/propulsion system interference effects Prediction methods that exist for afterbody/airframe interference effects are evaluated with respect to the requirements of breadth, ease of application and accuracy that are important for preliminary design (Author)

A79-38962 * # The selection of materials technologies for full-scale development G A Aronstamm (United Technologies Corp, Pratt and Whitney Aircraft Group, East Hartford, Conn) AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev, June 18-20, 1979, AIAA Paper 79-1152 8 p NASA-sponsored research

Candidate material technologies offering the largest application payoff for the least development costs and the least risk should be selected for full-scale development funding A cost/benefit methodology is developed to rate candidate material and process opportunities for future aircraft engine applications A development cost estimate and risk analysis is compared with the economic benefit to establish a ranking of the candidate advanced technologies Also included are examples of this methodology as applied to high-strength HIP turbine disks, advanced oxide dispersion strengthened burner liners, and ceramic first-stage high-pressure turbine vanes S D

A79-38963 # Cost benefits from improved hot section life prediction technology A J Dennis and T A Cruse (United Technologies Corp., Pratt and Whitney Aircraft Group, East Hart ford, Conn.) AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev., June 18-20, 1979, AIAA Paper 79 1154.9 p

Aircraft operating costs can be significantly reduced by increasing the life of engine hot section parts, the hot section consisting of the combustor and turbine. Improvements in hot section technology are essential to meet the combined need for higher performance and greater durability. The paper deals with improved analytical methods to predict hot section component lives more accurately, thus ensuring reduced aircraft operating costs. Hot section component life prediction uses nonlinear stress strain analysis which requires improved time dependent plasticity material models. The improved creep/fatigue life exhaustion model should be sensitive to actual mission usage. Verification and demonstration of these methods aim at establishing confidence for application to hardware design Attention is given to structures technology for improved combustor liner creep/fatigue life.

A79-38964 * # General aviation turbine engine /GATE/ concepts E J Lays and D L Murray (Williams Research Corp., Walled Lake, Mich) AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev, June 18-20, 1979, AIAA Paper 79-1157 14 p NASA sponsored research

The paper deals with only a portion of the work done by Williams Research Corporation for NASA. It provides a look at possible new-generation powerplants that offer the potential for remarkable airplane performance gains with attendant safety, utility, productivity and life cycle cost benefits. Attention is given to a turboprop engine concept and applications. A turbofan engine having core components in common with the turboprop is also discussed and an airplane application shown. Some of the more important findings are presented.

A79-38965 # A novel correlation of centrifugal compressor performance for off-design prediction D P Kenny (Pratt and Whitney Aircraft of Canada, Ltd, Longueuil, Quebec, Canada) AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev, June 18-20, 1979, AIAA Paper 79-1159 7 p

A method is proposed for generalizing the performance of centrifugal compressor impellers and diffusers with two simple correlations for each element. These are based upon throat blockage as a function of leading edge incidence and static pressure effective ness (measured from the throat) as a function of throat blockage Such correlations have been known for some time to provide unique relationships for diffusers. It has now been found that this is also true for impellers. These four generalized correlations then provide a simple means of predicting the off-design performance of centrifugal compressor stages. This is particularly applicable in defining the effect of changes in diffuser throat area or impeller diffusion and throat area. The method even lends itself to optimizing the overall geometry of a given centrifugal stage. (Author) A79-38966 # Turbo-fan design for general aviation - The evolution of the RB 401 G M Lewis (Rolls-Royce, Ltd, Aero Div, Bristol, England) AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev, June 18-20, 1979, AIAA Paper 79-1160 11 p

The paper discusses the engineering and design aspects of the evolution of the business jet aircraft gas turbine engine RB 401 as a candidate engine for the general aviation market. The discussion covers market requirement, cycle choice, technology base and engine configuration, initial project design, demonstrator engine test results, basis for redesign and some design features of RB 401-07 regine, RB 401-07 test results, and application of the RB 401-07 as a suitable candidate powerplant in the growing field of business jet aviation

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A79-38967 # Evaluation of an ejector-powered engine simulator at transonic Mach numbers C E Robinson, G D Smith, and R J Matz (ARO, Inc, Arnold Air Force Station, Tenn) AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev, June 18-20, 1979, AIAA Paper 79-1165 7 p

An experimental program was conducted in the AEDC Propulsion Wind Tunnel (16T) to evaluate an air-driven ejector for use as an airbreathing engine simulator. The simulator was installed in the right nacelle of a 0.06-scale B-1 model. The data obtained during this investigation are compared with data obtained using conventional testing techniques and with limited flight data. The comparisons demonstrate that the concept of using an ejector-powered engine simulator is valid. More extensive studies to document the capability of the simulator throughout the performance envelope of a typical aircraft should be conducted. (Author)

A79-38968 # A parametric study of support system interference effects on nozzle/afterbody throttle dependent drag in wind tunnel testing C S Finnerty (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio) and E A Price, Jr (ARO, Inc, Arnold Air Force Station, Tenn) AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev, June 18-20, 1979, AIAA Paper 79-1168 14 p 10 refs

A series of wind tunnel tests were conducted in the Arnold Engineering Development Center 16 foot transonic wind tunnel These test results utilized an 11% F 16 nozzle/afterbody model During the test, Mach number, Reynolds number, angle-of-attack, nozzle pressure ratio, and horizontal tail deflection were varied as well as support system geometry. The paper presents the support system interference effects resulting from the variations in the strut, wing-tip, and sting support systems. Support system variations include wing-tip support blade position, support boom diameter, length, spacing, and sting taper location. In general, the results presented indicate that the sting support with annular jet is the most interference free support system as compared to both the wing tip and strut support systems. (Author)

A79-38969 * # Effect of shocks on film cooling of a full scale turbojet exhaust nozzle having an external expansion surface D M Straight (NASA, Lewis Research Center, Cleveland, Ohio) AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev, June 18 20, 1979, AIAA Paper 79-1170 13 p 17 refs

Cooling is one of the critical technologies for efficient design of exhaust nozzles, especially for the developing technology of non axisymmetric (2D) nozzles for future aircraft applications. Several promising 2D nozzle designs have external expansion surfaces which need to be cooled. Engine data are scarce, however, on nozzle cooling effectiveness in the supersonic flow environment (with shocks) that exists along external expansion surfaces. This paper will present experimental film cooling data obtained during exploratory testing with an axisymmetric plug nozzle having external expansion and installed on an afterburning turbojet engine in an altitude test facility. The data obtained shows that the shocks and local hot gas stream conditions have a marked effect on film cooling effectiveness An existing film cooling correlation is adequate at some operating conditions but inadequate at other conditions such as in separated flow regions resulting from shock boundary-layer interactions

(Author)

A79-38974 * # Investigation of a laser Doppler velocimeter system to measure the flow field of a large scale V/STOL aircraft in ground effect A D Zalay, M R Brashears, A J Jordan, K R Shrider, and C D Vought (Lockheed Missiles and Space Co, Inc, Huntsville, Ala) AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev, June 18-20, 1979, AIAA Paper 79-1184 8 p 10 refs NASA-sponsored research

An experimental research program for measuring the flow field around a 70 percent scale V/STOL aircraft model in ground effect is described. The velocity measurements were conducted with a ground-based laser Doppler velocimeter at an outdoor test pad. The remote sensing instrumentation, experimental tests, and results of the velocity surveys are discussed. The distribution of vertical velocity in the fan jet and fountain, the radial velocity in the wall jet and the horizontal velocity along the aircraft underside are presented for different engine rpms and aircraft heights above ground. The study shows that it is feasible to use a mobile laser Doppler velocimeter to measure the flow field generated by a large scale V/STOL aircraft operating in ground effect. (Author)

A79-38975 # Infrared signature measurement techniques and simulation methods for aircraft survivability G E Varney (General Electric Co, Aircraft Engine Group, Cincinnati, Ohio) AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev, June 18-20, 1979, AIAA Paper 79-1186 10 p

This paper discusses the methodology of relating infrared signatures of aircraft weapon systems to their survivability in a combat situation. Techniques to measure the infrared radiation signatures for gas turbine engines are presented for outdoor static test and wind tunnel model testing. Infrared measurement instrumen tation and data analysis methods are given that characterize the band total, spectral and spatial distribution. Techniques for estimating the inflight aircraft signatures are also presented. Use of these in-flight signatures in air combat simulator for estimating aircraft combat survivability are then discussed.

A79-38976 # Damage tolerant design - An approach to reducing the life cycle cost of gas turbine engine disks C E Meece and C E Spaeth (United Technologies Corp, Pratt and Whitney Aircraft Group, West Palm Beach, Fla) AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev, June 18-20, 1979, AIAA Paper 79-1189 6 p USAF-supported research

The rupture of a disk in a gas turbine engine, although it is a rare occurrence, invariably requires engine shutdown and frequently results in extensive damage to the engine. For this reason disks are designed to be the most reliable parts in the rotating structure. This emphasis on reliability coupled with typical variations in material properties, engine operating characteristics, and manufacturing toler ances has resulted in the retirement of most disks from service before their total useful lives are depleted. Current disk lives are established so that at the end of the calculated lifetime one disk in one thousand will develop a very small crack at the limiting location. The life prediction method employs classical damage summation techniques to deal with mission complexities and identifies for the disk population a life at which disks must be removed to ensure safe operation. (Author)

A79-38977 * # The strainrange partitioning behavior of an advanced gas turbine disk alloy, AF2-1DA G R Halford and A J Nachtigall (NASA, Lewis Research Center, Cleveland, Ohio) AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev, June 18-20, 1979, AIAA Paper 79-1192 10 p 14 refs

The low-cycle, creep-fatigue characteristics of the advanced gas turbine disk alloy, AF2-1DA have been determined at 1400 F and are presented in terms of the method of strainrange partitioning (SRP) The mean stresses which develop in the PC (tensile Plasticity reversed by compressive Creep) and CP (tensile Creep reversed by compressive Plasticity) type SRP cycles at the lowest inelastic strainrange were observed to influence the cyclic lives to a greater extent than the creep effects and hence interfered with a conventional interpretation of the results by SRP A procedure is proposed for dealing with the mean stress effects on life which is compatible with SRP (Author)

A79-38978 # Aircraft engine design using experimental stress analysis techniques B L Koff (General Electric Co, Aircraft Engine Group, Cincinnati, Ohio) (NATO, AGARD, Symposium on Stresses, Vibrations, Structural Integration and Engine Integrity, Cleveland, Ohio, Oct 23-27 1978) AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev, June 18-20, 1979, AIAA Paper 79-1193 12 p

Experimental analyses are used more extensively in aircraft engine design today than ever before, primarily because of the demands for extended component life. The paper is a perspective of prominent experimental techniques used in current aircraft engine stress analyses. It addresses the verification of temperature, stress, steady state and dynamic deformation, pressure, and fatigue strength by employing advancements in instrumentation, including highenergy X-rays and high durability strain gages, computers and software to reduce vast amounts of data, increased photoelastic capabilities, and advancements for reproducing loading and environmental conditions in laboratory component tests. These experimental techniques and disciplines have continued to advance in both capability and importance, and the state of the art in structural engineering would be significantly reduced without them. (Author)

A79-38979 # Development of a gas turbine combustor dilution zone design analysis A S Novick, J R Arvin, and R E Quinn (General Motors Corp., Detroit Diesel Allison Div, Indianapolis, Ind) AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev, June 18-20, 1979, AIAA Paper 79-1194 11 p 13 refs

Recent advancements in developing an analytical technique applicable to gas turbine combustion design problems are presented A complex 3-D mathematical model computes the trajectories of a system of dilution jets within a combustor dilution zone and transition section. The jet velocity centerline trajectories are obtained as the solution of an approximate differential equation Boundary and initial conditions are factored into the solution in a natural manner, consequently, the interactions of jets with each other and confining walls are included. The analytical simulation and solution technique are detailed due to uniqueness of modeling the multi-jet trajectories and interactions in a confined environment Comparisons of the analytical predictions with available experimental data are shown. Results illustrating practical combustor flow problems show that significant progress has been made toward the realization of a useful design capability (Author)

A79-38980 * # Analysis of the impact of the use of broad specification fuels on combustors for commercial aircraft gas turbine engines E J Szetela (United Technologies Research Center, East Hartford, Conn), R P Lehmann (United Technologies Corp, Pratt and Whitney Aircraft Group, East Hartford, Conn), and A L Smith (NASA, Lewis Research Center, Cleveland, Ohio) AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev, June 18-20, 1979, AIAA Paper 79-1195 11 p 16 refs

An analytical study was conducted to assess the impact of the use of broad specification fuels with reduced hydrogen content on the design, performance, durability, emissions and operational characteristics of combustors for commercial aircraft gas turbine engines The study was directed at defining necessary design revisions to combustors designed for use of Jet A when such are operated on ERBS (Experimental Referee Broad Specification Fuel) which has a nominal hydrogen content of 128 percent as opposed to 137 percent in current Jet A. The results indicate that improvements in combustor liner cooling, and/or materials, and methods of fuel atomization will be required if the hydrogen content of aircraft gas turbine fuel is decreased (Author).

A79-38981 * # Test verification of a turbofan partial swirl afterburner K J Hanloser (United Technologies Corp., Pratt and Whitney Aircraft Group, West Palm Beach, Fla) and R Cullom (NASA, Lewis Research Center, Cleveland, Ohio) AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev, June 18-20, 1979, AIAA Paper 79-1199 6 p 6 refs

Flamespreading velocities exceeding conventional turbulent flamespreading values were demonstrated in a strong centrifugal flow field. This centrifugal flow field flamespreading concept was integrated into an F100 turbofan engine afterburner by introducing swirling airflow into the afterburner. Successful tests were conducted on F100 Engine P072 at sea level and at altitude conditions in a test chamber. This paper summarizes the design approach, engine design verification tests and performance data. Engine tests showed the swirl afterburner increased fuel-air capability improving combustion stability at adverse conditions for combustion in the engine flight envelope. No engine performance or durability degradation was observed. (Author)

A79-38982 # A European view on gas turbine engine monitoring of present and future civil aircraft S G Danielsson (Scandinavian Airlines System, Stockholm, Sweden) and G Dienger (Lufthansa, Hamburg, West Germany) AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev, June 18-20, 1979, AIAA Paper 79-1200 9 p 7 refs

The engine condition monitoring (ECM) approaches currently in use for wide bodied aircraft by SAS and Lufthansa are compared Technical requirements for expanded ECM systems planned for introduction with the AIRBUS A310 (Lufthansa) and the AIRBUS A300B4 (SAS) are outlined. The new systems will incorporate an engine module condition monitoring system which will allow assessment of actual module performance deterioration and degree of restoration required Expanded engine instrumentation and AIDS type data acquisition and recording equipment on board the aircraft will be required. The software for ground-based data processing will feature engine module performance analysis, trending logic for engine and module parameters, combination of trend data with other ECM relevant information (maintenance actions, crew reports, engine history including test cell data), automatic flagging of suspicious units, and real time processing CKD

A79-38983 # Fault-tolerant, high reliability electronic engine control system V G Mosca, C Rabinowitz, and H Kreamer (United Technologies Corp, Electronic Systems Dept, Windsor Locks, Conn) AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev, June 18-20, 1979, AIAA Paper 79-1202 9 p 9 refs Contract No F33615-77 C-2055

The paper introduces and applies the principles of redundancy management techniques to the design of highly reliable fault-tolerant electronic engine controls. The evaluation starts with a baseline electronic final control system design. The baseline system is then altered to evaluate the benefit of successive applications of redundancy management techniques such as selective triple redundancy, majority voting, fault coverage, built-in test, and reliability mathematical modeling methods. These trends and methods used in fly-by-wire system reliability are evaluated for applicability to fuel controls. An optimum mix of MTBP, safety, and hardware complexity can be achieved through application of selected dual and triple redundancy at the functional modular level with a high-degree of software cross-strapping. S D A79-38984 * # Application of digital controls on the quiet clean short haul experimental engines A A Saunders, Jr (General Electric Co, Aircraft Engine Group, Cincinnati, Ohio) and A C Hoffman (NASA, Lewis Research Center, Cleveland, Ohio) AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev, June 18-20, 1979, AIAA Paper 79-1203 8 p 6 refs Contract No NAS3-18021

The digital control systems for the Under-the-Wing (UTW) and Over the-Wing (OTW) engines developed on the NASA/General Electric Quiet Clean Shorthaul Experimental Engine (QCSEE) program are described. The system to control engine variables includes three major functional parts system sensors, digital control and system actuators. One of the primary control system functions is to prevent the engine from exceeding speed or temperature limits The UTW control system also provides fault detection and condition monitoring The control system requirements for the OTW engine are essentially the same as the UTW engine, however the inlet Mach number control requirement is eliminated, and failure indication and corrective action and full authority digital control are added. The digital controls scheduled the engine variables and maintained engine operation within all physical limits throughout the test program of approximately 200 hours of operation and provided stable and accurate control of both engines VΤ

A79-38991 # The application of rapid solidification rate superalloys to radial wafer turbine blades D B George, B T Brown, and A R Cox (United Technologies Corp., Pratt and Whitney Aircraft Group, West Palm Beach, Fla) AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev., June 18-20, 1979, AIAA Paper 79-1226 9 p 6 refs Contract No N00019-76 C-0552 ARPA Order 3152

The implementation of rapid-solidification rate (RSR) powder process alloy technology is expected to provide significant improvements in future advanced gas turbine engines. The paper describes separately the technologies of RSR powder process materials and wafer cooling. The synergistic combination of these two technologies is then reviewed in conjunction with a development plan devised to implement this technology in engines of the future. It is shown that the high-temperature capabilities of radial wafer blades fabricated from the RSR powder process material makes them well suited to an advanced engine design.

A79-38992 # Partially variable area turbine nozzle R H Andersen and R C Haubert (General Electric Co, Evendale, Ohio) AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev, June 18-20, 1979, AIAA Paper 79-1227 9 p Research supported by the General Electric Co, Contracts No F33657-76-C-0213, No F33657-72 C-0206

The concept of the partially variable turbine nozzle is described, with special emphasis on design evaluation. The evaluation program is discussed relative to air turbine rig tests, turbine blade stress effects and Fourier analysis, and engine testing. For structural reasons, the partially variable turbine nozzle is a segmented design where three-vane sectors containing one variable vane each are used together with fixed two-vane sectors which fill out the nozzle. It is shown that the partially variable turbine nozzle concept exhibits superior performance to the fully variable design because of reduced end-wall leakage.

A79-38993 # Engine demonstration test of a cooled laminated axial turbine R W Vershure, Jr (AiResearch Manufacturing Company of Arizona, Phoenix, Ariz) AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev, June 18-20, 1979, AIAA Paper 79-1229 8 p Contract No F33615-76-C 2176

The first successful engine demonstration test of a cooled laminated axial turbine rotor is described. A small integral turbine rotor was constructed with a unique fabrication method - the laminate process - which uses precision photoetched laminates bonded together to form a complete rotor. The results of the rotor component tests which led up to the engine test are discussed These component tests included material property data, NDE, overspeed, airflow, and blade vibration testing A 20 hour engine test was then conducted which demonstrated the mechanical integrity of a laminated turbine rotor. Using an advanced optical pyrometer system, repeatable blade-to blade metal temperatures were recorded A close correlation was achieved between the measured blade cooling effectiveness and the predicted cooling effectiveness, 0.52 and 0.53 respectively. This demonstration test showed that a very high heat-transfer performance is possible in small turbine engines using the laminate process. (Author)

A79-38994 # The monorotor gas turbine C Rodgers AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev, June 18-20, 1979, AIAA Paper 79-1230 10 p 6 refs

A monorotor gas turbine demonstrated both performance and endurance in a modified auxiliary power unit. This unit featured a single-stage radial compressor and turbine integrated back to-back in a single casting. Continuing development of the monorotor concept shows that, in addition to offering moderately high turbine inlet temperature capability without sophisticated internal air cooling, both manufacturing and life cycle costs can be significantly decreased This is a consequence of the extremely simple engine powerhead configuration which comprises the monorotor and integral shaft forming a single-mass, highly stable rotor assembly, single-piece compressor diffuser, turbine nozzle monostator assembly, inlet housing, and axial reverse flow combustor A second candidate aircraft application of the monorotor gas turbine concept appears to be in small, expendable, low cost, remote, pilotless vehicles. This paper describes the development of a small monorotor gas turbine and examines its potential for increased cost savings both in manufacturing and operation (Author)

A79-38995 # The role of three-dimensional flow analysis in the design of turbomachinery K D Mach (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio) AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev, June 18-20, 1979, AIAA Paper 79-1231 5 p 12 refs

The flow fields in turbomachinery, particularly in the turbines of gas turbine engines, are known to be the most complex. The paper examines the current status or three-dimensional flow analysis as applied to turbomachinery. Some typical results of a pertinent algorithm are presented. The computational environment is much less restrictive than in the past, and computer results are almost always quicker to obtain than test results. The probable course of future developments and their impact on the design of turbomachinery are discussed. Combined numerical and experimental investigations of flow fields are recommended, with threedimensional flow analysis to become an everyday design tool and a partial substitute for testing.

A79-38996 # Factors influencing nacelle design on the 747 M I K MacKinnon and B K Mehta (Boeing Commercial Airplane Co, Seattle, Wash) AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev, June 18-20, 1979, AIAA Paper 79-1236 9 p 7 refs

The paper briefly reviews the factors that have influenced nacelle design on the 747 airplane Currently available power plant installations for General Electric, Pratt and Whitney and Rolls-Royce engines are examined and compared Performance improvements for these existing nacelle types are discussed. The possibilities for future nacelle developments on the 747 are outlined, including the use of power plant packages being developed for new airplanes, and advanced nacelle concepts such as long duct forced mixer nozzles and structurally integrated nacelles.

A79-38997 # Ignition of liquid fuel jets in a supersonic air stream J A Schetz, S C Cannon (Virginia Polytechnic Institute and State University, Blacksburg, Va), and S Baranovsky AIAA,

SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev , June 18-20, 1979, AIAA Paper 79-1238 11 p 15 refs

Water, kerosene and carbon disulfide were injected both transverse (90 deg) and oblique-upstream (45 deg) with respect to a hot supersonic (M = 1.65) vitiated air flow at various stagnation temperatures and injection pressures (and hence flow rates and momentum ratios) Attention is given to the behavior of the liquid fuel layer that had previously been found to form on the surface near the injector Results of wall and in-stream temperature measurements and photographic records in both the visible and infrared wavelength spectra are discussed. For transverse injection at air temperatures up to 2260 F, little evidence of combustion is found for either kerosene or CS2, and the liquid layer is not expected to change radically in character with change in temperature. For the oblique-stream injection, ignition occurred for CS2 at stagnation temperatures of D

A79-39010 # Project Sunrise R J Boucher (Astro Flight, Inc, Venice, Calif) AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev, June 18-20, 1979, AIAA Paper 79-1264 6 p ARPA USAF sponsored research

The solar powered aircraft Sunrise is described, with special emphasis on the flight demonstration program, design features of the Sunrise air vehicle, aerodynamic configuration, airframe, solar power subsystem, propulsion subsystem, and flight envelope Calculated and measured performance are given The Sunrise Program demonstrated the feasibility of solar-powered flight Ways of harnessing the unique behavior and attributes of these solar-powered vehicles are now being explored SD

A79-39011 # Electric propulsion for high performance light aircraft A D Galbraith (Continental Group, Inc., Palo Alto, Calif) AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev., June 18-20, 1979, AIAA Paper 79-1265 10 p

An actual design example is presented for application to a representative light aircraft on the basis that its performance must match that of the gasoline engine drive train which is replaced Attention is given to concept description and analysis, derivation of requirements and design layout, lithium-aqueous electrolyte fuel cell. lithium recycling, metallic lithium as a fuel, propulsion motor and associated controls, and growth potential of the technology. It is shown that a representative high-performance single engine airplane can be powered by an electric drive train which produces power, duration, and weight equal or comparable to a gasoline powerplant, utilizing current state-of the-art devices. The resulting performance of the electric powered aircraft is comparable to turboprop aircraft and is independent of atmospheric air density, with the consequent advantages of high-altitude operation, speed, range, and weather avoidance SD

A79-39012 # Small hole drilling and inspection with pulsed laser systems A U Joilis (General Electric Co, Aircraft Engine Business Group, Cincinnati, Ohio) AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev, June 18-20, 1979, AIAA Paper 79-1268 7 p

Advances in laser technology are described which have led to the development of methods and equipment for drilling and inspecting small holes in air-cooled aircraft engine structures. These structures are made from high temperature alloys and incorporate cooling circuits which are comprised of small holes with large depth-todiameter ratios. The drill technique discussed in this paper utilizes solid state lasers while a scanning Helium/Neon laser beam is employed to inspect the holes between drill cycles. The laser devices are combined with numerically controlled positioning tables and other auxiliary equipment to form automated laser drill and inspection machines for production application. Process capabilities and equipment construction are reviewed and examples of drill operation are given (Author). A79-39013 # Advanced forging process for gas turbine engine fan blades C R Cook (TRW, Inc, Cleveland, Ohio) A/AA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev, June 18-20, 1979, A/AA Paper 79-1269 5 p 5 refs Contract No F33615-77-C-5002

Titanium 8AI-1Mo-1V alloy fan blades for the F100 engine have been precision forged using the isothermal forging process Forgings have been produced with dies operating at 1750 deg plus or minus 20 F The IN100 alloy forging dies accomplished 595 pressing operations without damage to the airfoil surfaces. Form and thickness control of the blades was maintained well below tolerances required Metallurgical characteristics of the forgings were entirely acceptable Reduced material requirements and less machining for finishing result in lower manufacturing costs Blades are being evaluated for engine qualification. (Author)

A79-39017 # Methodology for prediction of V/STOL propulsion induced forces in ground effect W H Foley (General Dynamics Corp., Aerospace Technology Dept., Fort Worth, Tex.) AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev., June 18-20, 1979, AIAA Paper 79-1281 8 p 15 refs Navy-sponsored research

The paper presents the development of an empirical method to calculate the pure suckdown component of the forces acting on the planform of a hovering V/STOL aircraft. The point of departure for the predictive methodology is the work of Karemaa et al (1973, 1978) wherein the net-induced force upon a planform is divided into three parts. While examination of the diagrams for the effect of eddy size on suckdown and the effect of nozzle pressure ratio on suckdown indicates that turbulence can cause changes in suckdown on the order of 20%, it must be recognized that the net force also includes fountain buoyancy, which can be of the same order as suckdown but of opposite sign. Thus, net force is determined as the difference between two relatively large numbers. In this context, a second-order change in either of these numbers can result in a first-order change in aircraft performance. It remains to work out a methodology for the prediction of fountain buoyancy and of the interference between the fountain and suckdown SD

A79-39018 # The impact of operational requirements on V/STOL propulsion concept selection W R Boruff and A J Roch, Jr (Vought Corp, Dallas, Tex) AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev, June 18 20, 1979, AIAA Paper 79-1283 9 p 10 refs

In recent years a wide variety of V/STOL propulsion concepts have been advanced as ways to perform vertical takeoff and landing This paper presents results of a recent Vought study that examines four supersonic V/STOL propulsion concepts. Aircraft sized to common design criteria and missions are compared for three lift/cruise concepts and one lift plus lift/cruise concept Both fighter escort and deck launched intercept mission requirements are considered Sizing constraints include acceleration capability, sustained load factor, ceiling, maximum speed, specific excess power, vertical takeoff thrust to weight, and engine-out thrust-to-weight Results emphasize the importance of well founded operational requirements An engine-out vertical landing requirement is shown to be an important design driver. Each propulsion system concept is sized by a different combination of mission and performance constraints, and each concept demonstrates a different sensitivity to variations in these requirements (Author)

A79-39019 # V/STOL aircraft configuration effects on exhaust gas ingestion. E D Spong, J H Kamman, C L Hall, and E T Seiffertt (McDonnell Aircraft Co, St Louis, Mo) AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev, June 18-20, 1979, AIAA Paper 79-1284 8 p 7 refs

A test program was conducted to investigate thermal flowfield properties and inlet system ingestion characteristics for three- and four-nozzle V/STOL aircraft configurations, utilizing a planform model The results indicate strong configuration effects on ingestion and the necessity for careful nozzle simulation. Potential methods of reducing ingestion are identified, which can be applied either in the design stage through optimum configuration arrangement or subsequent to configuration selection through shielding devices. It is further demonstrated that thermal flowfield data acquired in the free jet, fountain and stagnation upwash regions can be used to understand the ingestion characteristics. (Author)

A79-39020 * # Static test of a large scale swivel nozzle thrust deflector J F Federspiel (Rockwell International Corp , Columbus, Ohio) AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev , June 18-20, 1979, AIAA Paper 79-1285 9 p 6 refs NASA supported research

Experimental results from a swivel nozzle thrust deflector test program are presented. The deflector was installed behind a 36-inch fan with a tip turbine hot gas drive. The maximum nozzle pressure ratio was 1.2 Nozzle thrust and flow coefficients are presented for a range of vectoring angles. The results are also compared to small scale cold flow test results. The comparison suggests a need for accurate simulation of nozzle entry pressure and temperature profiles on model tests. (Author)

A79-39027 # Evaluation of ground-launch firings for the improved 2 75-inch rocket D M Bergbauer, J H Ferguson (US Naval Ordnance Station, Indian Head, Md), R W Bergman (US Army, Missile Research and Development Command, Redstone Arsenal, Ala), and R Bentley (Veda, Inc, Arlington, Va) A/AA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev, June 18-20, 1979, AIAA Paper 79-1297 9 p

An improved 2.75-inch rocket, the Mk 66 Mod O, was developed by the Navy in the early 1970s. Test results are presented for ground-launch firings of various modified designs. Because of the variety and large amount of test data, summary information is presented. For illustration, some specific data that are representative of rocket performance are included impact dispersion, spin rates, and burnout velocities. Results indicate improved dispersion with increased roll rate at launcher separation. Future plans for continued evaluation are briefly outlined.

A79-39031 * # Combined pressure and temperature distortion effects on internal flow of a turbofan engine W M Braithwaite and R H Soeder (NASA, Lewis Research Center, Cleveland, Ohio) AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev, June 18-20, 1979, AIAA Paper 79-1309 11 p 13 refs

The flow characteristics obtained experimentally for the compression of a 2-spool TF30-P-3 turbofan engine operating with 180 grad combined pressure and temperature distortion in the inlet flow are presented. The analytical model (Mazzawy and Banks, 1976), 'tuned' during Lewis testing, was used for pretest predictions of the effects that these distortions would have on the engine flow characteristics and the limiting distortion values. The effect of inlet flow distortion on the performance of the engine is discussed, including (1) the flow between a screen mounted in the inlet duct and the inlet guide vanes, (2) the flow through the compression system, and (3) the effects of the combined distortion and its orientation on the compressor stability limits. It is concluded that the model used in this program was capable of predicting the effects of total pressure, total temperature and combined total pressure-total temperature distortions in terms of flow profiles, inlet flow angles and attenuation of the distortions through the compressor system. It was also capable of predicting the trends of the limiting values experienced with various orientations of the combined distortions

A79-39032 # What small turbine engine does the small helicopter need, or The road to hell is paved with good intentions E E Cohen (Hughes Helicopters, Culver City, Calif) AIAA, SAE, and

VΤ

ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev , June 18-20, 1979, AIAA Paper 79-1314 $7~\rm{p}$

It is argued that today's small turbine engines do not meet the requirements of small helicopters as well as does the turbocharged piston engine. It is suggested that in developing advanced turbine engines for small helicopters, engine weight (unless it reduces the weight of the fuel system plus fuel) should be subordinate to other design considerations such as reduced fuel consumption, improved altitude performance, improved environmental acceptability, and increased engine reliability and maintainability. The specific fuel requirements of small turbine and piston engines are compared, growth trends in demand for small rotocraft are presented.

A79-39033 # Effect of maintenance plan and engine durability on helicopter propulsion system ownership cost C E Curry and A C Wei (General Motors Corp., Detroit Diesel Allison Div, Indianapolis, Ind) AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev, June 18-20, 1979, AIAA Paper 79-1317 6 p

Relative cost of ownership trade-offs between modular and nonmodular engine maintenance plans were evaluated. The relative gain/loss of operational availability resulting from scheduled and unscheduled engine removals for various levels of engine maximum operating time were analyzed over a range of premature removal rates from 0.2 to 1.0 removals per thousand engine operating hours Conclusions were drawn suggesting that helicopter operators could select an operating parameter set that would tend to minimize their engine-ownership costs, which were shown to be significant cost elements in their total helicopter ownership cost (Author)

A79-39034 * # Lean, premixed, prevaporized combustion for aircraft gas turbine engines E J Mularz (NASA, Lewis Research Center, US Army, Propulsion Laboratory, Cleveland, Ohio) AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev, June 18-20, 1979, AIAA Paper 79-1318 13 p 24 refs

The application of lean, premixed, prevaporized combustion to aircraft gas turbine engine systems can result in benefits in terms of superior combustion performance, improved combustor and turbine durability, and environmentally acceptable pollutant emissions Lean, premixed, prevaporized combustion is particularly attractive for reducing the oxides of nitrogen emissions during high altitude cruise. The NASA Stratospheric Cruise Emission Reduction Program will evolve and demonstrate lean, premixed, prevaporized combustion technology for aircraft engines. This multiphased program is described. In addition, the various elements of the Fundamental Studies Phase of the program are reviewed, and results to date of many of these studies are summarized. (Author)

A79-39035 * # Lean stability augmentation for premixing, prevaporizing combustors J B McVey and J B Kennedy (United Technologies Research Center, East Hartford, Conn) AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev , June 18-20, 1979, AIAA Paper 79-1319 12 p 5 refs Contract No NAS3-20804

An experimental program was conducted to investigate techniques for improving the lean combustion limits of premixing, prevaporizing combustors applicable to gas turbine engine main burners. Augmented flameholders employing recessed perforated plates, catalyzed tube bundles, and configurations in which pilot fuel was injected into the wakes of V-gutters or perforated plates were designed and tested. Stable operation of the piloted designs was achieved at equivalence ratios as low as 0.25, NOx emissions of less than 1.0 g/kg at simulated turbine engine cruise conditions were obtained. A piloted perforated plate employing four percent pilot fuel flow produced the best performance while meeting severe NOX constraints. (Author)

A79-39037 * # The effect of fuel sprays on emissions from a gas turbine combustor J A Nicholls, C W Kauffman, D G Pelaccio, D R Glass, and J F Driscoll (Michigan, University, Ann

Arbor, Mich) AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev, June 18-20, 1979, AIAA Paper 79-1321 8 p 10 refs Grant No NsG-3148

A research gas turbine combustor which allows for independent control of drop size, fuel/air ratio, air inlet temperature, pressure, reference velocity, and residence time has been used to study the influence of fuel spray characteristics on primary zone emissions Local concentrations of oxides of nitrogen, carbon monoxide and unburned hydrocarbons at various locations in the flow, local gas temperature, gas velocity, and the turbulence intensity (measured with laser velocimetry) are obtained A comprehensive data analysis program to compute the local fuel/air ratio and the sum of the mole fractions of the species present confirms the validity of the emissions data Increasing drop size is correlated with an increase in unburned hydrocarbons, while increasing residence time is associated with sharp decreases in hydrocarbons and carbon monoxide and an increase in oxides of nitrogen. J M B

A79-39038 * # Emission characteristics of a premix combustor fueled with a simulated partial-oxidation product gas R M Clayton (California Institute of Technology, Jet Propulsion Laboratory, Control and Energy Dw, Pasadena, Calif) AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev, June 18-20, 1979, AIAA Paper 79-1322 8 p 5 refs Contract No NAS7-100

A two-stage gas turbine combustor concept employing a very fuel-rich partial oxidation stage is being explored for broadening the combustion margin between ultralow emissions and the lean stability limit Combustion and emission results are presented for a series of experiments where a simulated partial oxidation product gas was used in a premix combustor operated with inlet air state conditions typical of cruise power for high-performance aviation engines (12 atm and 850 F) Ultralow NOx, CO, and HC emissions and an extended lean burning limit were achieved simultaneously (Author)

A79-39047 # The application of the Prop-Fan concept in preliminary design of a very advanced technology light twin /VATLIT '85/ F M W A Grosveld (Kansas, University, Lawrence, Kan) AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev, June 18-20, 1979, AIAA Paper 79-1343 13 p 12 refs

Design analysis for propeller and nacelle have been accomplished for application in preliminary design of a very advanced light twin engine airplane, using the uninstalled efficiency as a criterion. The project engine is based on a prediction of the performance of a turbo-engine which could fit in the Prop-Fan concept. The computerized procedure is based on the thermodynamic relations of the gas turbine and optimized for operations at high subsonic Mach number and at high altitude. Results are presented which indicate significant improvement in installed propeller efficiency and specific fuel consumption, at performance comparable to that of a jet airplane (Author)

A79-39048 # A streamlined control system development process C H Borgmeyer (United Technologies Corp., Pratt and Whitney Aircraft Group, West Palm Beach, Fla.) AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev., June 18-20, 1979, AIAA Paper 79-1344 7 p

The software development, the physical facilities and the engineering technology required for an advanced logic capability with full authority electronic control system in high reliability and performance multimission aircraft are described. The need for increased use of simulations, the application of system identification methodology to update simulations, and techniques for fault analysis and logic verification are discussed. It was found that the basic control design/development process can be improved by using multi-variable control techniques as a control mode design tool to quantify variable interactions, by expanding existing control logic technology into adaptive systems, redundancy management, and fault accomodation, by upgrading the accuracy of existing simulations, developing an automated system identification procedures to review engine and rig data, and using a specific control development/ integration facility to test complete or partial systems in open or closed loop. This approach will enhance mission reliability since fault detection and fail operational procedures can be developed and engine life management modes designed and test verified for the expected variations in engine performance and design margin. A T

A79-39059 # Analysis of an unsteady aerodynamic force on a blade due to ununiform amplitude gusts K Ishihara (Kawasaki Heavy Industries, Ltd., Akashi, Japan) and M Funakawa (Okayama College of Science, Okayama, Japan) JSME Bulletin, vol. 22, Apr 1979, p. 529 536.7 refs

Lift fluctuations of a cambered blade with angle of attack under periodic gusts with nonuniform amplitude were studied by using vortex theory under the assumption that the gust amplitude on an airfoil varies linearly. It was clarified that the nonuniformity of gust amplitude has a strong effect on fluctuating lift for small reduced frequency but does not for large reduced frequency. (Author)

A79-39070 Installation for studying fatigue strength of materials in acoustic loading V A Kuz'menko, lu M Golovanev, and L E Matokhniuk (Akademiia Nauk Ukrainskoi SSR, Institut Problem Prochnosti, Kiev, Ukrainian SSR) (Problemy Prochnosti, Sept 1978, p. 103, 104) Strength of Materials, vol. 10, no. 9, May 1979, p. 1098, 1099 Translation

During flight, aircraft skins are subjected to intense acoustic fields from engine noise, breaks in the air flow, etc. A facility was constructed to study the fatigue strength of aircraft structural materials and to determine the fatigue crack propagation velocity under acoustic loading. The facility consists of a high intensity sound source, an air siren capable of generating both sinusoidal and broadband sound. Photographs of siren noise spectra at constant and wariable rotor speeds are presented.

A79-39071 Method of determining non-steady-state force characteristics and flywheel effect of turbine blades from the streamflow pattern A V Dunaev (Problemy Prochnosti, Sept 1978, p 105, 106) Strength of Materials, vol 10, no 9, May 1979, p 1100-1102 5 refs Translation

The paper describes the AD-3 facility, a closed water tunnel with a working-part cross section of 140 x 80 mm, a maximum flow speed of 10 m/sec, and a total tunnel capacity of 0.7 cu m. The facility has been developed for investigating load characteristics associated with unsteady flow past plane cascades of vibrating blades, taking into account inlet flow pulsations and flow viscosity (with and without flow separation). The facility permits simultaneous investigation of hydrodynamic damping and streamflow patterns in separated flow. B J

A79-39088 # Aeroelastic models for cryogenic wind tunnels A Gravelle (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France) (Symposium on Cryogenic Wind Tunnels, Southampton, England, Apr 3-5, 1979) ONERA, TP no 1979-39, 1979 6 p

The application of Mach and Froude similarity rules to cryogenic wind tunnel testing of aeroelastic models is examined. It is shown that when stagnation temperatures are low and can be varied over a wide range, it is possible to obtain reasonable values for static loads and Reynolds numbers with flutter models. The scaling of models of the Airbus A300B and the F1 fighter for testing in a S2 MA wind tunnel is discussed and compared with possible scalings of similar models for testing in a cryogenic facility. C K D

A79-39089 # Balance and sting design for cryogenic wind tunnels M Bazin and M Dubois (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France) (Symposium on Cryogenic Wind Tunnels, Southampton, England, Apr 3-5, 1979) ONERA, TP no 1979-40, 1979 9 p 15 refs The paper deals with the problem of allowing for thermodynamic effects in the design and construction of aerodynamic balances and supporting rods (stings) of models in cryogenic wind tunnels. The need for new solutions is demonstrated Particular attention is given to the development of metals and insulating materials capable of sustaining stresses and thermal gradients at wind tunnel temperatures between 100 and 300 K V P

A79-39090 # Method of assessment of the antistatic protection of aircraft J Taillet (ONERA, Châtillon-sous-Bagneux, Hautsde Seine, France) (Conference on Electrostatics, Oxford, England, Apr 17-20, 1979) ONERA, TP no 1979-41, 1979 16 p 9 refs Research sponsored by the Direction des Recherches, Etudes et Techniques and Avions Marcel-Dassault-Brequet Aviation

The solutions proposed by ONERA to meet the requirements of a safe antistatic protection of aircraft are outlined A procedure is presented for testing the vulnerability of a protected or unprotected aircraft to static charging, as well as for assessing the validity of the methods used for this protection. The performance of pertinent instruments is discussed. A practical application is treated in some detail. Careful application of the test procedure is expected to increase the reliability of navigation/communication subsystems in operational use.

A79-39092 # Contribution to the development of motor emission regulations (Contribution a la mise au point de la réglementation des émissions des moteurs) M Planko (Groupe Sectoriel Franco-Soviétique, Sous-Groupe Effets du Transport Aérien sur l'Environnement, Réunion, 2nd, Moscow, USSR, Apr 25-29, 1979 J ONERA, TP no 1979 43, 1979 52 p In French

Methods used by the International Civil Aviation Organization to develop emissions standards for aircraft engines are discussed Attention is given to the approach used to establish acceptable limits for gaseous pollutants (NOx, CO, HC) within the context of a commonly accessible level of technology and to the problem of verifying conformity of individual engines or of engine types. Two statistical hypotheses for certification tests are examined. The first requires that the average engine of a given type satisfy emission limits the second requires that the vast majority (95 percent) of engines of a given type conform to emissions limits. The implications for verification procedures of the choice of one or the other of these hypotheses, the conditions of the choice of a known value for the average deviation from emissions standards are analyzed

CKD

A79-39093 # A study of the evolution of noise exposure under different hypotheses of regulation (Etude de l'evolution de l'exposition au bruit sous diverses hypothéses reglementaires) M Planko (Groupe Sectoriel Franco-Soviétique, Sous-Groupe Effects du Transport Aerien sur l'Environnement, Reunion, 2nd, Moscow, USSR, Apr 25-29, 1979) ONERA, TP no 1979 44, 1979 60 p In French

The evolution of noise exposure around a small (two runways of 3600 m) airport as a function of time between 1990 and 2000 has been analyzed for two different regulatory scenarios the absence of any new noise regulations and progressive adaptation of aircraft types to a set of regulations given elsewhere. The evolution of a representative fleet of long, medium, and short range carriers was considered. Noise curves for each aircraft at take-off and landing were calculated $C \ K \ D$

A79-39094 # Broad-band ultrasonic transducers for nondestructive inspection of aeronautical components (Transducteurs ultrasonores à large bande pour le contrôle non destructif de pièces aéronautiques) J-F de Belleval (ONERA, Châtillon-sous Bagneux, Hauts de-Seine, Compiègne Universite de Technologie, Compiegne, France) (NATO, AGARD, Meeting on Non-Destructive Inspection Methods for Propulsion Systems and Components, London, England and Milan, Italy, Apr 23-27, 1979) ONERA, TP no 1979-45, 1979 11 p 8 refs In French

The method generally used to increase the bandwidth of piezoelectric transducers used in ultrasonic non-destructive inspection of aeronautical components, based on damping of the piezoelectric wafer on its rear face, entails a significant loss of sensitivity. It is suggested that bandwidth could be increased and sensitivity improved by damping with a multilayer front face. A computer program has been developed to analyze the propagation of a wave through several layers of different thicknesses and optimize the impedence and thickness of layers composing the transducer These results were confirmed by comparison with the responses measured for transducers having front faces composed of one or two layers.

СКД

A79-39095 # Experimental analysis methods for unsteady flows in turbomachines (Méthodes d'analyse expérimentale des ecoulements instationnaires dans les turbomachines) R Larguier (ONERA, Châtillon sous Bagneux, Hauts de Seine, France) (Association Technique Maritime et Aéronautique, Session, Paris, France, May 14-17, 1979) ONERA, TP no 1979 59, 1979 25 p 29 refs In French Research supported by the Direction des Recherches, Etudes et Techniques

Measurement methods are described for characterizing unsteady flows in turbomachines. They primarily concern the flow in a rotor, its wake, and boundary layers on stator or rotor blades. The measuring instruments are pressure sensors or short time pressure detectors, hot-wire probes or hot film gages, and laser velocimeters. For the flow aligned with the rotor, the analysis of pressure variations on the casing enables one to determine the shock wave configuration on supersonic compressor rotors, and to study the flow pattern in the presence of rotating separation. For the rotor wake, the results agree with measurements by ordinary pressure sensors connected to the rotor. The unsteady nature of the boundary layer on a stator or rotor blade is determined with hot wire probes or hot-film gages.

A79-39096 # Estimation of compressible flows in turbomachines by an axisymmetric calculation method (Approche des écoulements compressibles dans les turbomachines par une méthode de calcul axisymétrique) R Sovrano and Y Ribaud (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France) (Association Technique Maritime et Aéronautique, Session, Paris, France, May 14-17, 1979.) ONERA, TP no 1979-60, 1979 16 p 6 refs In French Research supported by the Direction des Recherches, Etudes et Techniques

A matrix inversion method which allows extension of the symmetric flow approximation widely used for perfect fluids in nearly axial flow turbomachines to non-axial turbomachines (principally centrifugal compressors) is presented. The proposed method can be used to analyze flow through turbomachines with widely varying geometries, and takes into account flow irreversibilities due to a possible off-design attack of the blades and friction losses in the blade channels. As long as the Mach number is less than unity during all iterations, computation time is short. The program converges rapidly even if local Mach numbers are greater than unity at a generity action of the method to a centrifugal compressor with splitter vanes are presented.

A79-39500 Application of Laser Doppler Anemometry to aeroacoustic research J Haertig (Institut Franco-Allemand de Recherches, Saint-Louis, Haut-Rhin, France) In Dynamic measurements in unsteady flows, Proceedings of the Dynamic Flow Conference, Marseille, France, September 11 14, 1978 and Baltimore, Md, September 18 21, 1978 Skovlunde, Denmark, Proceedings of the Dynamic Flow Conference 1978, 1979, p 535-549 13 refs

Experiments performed by Institut Franco-Allemand de Recherches de Saint-Louis (ISL) in the framework of an investigation of jet noise were conducted on a cold jet at relatively high velocities which, without attaining those of real engine jets, are not very far below The cold round free jet facilities of ISL and the Laser Doppler Anemometry (LDA) system are described. Consideration is given to causality correlation measurement with results agreeing with those obtained at lower let exit velocities, and to the relation of velocity field coherence with sound radiated by a free jet. A large increase in coherence of the velocity field with higher excitation level was observed and it is noted that the convection velocity of these coherent structures is independent of the excitation. Attention is given to a resonance in transonic jets, concluding that the method used in the experiments gives reliable data without disturbing the flow or the acoustic fields VT

A79-39602 * Satellite interferometer as an advanced navigation/communication system G S Gopalapillai, G T Ruck, and A G Mourad (Battelle Columbus Laboratories, Columbus, Ohio) Navigation, vol 25, Winter 1978-79, p 405 418 10 refs Contract No NASw-2800 NASA Task 3

An orthogonal system of interferometry baselines aboard a geostationary satellite is proposed to be used for navigation, surveillance, and traffic control. Position determination is based on the relationship between the measured phase differences, the known and unknown transmitter locations, and other systematic error model parameters using a generalized least squares estimation procedure. It is shown that position accuracy is critically dependent on the baseline length and on the magnitude of the random component of the measuring errors. Several trade-offs with respect to the system accuracies, the number of users, data rates, hardware costs, etc , are examined Simultaneous use of the same channels for navigation and data transfer is found feasible and five candidate or 'strawman' interferometer system proposals are presented. It is concluded that the system's performance is excellent in comparison with present or planned systems, and that it is viable in meeting potential user's requirements MEP

A79-39751 # Vortex-induced oscillations - A selective review T Sarpkaya (US Naval Postgraduate School, Monterey, Calif) ASME, Transactions, Journal of Applied Mechanics, vol 46, June 1979, p 241 258 134 refs NSF-Navy-supported research

This paper reviews the vortex-induced oscillations in a few specific fundamental cases Research topics discussed are vortex shedding from a stationary bluff body, consequences of the synchronization phenomenon, wake-oscillator models, added mass, damping, and dynamic response measurements, flow-field models and the discrete-vortex method, mechanism of synchronization, and, finally, in-line oscillations Because of the selective nature of the review, a fairly comprehensive listing of recent contributions to the literature on these and related aspects of flow-induced oscillations research is an essential part of the exposition (Author)

A79-39801 * # Tone noise of three supersonic helical tip speed propellers in a wind tunnel J H Dittmar, R J Jeracki, and B J Blaha (NASA, Lewis Research Center, Cleveland, Ohio) Acoustical Society of America, Meeting, 97th, Cambridge, Mass, June 11-15, 1979, Paper 62 p 7 refs

Three eight bladed supersonic helical tip speed propellers were tested in the NASA Lewis Wind Tunnel at through flow Mach numbers of 0.6, 0.7, 0.75, 0.8, and 0.85 Such propellers are being considered as propulsors for a future energy conservative aircraft

The three propellers of equal performance incorporate different plan forms and different amounts of sweep in order to investigate their noise generation, which could cause a cabin environment problem. The acoustically designed propeller SR-3 had 45 deg of tip sweep and was significantly quieter at Mach 0.8 cruise than the straight bladed propeller, SR-2. An intermediate 30 deg tip sweep propeller, SR 1m exhibited a noise level between the other two. Enhanced pressure time traces at Mach-0.8 cruise while the SR-3 did not. Noise trends with varying helical tip Mach number and blade loading were also observed.

A79-39802 * # Assessment at full scale of nozzle/wing geometry effects on OTW aeroacoustic characteristics D Groesbeck and U von Glahn (NASA, Lewis Research Center, Cleveland, Ohio) Acoustical Society of America, Meeting, 97th, Cambridge, Mass, June 11-15, 1979, Paper 29 p 5 refs

The effects on acoustic characteristics of nozzle type and location on a wing for STOL engine over-the-wing configurations are assessed at full scale on the basis of model scale data. Three types of nozzle configurations are evaluated a circular nozzle with external deflector mounted above the wing, a slot nozzle with external deflector mounted on the wing and a slot nozzle mounted on the wing Nozzle exhaust plane locations with respect to the wing leading edge are varied from 10 to 46 percent chord (flaps retracted) with flap angles of 20 deg (take-off attitude) and 60 deg (approach attitude) Perceived noise levels (PNL) are calculated as a function of flyover distance at 152 m altitude From these plots, static EPNL values, defined as flyover relative noise levels, are calculated and plotted as a function of lift and thrust ratios. From such plots the acoustic benefits attributable to variations in nozzle/deflector/wing geometry at full scale are assessed for equal aerodynamic performance (Author)

A79-39803 * # An improved method for predicting the effects of flight on jet mixing noise J R Stone (NASA, Lewis Research Center, Cleveland, Ohio) Acoustical Society of America, Meeting, 97th, Cambridge, Mass, June 11-15, 1979, Paper 26 p 20 refs

A method for predicting the effects of flight on jet mixing noise has been developed on the basis of the jet noise theory of Ffowcs-Williams (1963) and data derived from model-jet/free-jet simulated flight tests Predicted and experimental values are compared for the J85 turbojet engine on the Bertin Aerotrain, the low-bypass refanned JT8D engine on a DC9, and the high-bypass JT9D engine on a DC-10 Over the jet velocity range from 280 to 680 m/sec, the predictions show a standard deviation of 1 5 dB

ЈМВ

A79-39804 * # Materials and structural aspects of advanced gas-turbine helicopter engines J C Freche (NASA, Lewis Research Center, Cleveland, Ohio) and J Acurio (US Army, Propulsion Laboratory, Cleveland, Ohio) Association Aéronautique et Astronautique de France, International Congress in Aeronautics, Paris, France, June 6-8, 1979, Paper 63 p. 122 refs

Advances in materials, coatings, turbine cooling technology, structural and design concepts, and component life prediction of helicopter gas-turbine-engine components are presented. Stationary parts including the inlet particle separator, the front frame, rotor tip seals, vanes and combustors and rotating components - compressor blades, disks, and turbine blades - are discussed. Advanced composite materials are considered for the front frame and compressor blades, prealloyed powder superalloys will increase strength and reduce costs of disks, the oxide dispersion strengthened alloys will have 100C higher use temperature in combustors and vanes than conventional superalloys, ceramics will provide the highest use temperature of 1400C for stator vanes and 1370C for turbine blades, and directionally solidified eutectics will afford up to 50C temperature advantage at turbine blade operating conditions. Coatings for surface protection at higher surface temperatures and design trends in turbine cooling technology are discussed. New analytical methods of life prediction such as strain gage partitioning for high temperature prediction, fatigue life, computerized prediction of oxidation resistance, and advanced techniques for estimating coating life are described AT

A79-39805 * # Diagnostics of wear in aeronautical systems L D Wedeven (NASA, Lewis Research Center, Cleveland, Ohio) American Chemical Society, State-of-the-Art Symposium on Corrosion and Wear, 15th, Washington, D C, June 4-6, 1979, Paper 4 p 17 refs

The use of appropriate diagnostic tools for aircraft oil wetted components is reviewed, noting that it can reduce direct operating costs through reduced unscheduled maintenance, particularly in helicopter engine and transmission systems where bearing failures are a significant cost factor. Engine and transmission wear modes are described, and diagnostic methods for oil and wet particle analysis, the spectrometric oil analysis program, chip detectors, ferrography, in-line oil monitor and radioactive isotope tagging are discussed, noting that they are effective over a limited range of particle sizes but compliment each other if used in parallel. Fine filtration can potentially increase time between overhauls, but reduces the effectiveness of conventional oil monitoring techniques so that alternative diagnostic techniques must be used. It is concluded that the development of a diagnostic system should be parallel and integral with the development of a mechanical system AT

A79-39814 * # Multivariable control altitude demonstration on the F100 turbofan engine B Lehtinen (NASA, Lewis Research Center, Cleveland, Ohio), R L DeHoff (Systems Control, Inc, Palo Alto, Calif), and R D Hackney (United Technologies Corp, Pratt and Whitney Aircraft Group, West Palm Beach, Fla) AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev, June 18-20, 1979, AIAA Paper 79-1204 29 p 16 refs

The control system designed under the Multivariable Control Synthesis (MVCS) program for the F100 turbofan engine is described The MVCS program, applied the linear quadratic regulator (LQR) synthesis methods in the design of a multivariable engine control system to obtain enhanced performance from cross-coupled controls, maximum use of engine variable geometry, and a systematic design procedure that can be applied efficiently to new engine systems Basic components of the control system, a reference value generator for deriving a desired equilibrium state and an approximate control vector, a transition model to produce compatible reference point trajectories during gross transients, gain schedules for producing feedback terms appropriate to the flight condition, and integral switching logic to produce acceptable steady-state performance without engine operating limit exceedance are described and the details of the F100 implementation presented. The engine altitude test phase of the MVCS program, and engine responses in a variety of test operating points and power transitions are presented

A79-39817 # Payback period - An engineering cost/benefit method D E Webb (United Technologies Corp., Pratt and Whitney Aircraft Group, East Hartford, Conn.) AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev., June 18-20, 1979, AIAA Paper 79-1235 7 p

An aircraft engine cost/benefit analysis method which uses the payback period (ratio of investment to before-tax annual cash savings) as the basic parameter is described. The payback period method provides a more accurate assessment of capital costs than does the conventional direct operating cost method, which considers only capital costs due to depreciation. The application of payback period analysis to design improvements in the JT8D turbofan engine is presented.

A79-39818 * # Autoignition of hydrogen injected transverse to a supersonic airstream C R McClinton (NASA, Langley Research Center, High Speed Aerodynamics Div, Hampton, Va) AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev, June 18-20, 1979, AIAA Paper 79-1239 12 p 13 refs

A parametric study of autoignition characteristics of transverse fuel injector patterns for a hydrogen-fueled, supersonic-combustion ramjet was conducted in direct-connect tests over a range of simulated hypersonic flight conditions. Autoignition limits, defined directly by visual observations and indirectly by measured wall pressure and temperature, are compared with a semi-empirical ignition limit model which accounts for first order effects on autoignition it is shown that to initiate combustion in the immediate region of the fuel injector, ignition must occur in the separation region ahead of the fuel jet Autoignition within this separation zone exhibits strong dependence on flow pressure and temperature, injector diameter, local boundary layer energy thickness, wall temperature, and on fluid dynamic interactions with adjacent downstream facing steps (such as inlet isolation steps) Secondary effects are also discussed. The empirical model is used to define limits of test temperature, pressure, and scale required for autoignition in a current subscale engine test program (Author)

A79-39819 # Predicted F100 engine response to circumferential pressure and temperature distortion W A Walter and M Shaw (United Technologies Corp., Pratt and Whitney Aircraft Group, West Palm Beach, Fla) AIAA, SAE, and ASME, Joint Propulsion Conference, 15th, Las Vegas, Nev., June 18-20, 1979, AIAA Paper 79-1310 6 p 5 refs

An analytical compressor flow model was used to investigate the F100(3) engine response to inlet circumferential distortion. The response characteristics predicted and the use of these results in planning engine stability tests is presented. Engine responses predicted for three different pressure patterns and three different temperature distortion profiles were combined into five distortion cases with the results showing that compression system response to combined pressure and temperature distortion depends upon the relative orientation, the individual amplitude, and circumferential extents of distortions. It is concluded that improved engine stability tests can be designed using the Pratt and Whitney analytical distortion model to extrapolate test results, and that analytical predictions are useful in planning engine distortion tests. A T

A79-39873 Dry friction in the aerospace industry (Le frottement sec dans l'industrie aérospatiale) M Armbruster (Sociéte Nationale Industrielle Aerospatiale, Laboratoire Central, Paris, France) Revue Française de Mécanique, 3rd Quarter, 1978, p 5-10 6 refs In French

An overview of applications of dry friction in the aerospace industry is given. The characteristics of different dry friction materials, including polymers, metals and inorganics, and solid lubricants are described. Three specific applications of dry friction in aerospace technology are examined. dry lubricants for bearings used in satellites, dry journal bearings for helicopter blade assemblies, and dry spherical swivels in airplane control surfaces. CKD

A79-39889 The F-16 RIW program H Balaban, G Harrison (Arinc Research Corp , Annapolis, Md), and D Cuppett (USAF, Aeronautical Systems Div , Wright-Patterson AFB, Ohio) In Annual Reliability and Maintainability Symposium, Washington, D C , January 23-25, 1979, Proceedings New York, Institute of Electrical and Electronics Engineers, 1979, p 79-82 8 refs

The F-16 RIW program is considered to be the most complex warranty procurement to date, involving a multinational logistics cooperative effort. Nine avionic line replaceable units (LRUs) are covered by the warranty, the coverage encompassing such elements as guaranteed MTBF, guaranteed turnaround times, and LRU/ module-level maintenance. This paper summarizes the background of the procurement, the major RIW features, and current issues that will influence the success of the RIW program. (Author)

A79-39890 The operational impact of Navy's first TAAF program J R Farrell (US Navy, Naval Material Command, Washington, D C) and H J Kindl (General Electric Co , Aerospace Electronic Systems Dept , Utica, N Y) In Annual Rehability and Maintainability Symposium, Washington, D C , January 23-25, 1979, Proceedings New York, Institute of Electrical and Electronics Engineers, 1979, p 116-120 5 refs

A Test, Analyze, And Fix (TAAF) reliability growth test program was carried out on Logic Unit 4 (LU-4), a part of the data analysis programming group AN/AYA 8 for the P-3C ASW patrol aircraft This device contains 9910 electronic parts and an electromechanical magnetic drum memory. The testing involved a total of 2751 operating hours in a MIL-STD-781B Test Level E environment The test duration was determined from MIL-HDBK-217A failure rates and empirical failure rates of microcircuits from AYA-8 field data and the rule that the MTBF expected early in the test program is 10% of the prediction. The cumulative MTBF was plotted, and a mean-square fit growth line was obtained with a slope of 0 44, which compares favorably with the planned growth of 0.4 Thirteen corrective actions were also validated by exposing test articles to at least 200 hours of test. The testing showed that the equipment should have a MTBF in excess of 930 hours, which has been confirmed by subsequent field data

A79-39893 CERT technology applied to an airborne radar H J Caruso, W Silver, D J Cichetti, and D M Kubilus (Westinghouse Product Qualification Laboratory, Baltimore, Md) In Annual Reliability and Maintainability Symposium, Washington, D C, January 23-25, 1979, Proceedings New York, Institute of Electrical and Electronics Engineers, 1979, p 131-135, 7 refs

The effectiveness of Combined Environmental Reliability Testing (CERT) is examined, considering the questions of necessary degree of realism, return on investment, test program structure, and Life-Cycle Cost Impact Candidate CERT facility designs are described, noting that complex environmental stress profiles and combinations can be performed with no more facility operators than required for single-environment tests, and existing reliability facilities can be modified to CERT requirements. The major advantage of CERT is its simultaneous disclosure of single environment failure modes, improving growth rate and more efficient use of available test time The value of CERT for disclosing synergistic failure modes is unresolved because such failure modes comprise only a small part of the total failure population or they are sensitive to as yet undefined variations in environmental combinations and dynamics. It is concluded that the timely use of CERT in program phases or in combination with traditional test methodology can result in development cost reductions and schedule benefits ΑT

A79-39895 # The aircraft air conditioner data revisited H Ascher (US Navy, Naval Research Laboratory, Washington, D C) and H Feingold (US Naval Material Command, David W Taylor Naval Ship Research and Development Center, Bethesda, Md) In Annual Reliability and Maintainability Symposium, Washington, D C, January 23-25, 1979, Proceedings New York, Institute of Electrical and Electronics Engineers, 1979, p 153-159 13 refs

Using Proschan's Air Conditioning data as a vehicle, this paper highlights some of the basic dissimilarities between repairable and nonrepairable system concepts. Widespread confusion over these concepts has obscured a salient feature of these data - overhaul degraded air conditioners. (Author)

A79-39900 RELSIM-A systems reliability simulation code E P Schelonka (California, University, Los Alamos, N Mex) In Annual Reliability and Maintainability Symposium, Washington, D C, January 23-25, 1979, Proceedings New York, Institute of Electrical and Electronics Engineers, 1979, p 194-197

A series of simulation programs designated RELSIM has been developed as part of the Los Alamos Scientific Laboratory Nuclear Safeguards Program to provide reliability projections for large interconnected arrays of digital components RELSIM is capable of simulating the general case of up to several hundred units linked in networks having a full range of tandem and parallel network configuration options, including those with nonidentical components in parallel BJ

A79-39912 Development of in-flight steady-state failure rates M B Shurman (Boeing Aerospace Co, Seattle, Wash) In Annual Reliability and Maintainability Symposium, Washington, D C, January 23 25, 1979, Proceedings New York, Institute of Electrical and Electronics Engineers, 1979, p 323-325

Two complementary procedures for converting failure rate data to in-flight steady-state failure rates are described. In the first approach, handbook-derived abort failure rate data and non-abort reliability data derived from field experience are used to calculate the nominal sortie duration for a given aircraft. The second used total failure rate data from handbooks together with average maintenance hours per fix to compute the maintenance manhours per flight hour for unscheduled maintenance. The final step in both methods is the calculation of a conversion constant to obtain in-flight steady state failure rates.

A79-39914 Lower avionic temperature - Lower life cycle cost D E Tuttle and M N Shwartz (Lockheed-California Co, Burbank, Calif) In Annual Reliability and Maintainability Symposium, Washington, D C, January 23-25, 1979, Proceedings

New York, Institute of Electrical and Electronics Engineers, 1979, p 332-337 8 refs Contract No N00163-77-C-0296

Results of a trade-off study evaluating the effects of environmental control system design on the reliability and maintainability of a modular avionics package for a V/STOL Type A aircraft are presented A baseline design offering the lowest total aircraft life cycle cost (LCC) was sought Differences in LCC were determined by summation of subsystem acquisition cost, aircraft gross takeoff weight (GTOW) specific cost, fuel cost, and cost to maintain over the projected life of the aircraft Reliability and weight were found to be driving factors in cost analysis Five environmental control systems were analyzed Minimum LCC was associated with a Freon vapor cycle system using recirculated air to provide component temperatures of 40 to 45 deg C C K D

A79-39915 Reliability and maintainability contribution to Hornet mission success R L McGee (McDonnell Douglas Corp., St Louis, Mo.) In Annual Reliability and Maintainability Symposium, Washington, D.C., January 23-25, 1979, Proceedings

New York, Institute of Electrical and Electronics Engineers, 1979, p. 338-341

The development of the weapon system design of the Hornet fighter/attack aircraft to satisfy duel requirements of 3.7 mean flight hours between failures and 0.8 mission completion probability is discussed. The impact of the mean flight time between failures requirement on maintainability, availability, and life cycle cost is examined. Reliability data for different Hornet subsystems are presented. CKD

A79-39919 RTCA standards - Improved specs and regulations W C Fuchs (Radio Technical Commission for Aeronautics, Washington, D C) In Annual Reliability and Maintainability Symposium, Washington, D C, January 23-25, 1979, Proceedings New York, Institute of Electrical and Electronics Engineers, 1979, p. 381-383

The Radio Technical Commission for Aeronautics (RTCA) develops minimum performance standards for avionics and telecommunications. These standards have been employed as specifications by manufacturers, and have also served as the basis for government regulation of the aviation industry Subjects under consideration by RTCA committees during 1978 included ground proximity warning

equipment, emergency locator transmitters, airborne Omega receivers, future civil aviation frequency spectrum requirements, and the role of mean-time-before-failure data in specifying safety standards. J M B

A79-39920 The effect of endless burn-in on reliability growth projections A G Bezat and L L Montague (Honeywell, Inc, Avionics Div, St Louis Park, Minn.) In Annual Reliability and Maintainability Symposium, Washington, D C, January 23-25, 1979, Proceedings New York, Institute of Electrical and Electronics Engineers, 1979, p. 392 397

Current reliability prediction methods treat solid-state electronics equipment on the basis of a constant failure rate throughout the operating life of the equipment This paper presents an extensive data base (over 19 billion part hours), supported by theory, that shows failure rate of solid state electronics to be a decreasing function with operational age of individual equipment Data is presented in graphical form, including a best fit equation for the data. The mechanics of prediction methods are shown, along with examples. The entire concept is summarized as a family of growth curves, wherein the applicable curve is dependent upon the design/ process maturity of the equipment at the time it is manufactured

(Author)

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STAR ENTRIES

N79-23888*# National Aeronautics and Space Administration Langley Research Center Hampton Va

CHARACTERISTICS OF THE ADVANCED SUPERSONIC TECHNOLOGY AST-105-1 CONFIGURED FOR TRANSPA-CIFIC RANGE WITH PRATT AND WHITNEY AIRCRAFT VARIABLE STREAM CONTROL ENGINES

Hal T Baber Jr Mar 1979 134 p refs

(NASA-TM-78818) Avail NTIS HC A07/MF A01 CSCL 02A

Credence to systems weights and assurance that the noise study AST concept can be balanced were studied. Current titanium structural technology is assumed. A duct-burning turbofan variable stream control engine (VSCE), with noise reduction potential through use of a coannular nozzle was used. With 273 passengers range of the AST-105-1 for a cruise Mach number of 2.62 is essent ally transpacific Lift-to-drag ratio is slightly higher than for previous AST configurations. It is trimmable over a center-ofgravity range of 47m (155 ft) Inherent high positive effective dihedral, typical of arrow-wing configurations in high-lift approach would limit AST-105-1 to operating in crosswinds of 116 m/sec (22.4 kt) or less with 75 percent of available lateral control Normal power takeoff with cutback results in noise in excess of Federal Aviation Regulation Part 36 but less than for conventional procedure takeoff Results of advanced (noncertificated) programmed throttle takeoff and approach procedures not yet optimized indicate that such can be an important additional method noise reduction S E S

N79-23889*# National Aeronautics and Space Administration Langley Research Center Hampton, Va

THE SCIENCE AND TECHNOLOGY OF LOW SPEED AND **MOTORLESS FLIGHT, PART 1**

Perry W Hanson comp 1979 299 p refs Conf held at Hampton Va 29-30 Mar 1979 cosponsored by NASA and (NASA-CP-2085 L-12973) Avail NTIS HC A13/MF A01

CSCL 02A

The proceedings of the Third International Symposium on the Science and Technology of Low Speed and Motorless Flight are reported Twenty-eight papers were presented in the areas of low speed aerodynamics new materials applications and structural concepts advanced flight instrumentation, sailplane optimal flight techniques and self launching and ultralight glider technology These papers are included in the document along with another paper which was not presented on proposed definitions for various categories of sailplanes and gliders

N79-23890*# Boeing Commercial Airplane Co Seattle Wash LOW-SPEED SINGLE ELEMENT AIRFOIL SYNTHESIS

John H McMasters and Michael L Henderson In NASA Langley Res Center The Sci and Technol of Low Speed and Motorless Flight Pt 1 1979 p 1-31 refs

Avail NTIS HC A13/MF A01 CSCL 01A

The use of recently developed airfoil analysis/design computational tools to clarify enrich and extend the existing experimental data base on low-speed single element airfoils is demonstrated A discussion of the problem of tailoring an airfoil for a specific application at its appropriate Reynolds number is presented This problem is approached by use of inverse (or synthesis) techniques wherein a desirable set of boundary layer characteristics performance objectives and constraints are specified which then leads to derivation of a corresponding viscous flow pressure distribution Examples are presented which demonstrate the synthesis approach following presentation of some historical

information and background data which motivate the basic synthesis process GY

N79-23891*# National Aeronautics and Space Administration Langley Research Center Hampton Va

AN EXPLORATORY INVESTIGATION OF THE EFFECT OF PLASTIC COATING ON THE PROFILE DRAG OF A PRACTICAL-METAL-CONSTRUCTION SAILPLANE AIR-FOIL

Dan M Somers In its The Sci and Technol of Low Speed and Motorless Flight, Pt 1 1979 p 33-64 refs

Avail NTIS HC A13/MF A01 CSCL 01A

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An exploratory investigation was performed in the Langley low-turbulence pressure tunnel to determine the effect of a plastic coating on the profile drage of a practical-metal-construction sailplaine airfoil The mode was tested with three surface configurations (1) filled painted and sanded smooth (2) rough bare metal and (3) plastic-coated. The investigation was conducted at Reynolds numbers based on airfoil chord of 1 100 000 2 200 000, and 3 300 000 at a constant Mach number of 0.10 The results indicate that at all three Reynolds numbers the order of the drag values of the three surface configurations starting with the highest drag, was filled painted and sanded smooth, rough bare metal and plastic-coated GΥ

N79-23892*# Technische Hochschule Darmstadt (West Germany)

OPTIMUM TAIL PLANE DESIGN FOR SAILPLANES

Kay Mayland In NASA Langley Res Center The Sci and Technol of Low Speed and Motorless Flight Pt 1 1979 p 65-80 refs

Avail NTIS HC A13/MF A01 CSCL 01C

Classical drag equations in a modern version were used to calculate the influence of tail modifications on the drag of a standard class sailplane. The profile drag which depends on the Reynolds number is included in the calculations. Minimum drag is compared with real drag for two lift coefficients. Some results have no clear tendency but low tail area and relatively low tail aspect ratio give some advantages. Optimum and real lift ratios between wing and tail plane are compared for the original sailplane

N79-23893*# Stuttgart Univ (West Germany) THE EFFECT OF DISTURBANCE ON A WING

Richard Eppler In NASA Langley Res Center The Sci and Technol of Low Speed and Motorless Flight Pt 1 1979 p 81-92 refs

Avail NTIS HC A13/MF A01 CSCL 01A

Disturbances such as flap and aileron hinges and poorly faired spoilers were simulated in a computer wind tunnel. The total drag of a single roughness element does not depend only on the size of that element. Its position on the wing has a surprisingly strong effect. In particular a roughness element on the convex side of a deflected flap or aileron causes a very substantial increase in drag. Very few experimental data are available for comparison Good agreement with experiment can be achieved however by adapting a fictive step size. The correlation between the real roughness-element size and the drag increase remains to be determined. Simple, fundamental experiments are suggested which will allow a theoretical estimation of the drag increase due to roughness elements GY

N79-23894*# Technische Univ Berlin (West Germany) GENERATION AND BREAKDOWN OF AERODYNAMIC LIFT PHYSICAL MECHANISM

Wolfgang Liebe In NASA Langley Res Center The Sci and Technol of Low Speed and Motorless Flight Pt 1 1979 p 93-102 refs

Avail NTIS HC A13/MF A01 CSCL 02A

A contribution is given to an old problem the explantion of the generation of aerodynamic lift. Physical models are described which provide a better understanding of the phenomena GY involved

N79-23895*# Bertelsen Mfg Co, Inc Neponset III INTRODUCTION TO THE ARCOPTER ARC WING AND THE BERTELSEN EFFECT FOR POSITIVE PITCH STABILITY AND CONTROL

William D Bertelsen In NASA Langley Res Center The Sci and Technol of Low Speed and Motorless Flight, Pt 1 1979 p 103-130 refs

Avail NTIS HC A13/MF A01 CSCL 01C

A brief report offered on a wing design, new in geometry, construction and flight characteristics Preliminary wind tunnel data on a three-dimensional model was well as some full-scale man-carrying test results are included. There are photos of all phases of the experiments and some figures which serve to illustrate the Bertelsen Effect a unique focus of aerodynamic forces in the arc wing system which allows the attainment of high lift coefficients with the maintenance of pitch stability and control G Y

N79-23896*# Stuttgart Univ (West Germany) SOME NEW AIRFOILS

Richard Eppler In NASA Langley Res Center The Sci and Technol of Low Speed and Motorless Flight, Pt 1 1979 p 131-154 refs

Avail NTIS HC A13/MF A01 CSCL 01A

A computer approach to the design and analysis of airfoils and some common problems concerning laminar separation bubbles at different lift coefficients are briefly discussed. Examples of application to ultralight airplanes canards and sailplanes with flaps are given GY

N79-23897*# Princeton Univ N J

A COMPARISON OF THE AERODYNAMIC CHARACTERIS-TICS OF EIGHT SAILWING AIRFOIL SECTIONS

Mark D Maughmer In NASA Langley Res Center The Sci and Technol of Low Speed and Motorless Flight Pt 1 1979 p 155-176 refs Avail NTIS HC A13/MF A01 CSCL 01A

The operational characteristics of sailwings are discussed with emphasis placed on the importance of the trailing edge cable tension. The three dimensional aerodynamic characteristics were obtained from wind tunnel tests and the results compared to determine the magnitude of the aerodynamic penalties paid for various structural simplifications. For the sectional thickness ratios it is concluded that while the basic double-membraned sailwing has exceptional aerodynamic performance even superior for some applications to the conventional hardwing any notable deviation from this configuration results in an unacceptably large performance penalty SES

N79-23899*# Rensselaer Polytechnic Inst Troy N Y WING SHAPE OPTIMIZATION FOR MAXIMUM CROSS-COUNTRY SPEED, WITH MATHEMATICAL PROGRAM-MING

Gunter Helwig In NASA Langley Res Center The Sci and Technol of Low Speed and Motorless Flight, Pt 1 1979 p 203-218 refs

Avail NTIS HC A13/MF A01 CSCL 01C

A computer program was developed to calculate numerically the speed and circling polars of an aircraft when the lift and drag characteristics of the wing airfoils are known. The planform of the wing is described by variables which are optimized so that the cross-country speed of the glider is maximum for the particular type of thermal model Two thermal models are compared and shown that with a greater wing area than now normally used the performance can be increased Author

N79-23902*# National Aeronautics and Space Administration Langley Research Center Hampton Va

THE APPLICATION OF MICROPROCESSOR TECHNOLOGY TO IN-FLIGHT COMPUTATION

Patricia L Sawyer and Dan M Somers In its The Sci and Technol of Low Speed and Motorless Flight, Pt 1 1979 p 267-284 refs

Avail NTIS HC A13/MF A01 CSCL 09B

A modular design of a general purpose microprocessor-based computer to perform in-flight computations for cross-country

soaring pilots is described. The basic requirements for the system are discussed. Several specialized applications of the computer are presented including real-time pilot feedback and flight-test data acquisition and reduction SES

N79-23903*# Massachusetts Inst of Tech, Cambridge DESIGN OF PROPELLERS FOR MOTORSOARERS

E Eugene Larrabee In NASA Langley Res Center The Sci and Technol of Low Speed and Motorless Flight, Pt 1 1979 p 285-303 refs

Avail NTIS HC A13/MF A01 CSCL 01C

A method was developed for the design of propellers of minimum induced loss matched to an arbitrary operating point characterized by disc loading (thrust or power) air density shaft speed flight speed and number of blades A consistent procedure is outlined to predict the performance of these propellers under off design conditions or to predict the performance of propellers of general geometry. The examples discussed include a man powered airplane a hang glider with a 7.5 kW (10 hp) 8 000 rpm engine and an airplane-like motorsoarer SES

N79-23904# Messerschmitt-Boelkow-Blohm G m b H , Ottobrunn (West Germany) Unternehmensbereich Flugzeuge DEVELOPMENT OF AN AIRBORNE MILITARY SYSTEM (MRCA SYSTEM) [ENTWICKLUNG EINES FLIEGENDEN WAFFENSYSTEMS AM BEISPIEL MRCA] Helmut Langfelder Feb 1977 19 p refs In GERMAN

(MBB-UFE-1322-0) Avail NTIS HC A02/MF A01

The problems (technical, economic, political, and financial) encountered when launching a new program for the construction of a series of military aircraft are discussed. The background to the 1969 options taken for MRCA Tornado are presented Two groups are involved PANAVIA (MBB 42.5 percent, German, BAC 42.5 percent British, FIAT 15 percent, Italian) and NAMMA (NATO MRC Agency) the former executing the program and the latter ordering 25,000 persons employed by 350 companies currently participate in this program in the three countries concerned This figure will increase to 70 000 persons by the end of the decade and involve some 800 aircraft costing 8 billion DM The program has thus so far been successful Author (ESA)

N79-23906 Cornell Univ., Ithaca, N Y NUMERICAL CALCULATION OF INVISCID TRANSONIC FLOW THROUGH ROTORS AND FANS Ph D Thesis Djordje Stevo Dulikravich 1979 249 p

Avail Univ Microfilms Order No 7910741

Steady transonic inviscid, potential lifting flows through two dimensional stationary air-foil cascades and three dimensional, rotating cascades mounted on a doubly infinite cylindrical hub were analyzed. The exact full potential equation was derived in its canonical form with appropriate boundary and periodicity conditions for these cases. Two separate computer programs were developed that numerically solve that equation, allowing for arbitrary airfoil shapes and blade taper sweep, dihedral and twist distribution as well as for the occurrence of the weak shocks. The computational domain was formed using a sequence of geometric transformations of the physical domain providing the boundary fitted corrdinate system. These algorithms can serve for the flow prediction about isolated propellers hovering rotors, wind turbines ducted fans, stators and finned missiles

Dissert Abstr

N79-23908*# National Aeronautics and Space Administration, Washington, D C AERODYNAMICS

N F Krasnov 1978 758 p refs Transl into ENGLISH of the book Aerodinamika Moscow Vysshaya Shkola Publishers, 1971 Sponsored by NASA and NSF Transl by Amerind Pub Co pvt Ltd New Delhi

(NASA-TT-F-765. TT74-52006) Avail NTIS HC A99/MF A01 CSCL 01A

The applications of aerodynamics particularly in rocket technology and modern high-speed aviation are studied along with the general laws of motion of a gas medium. The first six chapters of the book cover the following basic concepts and definition of aerodynamics kinematics of a fluid medium equations of motion of a gas in the general case (where variations in its physico-chemical properties are considered), the theory of shock waves, the method of characteristics (very widely used in the investigation of supersonic flows), and the general theory of the motion of a gas in two-dimensional space. The practical applications or connections with the formulation of methods of aerodynamic calculations for flight vehicles and their individual elements are shown G Y

N79-23911*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio

THEORETICAL FAN VELOCITY DISTORTIONS DUE TO INLETS AND NOZZLES

J Dennis Hawk 1979 12 p refs Presented at the Workshop on V/STOL Aerodyn Monterey Calif, 16-18 May 1979 (NASA-TM-79150 E-006) Avail NTIS HC A02/MF A01 CSCL 01A

Nonuniform velocity profiles imposed on the propulsion system fan can cause fan blade stresses and thrust losses. A theoretical parametric study of the effects of inlets with 0 deg and 90 deg nozzle deflection on the velocity profile at a hypothetical fan is presented The parameters investigated are fan-to-nozzle spacing and inlet centerline offset. The interaction between the inlet and nozzle is also investigated. The study is made using a two-ARH dimensional analysis

N79-23912*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio

AIRCRAFT ICING Bernard J Blaha comp 1979 147 p refs Workshop held

at Cleveland 19-21 Jul 1978 (NASA-CP-2086 FAA-RD-78-109 E-027) Avail NTIS HC A07/MF A01 CSCL 01C

The results of a conference on the problems of aircraft icing

are reported

N79-23913*# National Aeronautics and Space Administration Washington D C

AIRCRAFT ICING INTRODUCTION

John H Enders In NASA Lewis Res Center Aircraft Icing 1979 3 p

Avail NTIS HC A07/MF A01 CSCL 01C

The objectives of the Workshop were as follows (1) to assess the current understanding of fixed wing and rotorcraft operational icing environments and problems (2) to evaluate facilities requirements for R&D and certification purposes (3) to examine means of improving icing forecasts (4) to identify shortcomings in aeronautical icing knowledge which can be alleviated by new research and instrumentation development

LS

N79-23914*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio

EXECUTIVE SUMMARY OF AIRCRAFT ICING SPECIALISTS WORKSHOP

Milton A Beheim In its Aircraft loing 1979 p 1-16

Avail NTIS HC A07/MF A01 CSCL 01C

In a period of escalating development costs for new aircraft, there is growing interest in a renewed and coordinated icing research effort to achieve an updating or modernization of each aspect of the technological issues that are involved This includes the data base analysis methods test techniques and test facilities LS

N79-23915*# Air Force Geophysics Lab Hanscom AFB Mass ICING OF AIRCRAFT SOME REMARKS WITH AN HISTORI-CAL SLANT FROM A CLOUD PHYSICIST

Robert M Cunningham In NASA Lewis Res Center Aircraft lcing

Avail NTIS HC A07/MF A01 CSCL 01C

Three areas of interest are commented on cloud physics nowcasting, and instrumentation. A comparison is made of what was done 30 years ago to what might be done in light of developments in related areas of cloud physics, weather modification and instrumentation LS

N79-23916*# National Transportation Safety Board, Washington, DC

SAFETY HAZARD OF AIRCRAFT ICING

James C McLean Jr /n NASA Lewis Res Center Aircraft lcing 1979 p 21-27

Avail NTIS HC A07/MF A01 CSCL 01C

The problem of aircraft icing is reported as well as the type of aircraft affected, the pilots involved, and an identification of the areas where reduction in icing accidents are readily accomplished MMM

N79-23917*# RCA Flight Operations Trenton, N J CIVIL HELICOPTER ICING PROBLEMS

Peter B Sweenkey In NASA Lewis Res Center Aircraft lcing 1979 p 29-30

Avail NTIS HC A07/MF A01 CSCL 01C

The ice capabilities of rotary wing aircraft are examined Recommendations are given to improve the inadequacies of the weather forecasts pertaining to ice and to adopt a low maintenance anti-ice system MMM

N79-23918*# Cessna Aircraft Co Wichita, Kans A REVIEW OF THE ICING SITUATION FROM THE STAND-POINT OF GENERAL AVIATION

Dennis W Newton /n NASA Lewis Res Center Aircraft long 1979 p 31-38 refs

Avail NTIS HC A07/MF A01 CSCL 01C

An overview of the present situation in the field of aircraft icing with respect to certification and operation of nontransport category airplanes is given Problems of definition and inconsistencies are pointed out. Problems in the forecasting and measurement of icing intensities are discussed. The present regulatory environment is examined with respect to its applicability and appropriateness to nontransport airplanes MMM

N79-23919*# Army Research and Technology Labs , Fort Eustis Va Applied Technology Lab

OVERVIEW OF HELICOPTER ICE PROTECTION SYSTEM DEVELOPMENTS

Richard I Adams In NASA Lewis Res Center Aircraft Icing 1979 p 39-65 refs

Avail NTIS HC A07/MF A01 CSCL 01C

Helicopter ice protection design criteria was developed and technological shortcoming in meeting helicopter mission requirements is that of helicopter rotor blade ice protection. Airframe components are protected using existing technology while the rotor blade protected using the cyclic electrothermal deicing MMM concept

N79-23921*# North Carolina State Univ Raleigh Dept of Mechanical and Aerospace Engineering INVESTIGATION OF AERODYNAMIC CHARACTERISTICS

OF SUBSONIC WINGS Final Report

Fred R DeJarnette and Neal T Frink 11 Jun 1979 148 p refs

(Grant NsG-1437)

(NASA-CR-158661) Avail NTIS HC A07/MF A01 CSCL 01A

An analytical strake design procedure is investigated A numerical solution to the governing strake design equation is used to generate a series of strakes which are tested in a water tunnel to study their vortex breakdown characteristics. The strakes are scaled for use on a half-scale model of the NASA-LaRC general research fuselage with a 44 degrees trapezoidal wing An analytical solution to the governing design equation is obtained The strake design procedure relates the potential-flow leading-edge suction and pressure distributions to vortex stability Several suction distributions are studied and those which are more triangular and peak near the tip generate strakes that reach higher angles of attack before vortex breakdown occurs at the wing trailing edge. For the same suction distribution a conical rather than three dimensional pressure specification results in a better strake shape as judged from its vortex breakdown characteristics.

N79-23922*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif

AN INVESTIGATION OF A FULL-SCALE ROTOR WITH FOUR BLADE TIP PLANFORM SHAPES

Robert H Stroub May 1979 72 p refs Sponsored in part by AVRADCOM

(NASA-TM-78580 AVRADCOM-TR-79-14 A-7793) Avail NTIS HC A04/MF A01 CSCL 01A

A test of a full-scale helicopter rotor was conducted in the Ames Research Center 40- by 80-Foot Wind Tunnel to investigate performance loads and noise characteristics of rotors with various tip geometries Four blade tip geometries were investigated rectangular trapezoidal swept rectangular and swept trapezoidal The investigation was accomplished over an advance-ratio range of 0.2 to 0.375 and an advancing blade Mach number range of 0.72 to 0.97 The performance aspects are presented with power comparisons between tip shapes On a power basis the best overall tip shape was the swept trapezoidal geometry JMS

N79-23923*# Vought Corp Hampton Va Technical Center MINIMIZATION THEORY OF INDUCED DRAG SUBJECT TO CONSTRAINT CONDITIONS

John DeYoung Washington NASA Jun 1979 126 p refs (Contract NAS1-13500)

(NASA-CR-3140) Avail NTIS HC A07/MF A01 CSCL 01A Exact analytical solutions in terms of induced drag influence coefficients can be attained which define the spanwise loading with minimized induced drag, subject to specified constraint conditions for any nonplanar wing shape or number of lift plus wing bending moment about a given wing span station. Example applications of the theory are made to a biplane, a wing in ground effect, a cruciform wing a V-wing a planar-wing winglet and linked wingtips in formation flying. For minimal induced drag the spanwise loading, relative to elliptic, is outboard for the biplane and is inboard for the wing in ground effect and for the planar-wing winglet A spinoff of the triplane solution provides mathematically exact equations for downwash and sidewash about a planar vorticity sheet having an arbitrary loading distribution

Author

N79-23924*# Old Dominion Univ Norfolk Va NUMERICAL OPTIMIZATION TECHNIQUES FOR BOUND CIRCULATION DISTRIBUTION FOR MINIMUM INDUCED DRAG OF NONPLANAR WINGS BASIC FORMULATIONS Final Report

John Kuhlman Jun 1979 47 p refs (Grant NsG-1357)

(NASA-CR-3154) Avail NTIS HC A03/MF A01 CSCL 01A A theoretical method was developed for determining the optimum span load distribution for minimum induced drag for subsonic nonplanar configurations. The undistorted wing wake is assumed to have piecewise linear variation of shed vortex sheet strength resulting in a quadratic variation of bound circulation and span load. The optimum loading is obtained either through a direct technique, whereby derivatives of the drag expression are calculated analytically in terms of the unknown wake vortex sheet strengths. Both techniques agree well with each other and with available exact solutions for minimum induced drag.

N79-23925# Committee on Commerce, Science, and Transportation (U S Senate)

PROPELLED LIGHTER-THAN-AIR VEHICLES

Washington GPO 1979 157 p refs Hearings before the Subcomm on Sci Technol and Space of the Comm on Commerce, Sci and Transportation 96th Congr 1st Sess, 27 Feb, 1 Mar 1979

(GPO-43-457) Avail Subcomm on Sci Technol and Space

N79-23928# Air Force Systems Command, Wright-Patterson AFB Ohio Foreign Technology Div

THEORY OF THIN WING IN A SUPERSONIC FLOW WITH CONSIDERATION OF THE NON-EQUILIBRIUM STATE OF EXCITATION OF OSCILLATING DEGREES OF FREEDOM Ye P Aksenov and Yu N Grigoryev 9 Nov 1978 18 p refs Transl into ENGLISH from Uch Zap Perm Gos Univ (USSR), no 156, 1966 18 p

(AD-A065992, FTD-ID(RS)T-1775-78) Avail NTIS HC A02/MF A01 CSCL 20/4

The non equilibrium state in excitation of oscillating degrees of freedom was calculated. The problem of the steady state in the supersonic gas flow surrounding the wings were studied.

SES

N79-23929# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div

SUPERSONIC FLOW IN THE AREA OF ANTISYMMETRIC THIN CRUCIFORM WINGS WITH SUPERSONIC LEADING EDGES IN A HORIZONTAL PLANE, WITH CONSIDERATION OF FLOW SEPARATION ON THE EDGES

Stefan Staic 30 Oct 1978 19 p refs Transl into ENGLISH from Bul Inst Politehnic (Romania), vol 33, no 1 1971 p 103-118

AD-A065993, FTD-ID(RS)T-1859-78) Avail NTIS HC A02/MF A01 CSCL 20/4

The flow in the supersonic regime in the area of a thin cruciform wing antisymmetric distribution of incident angles was studied A cruciform wing composed of two simple delta wings perpendicular to one another with Cartesion axes was designed SES

N79-23931# Boeing Vertol Co., Philadelphia Pa

INTERACTIONAL AERODYNAMICS OF THE SINGLE ROTOR HELICOPTER CONFIGURATION VOLUME 6B ONE-THIRD OCTAVE BAND SPECTROGRAMS OF WAKE SINGLE FILM DATA, BASIC CONFIGURATION WAKE EXPLORATIONS Final Report, 15 Mar 1977 - 13 Feb 1978 Phillip F Sheridan Sep 1978 374 p Prepared for Army Res

Phillip F Sheridan Sep 1978 374 p Prepared for Army Res and Technol Labs, Fort Eustis Va 4 Vol

(Contract DAAJ02-77-C-0020)

(AD-A061861 USARTL-TR-78-23F-Vol-6B) Avail NTIS HC A16/MF A01 CSCL 01/3

Spectrograms of the six velocity measurements taken from the single film transducers are presented. The transducers were located outboard on the wake rake to the left and right of the split film transducers. These plots are machine plotted spectrograms in the one-third octave band format. J M S

N79-23932# Boeing Vertol Co., Philadelphia Pa

INTERACTIONAL AERODYNAMICS OF THE SINGLE ROTOR HELICOPTER CONFIGURATION VOLUME 3A FLOW ANGLE AND VELOCITY WAKE PROFILES IN LOW FRE-QUENCY BAND, BASIC INVESTIGATIONS AND HUB VARIATIONS Final Report, 15 Mar 1977 - 13 Feb 1978 Phillip F Sheridan Sep 1978 175 p Prepared for Armv Res and Technol Labs, Fort Eustis, Va 4 Vol (Contract DAAJ02-77-C-0020)

(AD-A061766, USARTL-TR-78-23C-Vol-3A) Avail NTIS HC A08/MF A01 CSCL 01/3

Profiles of the RMS values of the wake flow angles and velocities in the 1 omega and 2 omega range are presented. The format is waterline on the ordinate and velocity or flow angle on the abscissa Each graph shows a comparison of the baseline flow to the flow modified by some device or condition Build-up to baseline baseline wake exploration, and the effects of various hub caps are covered J MS

N79-23933# Boeing Vertol Co Philadelphia Pa

INTERACTIONAL AERODYNAMICS OF THE SINGLE ROTOR HELICOPTER CONFIGURATION VOLUME 3B FLOW ANGLE AND VELOCITY WAKE PROFILES IN LOW FRE-QUENCY BAND, AIR EJECTOR SYSTEMS AND OTHER DEVICES Final Report, 15 Mar 1977 - 13 Feb 1978

Phillip F Sheridan Sep 1978 203 p Prepared for Army Res and Technol Labs Fort Eustis, Va 4 Vol (Contract DAAJ02-77-C-0020)

(AD-A061767 USARTL-TR-78-23C-Vol-3B) Avail NTIS HC A10/MF A01 CSCL 01/3

Profiles of the RMS values of the wake flow angles and velocities in the 1 omega and 2 omega range are presented The format is waterline on the ordinate and velocity or flow angle on the abscissa Each graph shows a comparison of the baseline flow to the flow modified by some device or condition Air ejector systems, air ejectors and hub caps in the same configuration wings fairings and miscellaneous devices are covered J M S

N79-23934# Boeing Vertol Co Philadelphia Pa INTERACTIONAL AERODYNAMICS OF THE SINGLE ROTOR HELICOPTER CONFIGURATION VOLUME 28 HARMONIC ANALYSES OF AIRFRAME SURFACE PRESSURE DATA, RUNS 7 - 14, MIDSECTION Final Report, 15 Mar 1977 -

13 Feb 1978 Phillip F Sheridan Sep 1978 219 p Prepared for Army Res and Technol Labs Fort Eustis Va 4 Vol

(Contract DAAJ02-77-C-0020)

(AD-A061860 USARTL-TR-78-23B-Vol-2B) Avail NTIS HC A10/MF A01 CSCL 01/3

Harmonic analyses of the waveforms generated by each of the 53 pressure transducers, which covered the surface of the model fuselage and empennage are presented. The analyses encompass the transducers in the middle section of the model Test conditions and configurations include baseline data climb and descent disk loading variation and application of strakes JMS

N79-23935# Messerschmidt-Boelkow G m b H Munich (West "Unternehmungsbereich Flugzeuge- Entwicklung Germany) A FINITE ELEMENT METHOD FOR THE COMPUTATION OF THE TRANSONIC POTENTIAL FLOW PAST AIRFOILS Albrecht Eberle 23 Sep 1977 63 p refs In GERMAN **ENGLISH** summary

(MBB-UFE-1352-0) Avail NTIS HC A04/MF A01

A special finite element method for computing the transonic potential flow with shocks past airfoils is presented. The artificial viscosity concept is used for the local supersonic flow regime. Since in general classical elements do not meet the requirements of advanced numerical aerodynamics, particular attention was given to classing an appropriate element. The usefulness of the method is demonstrated by a series of computed pressure distributions Author (ESA)

N79-23936# Messerschmitt-Boelkow-Blohm GmbH, Ottobrunn (West Germany) Unternehmensbereich Flugzeuge-Entwicklung

AERODYNAMIC PROBLEMS IN ENGINE AIRFRAME INTEGRATION ON FIGHTER AIRPLANES

Kurt Lotter 26 Sep 1977 80 p refs In GERMAN ENGLISH summary Presented at 85th Wehrtech Symp Luftfahrttechn III Moderne Triebwerkstechnol Mannheim West Ger 21-22 Sep 1977

(MBB-UFE-1359-O) Avail NTIS HC A05/MF A01

Different types of intake are discussed together with engine mass flow/air intake matching problems Emphasis is given to intake/engine compatibility and instantaneous distortion measurements The sources and consequences of intake malfunctions are illustrated some typical supersonic fighter aircraft intakes are described Nozzle concepts are presented and interference effects between propulsive jet and external flow are shown. The afterbody drag of fighter aircraft is given Improvements with convergent/divergent nozzles are shown Thrust reversal interference effects are mentioned. Future trends are presented Author (ESA)

N79-23937# Messerschmitt-Boelkow-Blohm G m b H Ottobrunn (West Germany) Unternehmensbereich Flugzeuge-Entwicklung

AIRFOIL OPTIMIZATION FOR TRANSONIC FLOW USING THE METHODS OF FINITE ELEMENTS AND CHARACTERIS-TICS

Albrecht Eberle 2 Nov 1977 59 p refs in GERMAN ENGLISH summary

(MBB-UFE-1362-D) Avail NTIS HC A04/MF A01

A simple method for the optimization of airfoilds was derived from the principle of the elliptic continuation in the supersonic Contour deformations on arbitrary input airfoils flow regime are derived in such a way that the resulting supercritical flow is shockless The subsonic flow field was computed by the method of finite elements. The supersonic problem was solved separately by the method of characteristics Author (ESA)

N79-23938# Oxford Univ (England) Engineering Lab MEASUREMENT OF THE DRAG OF SLENDER CONES IN HYPERSONIC FLOW AT LOW REYNOLDS NUMBERS USING A MAGNETIC SUSPENSION AND BALANCE T F Haslam-Jones 1978 119 p refs

(Contract MIN-DEF/PE-AT/2057/042)

(OUEL-1235/78) Avail NTIS HC A02/MF A01

In order to carry out a comprehensive experimental survey of aerodynamic force on slender axisymmetric bodies in rarefied hypersonic flow an electromagnetic jig and balance was built for use with the Oxford University low density tunnel The design of this apparatus was based on the magnetic jig for spheres built in the same laboratory. The drag force measurements on sharp cones are given for freestream Reynolds numbers based on cone diameter of 120 to 1200 at free stream Mach numbers between 5 and 9 These data were obtained by using a contoured nozzle and free jets. The results from the two types of flow devices overlapped and afforded direct comparisons between them. Comparisons are made with other experimental results and the general correlation of all relevant data is Author (ESA) discussed

N79-23939# National Technical Information Service Springfield Va

AIRCRAFT WAKE VORTICES A BIBLIOGRAPHY WITH

ABSTRACTS Progress Report, 1964 - Feb 1979 Guy È Habercom Jr Mar 1979 266 p Supersedes NTIS/PS-78/0122 NTIS/PS-77/0067 NTIS/PS-76/0072 and NTIS/PS-75/164

(NTIS/PS-79/0166/3 NTIS/PS-78/0122 NTIS/PS-77/0067 NTIS/PS-76/0072 NTIS/PS-75/164) NTIS Avail HC \$28 00/MF \$28 00 CSCL 01A

Wake vortices and turbulent flow across aircraft lifting surfaces were investigated in the Government-sponsored research Aerodynamic characteristics of vortices were reviewed with special attention made to trailing aircraft and aviation safety. This updated bibliography contains 258 abstracts, 27 of which are new entries to the previous edition GRA

N79-23940*# Boeing Commercial Airplane Co., Seattle Wash INFLIGHT FUEL TANK TEMPERATURE SURVEY DATA Final Report

A J Pasion May 1979 60 p refs (Contract NAS3-20815) NTIS (NASA-CR-159569 D6-48611) Avail HC A04/MF A01 CSCL 01C

Statistical summaries of the fuel and air temperature data for twelve different routes and for different aircraft models (B747 B707, DC-10 and DC-8) are given The minimum fuel total air and static air temperature expected for a 0.3% probability were summarized in table form. Minimum fuel temperature extremes agreed with calculated predictions and the minimum fuel temperature did not necessarily equal the minimum total air temperature even for extreme weather long range flights RES

N79-23943# Messerschmidt-Boelkow G m b H Munich (West Unternehmensbereich Flugzeuge- Entwicklung Germany) THE TIME BUDGET AS A CRITERION FOR THE WORKLOAD OF AIR TRAFFIC CONTROLLERS

Guenther Och 13 Sep 1977 15 p refs In GERMAN ENGLISH summary

(MBB-UFE-1353-O) Avait NTIS HC A02/MF A01

A time optimization method for evaluating the capacity of air traffic controllers is presented. As within a given time interval only a limited number of minutes can be used for active control the time consumption for the control of various flight phases was measured and used to calculate the number of flights which could be controlled during this interval. A capacity profile for the entire air space of the Federal Republic of Germany, was constituted from characteristic traffic patterns obtained for each control sector. Author (ESA)

N79-23945# National Technical Information Service Springfield Va

DISCRETE ADDRESS BEACON SYSTEM A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, 1964 - Feb 1979

William E Reed Apr 1979 149 p Supersedes NTIS/PS-78/ 0064 NTIS/PS-77/0035, NTIS/PS-76/0039

(NTIS/PS-79/0244/8 NTIS/PS-78/0064 NTIS/PS-77/0035 NTIS/PS-76/0039) Avail NTIS HC \$28.00/MF \$28.00 CSCL 17G

The development of the discrete address beacon system is treated in these Federally-sponsored research reports Topics include the data link, message formats antenna systems, signal propagation transponders and interface with the air traffic control radar beacon system. This updated bibliography contains 140 abstracts, 27 of which are new entries to the previous edition.

N79-23946# Advisory Group for Aerospace Research and Development Paris (France)

TECHNICAL EVALUATION REPORT ON THE 27TH GUID-ANCE AND CONTROL PANEL SYMPOSIUM ON THE V/STOL AIRCRAFT AT NIGHT AND IN POOR VISIBILITY G C Howell (RAE, Bedford, Engl.) May 1979 13 p

(AGARD-AR-142 ISBN-92-835-1319-3) Avail NTIS HC A02/MF A01

The desire of operators of all three services of the NATO nations to extend the use of helicopters and V/STOL aircraft into night and conditions of poor visibility has caused an expansion of activity in various technological fields but most particularly in the electro-optical and radar sensors of various kinds. The integration of these new sensors into modern navigation, flight control and display systems is an important aspect - particularly in helicopters where space and weight are at a premium Also the pilot workload is already high in helicopters and V/STOL aircraft near the ground and any new technology must be introduced in a manner to keep the workload within bounds so as not to lose the benefits of the new sensors.

N79-23947# General Dynamics/Fort Worth Tex ENERGY MANEUVERABILITY DISPLAY VALIDATION Funal Report May 1976 - Apr. 1978

Final Report, May 1976 - Apr 1978 A H Lusty Jr M K Fox, J M Norton and R J Wenham Apr 1978 121 p

(Contract F33615-76-C-3099)

(AFFDL-TR-78-35-Vol-1 AF Proj 2403) Avail NTIS HC A06/MF A01

Comparative testing of the F-16 aircraft energy maneuverability display (EMD) and a conventional display (CD) was performed in an F-16 simulation implemented on a large amplitude multimode aerospace research simulator. The test subjects (fighter pilots) performed two basic maneuvers with each display. Flight times were recorded for the turn and energy gain portions of each maneuver These times were statistically compared and engineering conclusions were made. Results of the simulation tests show that (1) for the hard turn maneuver the CD (with well-chosen rules-of-thumb) and the EMD are equally effective, (2) for the energy gain maneuver the CD and the EMD are equally effective for the 'clean' configuration however, for configurations with stores, the use of the EMD shows a significant advantage, and (3) for the combined sustained energy turn and energy gain maneuver the EMD is more effective than the CD for all configurations tested ARH

N79-23948*# Hydraulic Research Textron, Valencia, Calif AN ELECTRIC CONTROL FOR AN ELECTROHYDRAULIC ACTIVE CONTROL AIRCRAFT LANDING GEAR Final Report

Irving Ross and Ralph Edson Apr 1979 169 p refs (Contract NAS1-14459)

(NASA-CR-3113) Avail NTIS HC A08/MF A01 CSCL 01C An electronic controller for an electrohydraulic active control aircraft landing gear was developed Drop tests of a modified gear from a 2722 Kg (6000 lbm) class of airplane were conducted to illustrate controller performance. The results indicate that the active gear effects a force reduction, relative to that of the passive gear from 9 to 31 percent depending on the aircraft sink speed and the static gear pressure JMS

N79-23949# Iowa Univ Iowa City Materials Engineering Div

SUBSTRUCTURING METHODS FOR DESIGN SENSITIVITY ANALYSIS AND STRUCTURAL OPTIMIZATION Interim Technical Report, May - Aug 1977

A K Govil \dot{J} S Arora, and E J Haug Aug 1977 229 p refs

(Contracts DAAK11-77-C-0023 DAAA09-76-C-2013) (AD-A065935 TR-34) Avail NTIS HC A11/MF A01 CSCL 01/3

This report presents an iterative method for optimal design of large scale structures that incorporates the concept of substructuring Design sensitivity analysis for the method is developed in a state space setting in which the symmetry of the structural stiffness matrix is utilized to define efficient adjoint calculations that yield explicit design derivatives. The entire procedure is then presented as a convenient computational algorithm Applications of the method are given for optimal design of two and three dimensional truss idealized wing and framed structures Computer programs based on the present algorithm are presented for three truss structures (10 member plane cantilever truss 200 member plane truss, 63 member space truss), three idealized wing structures (18 element wing box beam, 39 element rectangular wing 150 element swept wing) and three framed structures (one-bay two-story plane frame, two-bay six-story plane frame 48 element space frame) Results obtained with the substructing formulation are compared first with results obtained without substructing and then with results obtained with other methods GRA

N79-23950# Iowa Univ, Iowa City Materials Engineering Div

FAIL-SAFE OPTIMAL DESIGN OF STRUCTURES WITH SUBSTRUCTURING Interim Technical Report, May 1977 -Aug 1978 D T Nguyen, A K Govil J S Arora, and E J Haug Aug

D T Nguyen, A K Govil J S Arora, and E J Haug Aug 1978 188 p refs

(Contract DAAK11-77-C-0023)

(AD-A065936, TR-45) Avail NTIS HC A09/MF A01 CSCL 01/3

The problem of fail-safe structural design is defined An optimal design formulation for the problem is developed with substructuring An optimal design algorithm based on the state space gradient projection method is derived. Optimal designs for several cases of an open and closed tail-boom structures for the Army Cobra helicopter are obtained and analyzed Constraints are imposed on stresses displacements buckling natural frequency and member sizes A user's manual for a computer program based on the algorithm is also described Author (GRA)

N79-23951# Kaman Avidyne Burlington Mass

NOVA-25, A STIFFENED PANEL EXTENSION OF THE NOVA-2 COMPUTER PROGRAM Final Report

Lawrence J Mente and William N Lee Kirtland AFB, N Mex Air Force Weapons Lab Dec 1978 153 p refs

(Contract F29601-78-C-0019)

(AD-A066038, AD-E200233 KA-TR-153 APNL-TR-78-182) Avail NTIS HC A08/MF A01 CSCL 01/3

A stiffened panel extension is developed into the NOVA-2S and NOVA-2LTS computer programs which replace the NOVA-2 and NOVA-2LT programs for nuclear overpressure vulnerability and analysis of aircraft These new versions are capable of analyzing a stiffened flat or cylindrical panel in both the elastic and inelastic response regions as well as retaining the capability of analyzing stiffeners and pure panels, individually in the stiffened panel analysis the stiffeners are treated discretely in either or both coordinate directions and are allowed various eccentric positions relative to the single-layered, multilayered and honeycomb panel skin configurations. The stiffened panel analysis is evaluated successfully by comparing the analytical solutions with experimental results from 3 test programs that measured strains and displacement responses on stiffened panels. An evaluation of the stiffened panel analysis versus the approach of analyzing individual elements of the stiffened panel is made by comparing the two approaches on the basis of response quantities at constant range and slant ranges at constant damage level. Three stiffened panels that are very similar to those found on the B-52 aircraft were used and it was concluded that, in general the individual element approach is not adequate and the stiffened panel analysis should be used for these types of stiffened panels GRA

N79-23952# Air Force Inst of Tech Wright-Patterson AFB, Ohio School of Engineering

THE PRODUCTION FUNCTION AND AIRFRAME COST ESTIMATION M S Thesis

John A Long Dec 1978 75 p refs (AD-A065570 AFIT/GOR/SM/78D (AD-A065570 AFIT/GOR/SM/78D-8) HC A04/MF A01 CSCL 14/1 NTIS Avail

In recent years, men and governments have become keenly aware of the huge capital outlays necessary in the acquiring of new weapons systems. Increased burden on limited capital has required more complete and careful planning. This planning has led to the need for accurate and timely cost predictions of new systems. Historically the variables affecting the future cost of aircraft airframes have been proven to be airframe weight and aircraft speed. These are often combined with learning hypothesis to form an airframe cost model. In this paper, the production function of microeconomics is combined with weight, speed and learning to form a nonlinear cost estimation model. Nonlinear least squares regression analysis was used in evaluating this model Although the results are inconclusive based on the data used weight and speed combined with learning still appear to be the best predictors of aircraft airframe cost Author (GRA)

N79-23954# Vought Astronautics, Dallas, Tex

VOLAR A DIGITAL COMPUTER PROGRAM FOR SIMU-LATING VSTOL AIRCRAFT LAUNCH AND RECOVERY FROM SMALL SHIPS VOLUME 1 PROGRAM DESCRIP-**TION Final Report**

Julian Wolkovitch and Billy B Brassell Dec 1978 124 p refs

(Contract N62269-77-R-0389)

(AD-A066172 Rept-2-32000/8R-41672-Vol-1

NADC-77123-30-Vol-1) Avail NTIS HC A06/MF A01 CSCL 01/2

A digital computer program has been developed for simulating the launch and recovery of VSTOL aircraft operating from small ships Volume 1 of this report describes the program, Volume 2 is the user's manual. The program known as VOLAR (Vought Launch and Recovery Dynamics Program) employs the computational technique of nonlinear covariance propagation. This permits the time histories of the means and variances of all systems state variables to be computed from a single run, as opposed to the Monte Carlo technique which requires multiple runs plus subsequent averaging Typically VOLAR requires approximately 7 percent of the computer time required for comparable Monte Carlo simulations. The program includes a general airframe mathematical model suitable for helicopters or fixed-wing aircraft The airwake of a small ship is also modeled and ship motion models are included. Two alternative models of the human pilot are supplied one is based on verbal adjustment rules, the other is based on optimal control theory, utilizing performance index parameters deduced from manned simulator experiments. The program is demonstrated for AV-8A recovery on a small ship The trends predicted by VOLAR are shown to agree with flight test data Author (GRA) N79-23955# Vought Astronautics Dallas Tex

VOLAR A DIGITAL COMPUTER PROGRAM FOR SIMU-LATING VSTOL AIRCRAFT LAUNCH AND RECOVER FROM SMALL SHIPS VOLUME 2 APPENDICES Final Report

Julian Wolkovitch and Billy B Brassell Dec 1978 338 p refs

(Contract N62269-77-R-0389)

(AD-A066173 Rept-2-32000/8R-51672-Vol-2,

NADC-77123-30-Vol-2) Avail NTIS HC A15/MF A01 CSCL 01/2

Partial Contents User's Manual Listing for Classical Pilot Model, Listing for Optimal Controller Pilot Model, Describing Functions of General Single-Valued Nonlinearities Representable by Straight-Line Segments and The I and R Arrays GRA

N79-23956# Air Force Flight Dynamics Lab, Wright-Patterson AFB. Ohio

PREDICTION OF THE ANGULAR RESPONSE POWER SPECTRAL DENSITY OF AIRCRAFT STRUCTURES Final Report, Jan 1976 - Jun 1978

Jon H Lee Michael Obal W and Dansen L Brown Dec 1978 98 p refs

NTIS (AD-A066141 AFFDL-TR-78-188) Δvail HC A05/MF A01 CSCL 01/3

The design of airborne electro-optical systems requires the knowledge of angular vibration as well as linear vibration of aircraft structures. Rather than predicting the angular vibration subject to aerodynamic and acoustic excitations an attempt is made here to relate the angular vibration directly to the linear vibration response. With the Bernoulli-Euler beam used as a theoretical model, a relationship has been derived between the linear and angular vibration power spectral density functions Based on this relationship together with the angular root-meansquared vibration amplitude as previously predicted by Lee and Whaley (AFFDL-TR-76-56, AF Flight Dynamcs Laboratory, Wright-Patterson AFB, Ohio), it is now possible to predict the angular power spectral density and a length scale associated with the angular measurement technique. Tested on the typical flight test data of RF-4C and F-15 fighters CH-3E helicopter, and B-52 bomber the predicted angular power spectral density lies within a + or - 0 db band about the measurement Though crude, such a prediction is useful in the preliminary design stage in that one can quickly estimate the angular vibration environment Author (GRA) prior to fabrication

N79-23958# Analytic Sciences Corp Reading Mass AVIONICS STANDARDIZATION POTENTIAL ANALYSIS

Final Report, 16 May 1977 - 16 May 1978 Robert K Gates and Robert F Shipp 30 Nov 1978 89 p

refs (Contract F33615-77-C-1167 AF Proj 2003)

AD-A066138, TASC-TR-1059-3, AFAL-TR-78-168) Avail NTIS HC A05/MF A01 CSCL 09/3

The objective of the Avionics Standardization Potential Analysis program is to develop a general methodology for evaluating the benefits accruing from the use of standard equipment across future USAF avionics systems. The methodology has been developed using navigation avionics as being representative of avionics in general, in a study of standardization potential across navigation systems (SPANS) The methodology covers the process of establishing future avionics systems requirements through mission analysis identification of available equipment for the design of mission-responsive avionics suites, evaluation of future quantitative demands for avionics equipment synthesis of mission-capable avionics systems collection of relevant cost and reliability data and evaluation of standardization options using a computer-based Standardization Evaluation Program (STEP)

GRA

N79-23959# National Technical Information Service Springfield Va

AEROSPACE COMPUTER SYSTEMS PART 1 AVIONICS APPLICATIONS, VOLUME 2 A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, 1976 - 1977 Brian Carrigan Apr 1979 210 p

(NTIS/PS-79/0312/3) Avail NTIS HC \$28 00/MF \$28 00 CSCL 09B

Studies of computer hardware and supporting software for aircraft applications are cited. The bibliography includes research on onboard data processing equipment, as well as navigation and guidance computers. This updated bibliography contains 203 abstracts, none of which is new to the previous edition. GRA

N79-23960# National Technical Information Service, Springfield, Va

AEROSPACE COMPUTER SYSTEMS PART 1 AVIONICS APPLICATIONS, VOLUME 3 A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, 1978 - Mar 1979

Brian Carrigan Apr 1979 97 p Supersedes NTIS/PS-78/0289, NTIS/PS-77/0126, NTIS/PS-76/0042

(NTIŚ/PS-79/0313/1 NTIS/PS-78/0289 NTIS/PS-77/0126, NTIS/PS-76/0042) Avail NTIS HC \$28.00/MF \$28.00 CSCL 09B

Equipment and computer programs for onboard data processing in support of aircraft guidance, flight control and air navigation are described in reports cited in this updated bibliography which contains 91 abstracts all of which are new to the previous edition GRA

N79-23963*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio

COMBINED PRESSURE AND TEMPERATURE DISTORTION EFFECTS ON INTERNAL FLOW OF A TURBOFAN ENGINE W M Braithwaite and Ronald H Soeder 1979 19 p refs Presented at the 15th Joint Propulsion Conf Las Vegas, 18-20 Jun 1979 cosponsored by AIAA, the Soc of Automotive Engr and ASME

(NASA-TM-79136, E-9984) Avail NTIS HC A02/MF A01 CSCL 21E

An additional data base for improving and verifying a computer simulation developed by an engine manufacturer was obtained The multisegment parallel compressor simulation was designed to predict the effects of steady-state circumferential inlet total-pressure and total-temperature distortions on the flows into and through a turbofan compression system. It also predicts the degree of distortion that will result in surge of the compressor The effect of combined 180 deg square-wave distortion patterns of total pressure and total temperature in various relative positions is reported. The observed effects of the combined distortion on a unitary bypass ratio turbofan engine are presented in terms of total and static pressure profiles and total temperature profiles at stations ahead of the inlet guide vanes as well as through the fan-compressor system These observed profiles are compared with those predicted by the complex multisegment model The effects of relative position of the two components comprising the combined distortion on the degree resulting in surge are discussed Certain relative positions required less combined distortion than either a temperature or pressure distortion by SES itself

N79-23964*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio

LEAN, PREMIXED, PREVAPORIZED COMBUSTION FOR AIRCRAFT GAS TURBINE ENGINES

Edward J Mularz 1979 18 p refs Presented at the 15th Propulsion Conf Las Vegas, 18-20 Jun 1979 cosponsored by AIAA the Soc of Automotive Eng and ASME Prepared in cooperation with Army Aviation Res and Develop Command, St Louis Mo

(NASA-TM-79148 E-004, AVRADCOM-TR-79-18) Avail NTIS HC A02/MF A01 CSCL 21E

The application of lean, premixed prevaporized combustion to aircraft turbine engine systems can result in benefits in terms of superior combustion performanace improved combustion and turbine durability and environmentally acceptable pollutant emissions Lean, premixed prevaporized combustion is particularly attractive for reducing the oxides of nitrogen emissions during high altitude cruise. The NASA stratospheric cruise emission reduction program will evolve and demonstrate lean premixed, prevaporized combustion technology for aircraft engines. This multiphased program is described. In addition, the various elements of the fundamental studies phase of the program are reviewed and results to date of many of these studies are summarized Author

N79-23965*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio

EFFECT OF DEGREE OF FUEL VAPORIZATION UPON EMISSIONS FOR A PREMIXED PREVAPORIZED COMBUS-TION SYSTEM

L P Cooper 1979 17 p refs Presented at the 15th Joint Propulsion Conf Las Vegas 18-20 Jun 1979, cosponsored by AIAA, SAE and ASME

(NASA-TM-79154 E-010) Avail NTIS HC A02/MF A01 CSCL 21E

An experimental and analytical study of the combustion of partially vaporized fuelair mixtures was performed to assess the impact of the degree of fuel vaporization upon emissions for a premixing-prevaporizing flametube combustor. Data collected show near linear increases in nitrogen oxide emissions with decreasing vaporization at equivalence ratios of 0.6 For equivalence ratio of 0.72 the degree of vaporization had very little impact on nitrogen oxide emissions. A simple mechanism which accounts for the combustion of liquid droplets in partially vaporized mixtures was found to agree with the measured results with fair accuracy with respect to both trends and magnitudes.

N79-23966*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio

EFFECT OF SHOCKS ON FILM COOLING OF A FULL SCALE TURBOJET EXHAUST NOZZLE HAVING AN EXTERNAL EXPANSION SURFACE

David M Straight 1979 20 p refs Presented at the 15th Joint Propulsion Conf Las Vegas 18-20 Jun 1979 cosponsored by AIAA, SAE and ASME

(NASA-TM-79157 E-013) Avail NTIS HC A02/MF A01 CSCL 21E

Experimental film cooling data obtained during exploratory testing with an axisymmetric plug nozzle having external expansion and installed on an afterburning turbojet engine in an altitude test facility is presented. The shocks and local hot gas stream conditions had a marked effect on film cooling effectiveness.

 existing film cooling correlation was adequate at some operating conditions but inadequate at other conditions such as in separated flow regions resulting from shock boundary layer interactions RES

N79-23968*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio

EFFECTS OF STEADY-STATE PRESSURE DISTORTION ON THE STALL MARGIN OF A J85-21 TURBOJET ENGINE

George A Bobula Mar 1979 28 p refs Prepared in cooperation with Army Aviation Research and Development Command Cleveland St Louis Mo

(NASA-TM-79123 E-9958 AVRADCOM-TR-79-12) Avail NTIS HC A03/MF A01 CSCL 21E

The effects of the inlet pressure distortions induced by five screen patterns on the performance of a J85-21 turbojet engine was conducted at the NASA Lewis Research Center Testing was in support of the HiMAT RPRV program at Dryden Flight Research Center Distortion patterns were chosen based on anticipated application of test results of the HiMAT installation Tests were conducted at a simulated Mach number and altitude condition of 0 9 and 10 973 meters Results are presented in terms of distortion levels and standard compressor performance parameters Author

N79-23969*# National Aeronautics and Space Administration Lewis Research Center, Cleveland Ohio

EFFECT OF STEADY-STATE PRESSURE DISTORTION ON FLOW CHARACTERISTICS ENTERING A TURBOFAN ENGINE

Ronald H Soeder and George A Bobula Apr 1979 34 p refs Prepared in cooperation with Army Aviation Research and Development Command St Louis Mo

(NA SA -TM - 79134 E-9982, AVRADCOM-TR-79-19) Avail NTIS HC A03/MF A01 CSCL 21E

Flow angle static-pressure and total-pressure distributions were measured in the passage ahead of a turbofan engine operating with inlet pressure distortion. Distortions were generated with five screen configurations and one solid plate configuration The screens and solid plate were circumferential and mounted on a rotatable assembly Reynolds Number Index upstream of the distortion device was maintained at 05, 035, or 02 and engine corrected low-rotor speeds were held at 6000 rpm and 8600 rpm Near the engine inlet, flow angle was largest at the hub and increased as flow approached the engine. The magnitude of static-pressure distortion measured along the inlet-duct and extended bullet nose walls increased exponentially as the flow approached the engine Wall static-pressure distortion was also a function of distortion harmonic Author

N79-23971*# National Aeronautics and Space Administration Ames Research Center Moffett Field, Calif

AIRCRAFT ENGINE NOZZLE Patent Application

Norman E Sorensen and Eldon A Latham inventors (to NASA) Filed 23 Mar 1979 14 p (NASA-Case-ARC-10977-1, US-Patent-Appl-SN-023436) Avail

NTIS HC A02/MF A01 CSCL 21E

A variable area exit nozzle arrangement for an aircraft engine having a substantially reduced length and weight is described It comprises longitudinally movable radial vanes and fixed radial vanes The movable radial vanes are alternately disposed with respect to the fixed radial vanes. Means for displacing the movable radial vanes along the longitudinal axis of the engine relative to the fixed radial vanes are determined. The fixed radial vanes radially extend across the main exhaust flow of the engine

NASA

N79-23973# Kaman Aerospace Corp Bloomfield Conn DRIVESHAFT ALIGNMENT INDICATOR Final Technical Report, Nov 1975 - May 1978 Frank A Bill and Robert B Bossler Jr Jan 1979 117 p

(Contract DAAJ02-77-C-0006 DA Proj 1L2-62209-AH-76) (AD-A065988, R-1547 USARTL-TR-79-3) Avail NTIS HC A06/MF A01 CSCL 01/3

The purpose of this program was to reduce the difficulty of drive-shaft alignment and to improve dynamic alignment by allowing inflight measurement on Army UH-1/AH-1 helicopters Under Contract DAAJ02-76-C-0010, a first-concept driveshaft alignment indicator was investigated The program included ground and flight tests on an Army UH-1 helicopter A second-generation concept was evolved which indicated improved accuracy and greatly reduced system cost. The second-generation concept was investigated under Contract DAAJ02-77-C-0006 The investigation included design and manufacture of a prototype alignment measuring tool ground and flight tests and a survey of the existing driveshaft alignments of Army helicopters The survey included eight UH-1 at Bradley Field Connecticut ten UH-1 at Felker Field Fort Eustis, Virginia and ten UH-1 at Simmons Field Fort Bragg North Carolina Subsequently three AH-1 were measured at Felker Field and finally a UH-1 with sling load was measured at Kaman. The significant measurements were static alignment hover at a 5-foot skid height, and low-speed high-power climb (70 knots forward speed, 1000 ft/minute GRA climb)

N79-23974# General Electric Co., Cincinnati Ohio Aurcraft Engine Group

TURBINE DESIGN SYSTEM Final Technical Report, 1 Nov 1975 - 30 Nov 1977

R R Wysong, T C Prince, D T Lenahan R D Caney and J S Keith Nov 1978 117 p refs (Contract F33615-75-C-2073 AF Proj 3066)

(AD-A066092, R78AEGXXX) Avail NTIS HC A06/MF A01 CSCL 21/5

A time-sharing computer system has been developed which provides for the interactive design and analytical performance evaluation of aircraft engine turbines. The system is modularized to permit the user to deal with one functional aspect of the design at a time twelve modules are employed to encompass the turbine aerodynamic, heat transfer, and mechanical design The analytical and numerical methods employed in each module

and their theoretical basis, are presented in this report Author (GRA)

N79-23977*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif A SIMPLIFIED ROTOR SYSTEM MATHEMATICAL MODEL

FOR PILOTED FLIGHT DYNAMICS SIMULATION

Robert T N Chen May 1979 28 p refs (NASA-TM-78575 A-7538) Avail NTIS HC A03/MF A01 CSCL 01C

The model was developed for real-time pilot-in-the-loop investigation of helicopter flying qualities. The mathematical model included the tip-path plane dynamics and several primary rotor design parameters such as flapping hinge restraint, flapping hinge offset, blade Lock number and pitch-flap coupling The model was used in several exploratory studies of the flying qualities of helicopters with a variety of rotor systems. The basic assumptions used and the major steps involved in the development of the set of equations listed are described. The equations consisted of the tip-path plane dynamic equation the equations for the main rotor forces and moments and the equation for control phasing required to achieve decoupling in pitch and roll due to cyclic inputs S E S

N79-23978*# Calspan Corp Buffalo, N Y ACTIVE CONTROL FOR THE TOTAL-IN-FLIGHT SIMULA-TOR (ACTIFS) Final Report

E G Rynaski D Andrisani II and N Weingarten Apr 1979 303 p refs Sponsored by NASA

(Contract F33615-73-C-3051) (NA SA-CR-3118, AK-5280-F-11) HC A14/MF A01 CSCL 01C

An identification procedure was developed that is used to systematically improve or update the mathematical model of the aeroelastic behavior of an airplane. A mathematical model that was originally obtained by analytical or theoretical methods is made amenable to piecemeal acceptance of parameters estimated from the data taken during flight tests. Linear optimal control theory was used to evolve a performance index specifying closed loop system dynamics. Control laws for the proper pole placement of seven modes of motion of the TIFS airplane two rigid body and five elastic modes were specified according to criteria developed The phase variable canonical transformation was used to help specify a minimum complexity observer network that required no interconnections of the sensor outputs and no measurements of the control input A conceptual design example of a simplified observer feedback control law for structural mode control of the TIFS airplane is presented. Gust alleviation techniques involving direct gust measurement and maneuver load control techniques were also developed resulting in a command augmentation system that simultaneously commands multiple surface deflections to a pilot command input ARH

N79-23979*# National Aeronautics and Space Administration Hugh L Dryden Flight Research Center Edwards, Calif PRECISION CONTROLLABILITY OF THE F-15 AIRPLANE

Thomas R Sisk and Neil W Matheny May 1979 46 p refs (NASA-TM-72861 H-1073) Avail NTIS HC A03/MF A01 CSCL 01C

A flying qualities evaluation conducted on a preproduction F-15 airplane permitted an assessment to be made of its precision controllability in the high subsonic and low transonic flight regime over the allowable angle of attack range. Precision controllability, or gunsight tracking studies were conducted in windup turn maneuvers with the gunsight in the caged pipper mode and depressed 70 mils This evaluation showed the F-15 airplane to experience severe buffet and mild-to-moderate wing rock at the higher angles of attack. It showed the F-15 airplane radial tracking precision to vary from approximately 6 to 20 mils over the load factor range tested. Tracking in the presence of wing rock essentially doubled the radial tracking error generated at the lower angles of attack. The stability augmentation system affected the tracking precision of the F-15 airplane more than it did that of previous aircraft studied Author

N79-23980# Messerschmitt-Boelkow-Blohm G m b H , Munich (West Germany)

EVALUATION OF A DIGITAL HELICOPTER CONTROL SYSTEM

Wolfgang J Kubbat 1977 13 p refs Presented at Assoc Aeron et Astronautique 3d European Rotocraft and Powered Lift Aircraft Forum Aix-en-Provence, France 7-9 Sep 1977 (MBB-UFE-1349-0) Avail NTIS HC A02/MF A01

An experimental digital control system for helicopter applications is described. The system incorporates the functions of control and stabilization autopilot air data computation and strap down computation. Realization of the system was made using a double processor computer. The control system and the sensors are selfmonitored providing a fail safe capability for one channel. It may also be used in redundant applications Successful flight tests were conducted. Author (ESA)

N79-23981# Advisory Group for Aerospace Research and Development Paris (France)

TECHNICAL EVALUATION REPORT ON THE FLUID DYNAMICS PANEL SYMPOSIUM ON DYNAMIC STABILITY PARAMETERS

Lars E Ericsson (LMSC Sunnyvale Calif) Apr 1979 16 p Symp held at Athens, 22-24 May 1963

(AGARD-AR-137 ISBN-92-835-1320-7) Avail NTIS HC A02/MF A01

An evaluation of the symposium is given along with the presentations made in the areas of wind tunnel techniques flight testing techniques analytical techniques, motion analyses and nonlinear formulations and sensitivity and simulator studies In addition, a workshop session and roundtable discussion on the presentations are discussed. Conclusions on the state of the art and recommendations for future activity complete the evaluation J M S

N79-23982# Aeronautical Research Labs Melbourne (Australia) AN INTRODUCTION TO DYNAMIC DERIVATIVES 2 THE EQUATIONS OF MOTION FOR WIND TUNNEL PITCH-YAW OSCILLATION RIGS

G F Forsyth Aug 1978 22 p refs (ARL-Aero-Note-377, AR-001-296)

(ARL-Aero-Note-377, AR-001-296) Avail NTIS HC A02/MF A01

The equations of motion were developed for a simplified free flight pitch-yaw system and for spring-mounted and rigidly-driven wind tunnel systems. For the spring-mounted system both initial displacement and forced-oscillation conditions were examined. A simplified cable towed system was also derived

JAM

N79-23984# ARO, Inc. Arnold Air Force Station Tenn MODEL DIFFUSER INVESTIGATION FOR PROPULSION WIND TUNNEL 16T Final Report, 21 Apr. - 5 Sep 1978 L J David and M G Hale AEDC 9 Nov 1978 34 p refs. (AD-A065822, AEDC-TSR-78-P48) Avail HC A03/MF A01 CSCL 20/4

A 1/16-scale model of the diffuser of the Propulsion Wind Tunnel (16T) was installed and tested in the Aerodynamic Wind Tunnel (1T) Objectives of the test were to evaluate the effectiveness of a number of geometric modifications of the diffuser to improve diffuser performance. Thirteen configurations involving combinations of six geometric modifications were evaluated in the tunnel Mach number range from 0.60 to 1.50 Author (GRA)

N79-23985# Air Force Human Resources Lab, Brooks AFB Tex

CONTRIBUTIONS OF PLATFORM MOTION TO SIMULATOR TRAINING EFFECTIVENESS STUDY 2 AEROBATICS Interim Report, Mar 1976 - Nov 1977 Elizabeth L Martin and Wayne L Waag Sep 1978 32 p

refs (AF Proj 1123)

(AD-A064305, AFHRL-TR-78-52) Avail NTIS HC A03/MF A01 CSCL 05/9 W J Renton Sep 1978 195 p refs 2 Vol (Contract F33615-76-C-5205)

(AD-A065500, Rept-2-53500/8CRL-96

AFML-TR-78-127-Vol-1) Avail NTIS HC A09/MF A01 CSCL 11/1

A ranked list of adhesive property data required to predict the response of the adhesive in a bonded joint under a variety of load and environmental conditions experienced by aircraft structures is presented. The assessed merits and deficiencies of existing test procedures to provide the adhesive property data are given along with a set of standard recommended test procedures for providing reliable low cost data. The utility ease of performance, and low cost of these various test methods for adhesives representing brittle and ductile structural behavior is demonstrated. J M S

N79-24155# Vought Helicopter Inc Dallas, Tex STRUCTURAL PROPERTIES OF ADHESIVES, VOLUME 1 Final Technical Report, Apr 1976 - Sep 1978

A transfer of training design was used to evaluate platform of simulator training with synergistic six-degree-of-freedom platform motion to the acquisition of aerobatic skills in the novice pilot Thirty-six pilot trainees with no previous jet piloting experience were randomly assigned to one of the three groups motion no-motion, and control Student performances was evaluated by instructor ratings and data cards It is concluded that from an operational viewpoint, the data revealed no practical value of platform motion cueing and questions the cost effectiveness of acrobatic simulator training FOS

N79-24158# Army Mobility Equipment Research and Development Command, Fort Belvoir Va

WATER ABSORPTION OF FLUIDS/OILS Final Report Robert G Jamison Jun 1978 32 p

	IS
HC A03/MF A01 CSCL 11/8	

The object of the investigation was to determine the effects of water absorption on the inhibitor systems and basestocks of various hydraulic fluids and engine oils. From this experimentation a need was generated to develop a more accurate method for analyzing water in these fluids and oils. The results subsequently obtained verified the fact that absorbed water affects the stability of the inhibited fluid and oil systems. Author (GRA)

N79-24161# Army Armament Research and Development Command, Dover N J Large Caliber Weapon Systems Lab EVALUATION OF NEW BONDING SYSTEMS FOR DEPOT-LEVEL MAINTENANCE OF AIRCRAFT HONEYCOMB PANELS Final Report

Raymond F Wegman Marie C Ross William Russell and Elizabeth A Garnis Dec 1978 55 p refs

AD-A066117 AD-E400280 ARLCD-TR-78019) Avail NTIS HC A04/MF A01 CSCL 11/1

Four adhesive systems, EA 9628 ADX 656 2 PL 717B and M1113, are evaluated and reported to be improvements over adhesives presently used for bonding honeycomb structures in army helicopters. These systems have increased durability and fatigue properties but do not change the stiffness of the panel Using corrosion-inhibiting primers can increase the life expectancy of the structure provided the application of the primer is very stringently controlled An investigation into fracture analysis of failed joints indicates that the origin of failure the mechanism of crack propagation and an estimate of the load the joint experienced at the time of failure can be detected by a careful analysis of the joint. A nondestructive technique by which the degradation in a bonded panel can be followed using the Harmonic Bond Tester has been evaluated The technique detects changes in the adhesive the onset of corrosion in the bond line and the presence of voids Author (GRA)

N79-24163# McDonnell Aircraft Co St Louis Mo DEFINITION AND NON-DESTRUCTIVE DETECTION OF CRITICAL ADHESIVE BOND-LINE FLAWS Final Report, 27 Jun 1975 - 31 Jul 1978

H T Clark Wright-Patterson AFB Ohio AFML Jul 1978 93 p refs (Contract F33615-75-C-5209 AF Proj 486U) (AD-A065584 AFML-TR-78-108) Avail NTIS HC A05/MF A01 CSCL 11/6

Fatigue tests were conducted on adhesive bonded aluminum specimens with intentionally induced adhesive bondline flaws Specimen design details, materials type of surface preparation. The test loadings were selected to be representative of those on the bonded wide-body fuselage test article designed and built in the PABST program. Tests conducted in this report show that bondline flaws loaded primarily in shear did not grow whereas those loaded by peel or tension forces did exhibit flaw growth Flaw growth rate was higher at the slow rate of two cycles per hour than for a fast-cycle rate of 30 Hz. Bondline flaws grew incrementally with load cycles and could be tracked by state-of-the-art NDE.

N79-24169# Air Force Academy Colo Research Lab AIRCRAFT ENGINE OIL ANALYSIS BY NEUTRON ACTIVA-TION TECHNIQUES Summary Report

Thomas A Menard Dec 1978 60 p refs (AF Proj 2303)

(AD-A066202, FJSRL-TR-78-0016) Avail NTIS HC A04/MF A01 CSCL 11/8

At the present time all three military services use the Spectrometric Oil Analysis Program (SOAP) for the routine analysis of engine oil samples. The purpose of this program is to continually monitor the amounts of wear metal contaminants found in engine oil as an indicator of engine wear and possible engine failure Use of such a program results in large savings by extending the time between oil changes and more importantly by indicating when engines should be taken out of service for preventive maintenance. The current program uses either atomic emission or atomic absorption for the analysis. The problems associated with the current methods are twofold First, the instruments require a laboratory environment and the results from a particular sample may take days to return to the user. Under these conditions an engine might be operated to failure before notification of a failed oil sample. Secondly, the instruments are fairly expensive. This report summarizes the research which was done using Californium-252 as a neutron source in order to determine the feasibility of using such a source for analyzing USAF aircraft engine oil samples by neutron activation techniques. The desired solution would be an inexpensive facility which could be located on every flightline and provide the individual concentration of 13 different elements in each oil sample prior to the aircraft being flown again GRA

N79-24172*# Boeing Commercial Airplane Co Seattle, Wash DESIGN AND EVALUATION OF AIRCRAFT HEAT SOURCE SYSTEMS FOR USE WITH HIGH-FREEZING POINT FUELS Final Report

A J Pasion NASA May 1979 53 p refs (Contract NAS3-20815) (NASA-CR-159568 D6-48097) A

(NASA-CR-159568 D6-48097) Avail NTIS HC A03/ MF A01 CSCL 21D Avail NTIS

The objectives were the design performance and economic analyses of practical aircraft fuel heating systems that would permit the use of high freezing-point fuels on long-range aircraft Two hypothetical hydrocarbon fuels with freezing points of -29 C and -18 C were used to represent the variation from current day jet fuels A Boeing 747-200 with JT9D-7/7A engines was used as the baseline aircraft A 9300 Km mission was used as the mission length from which the heat requirements to maintain the fuel above its freezing point was based JAM

N79-24178# Department of Energy Bartlesville Okla Energy Technology Center

STABILITY CHARACTERISTICS OF HYDROCARBON FUELS FROM ALTERNATIVE SOURCES

Dennis W Brinkman, M L Whisman, and John N Bowden Mar 1979 40 p refs

(BETC/RI-78/23) Avail NTIS HC A03/MF A01

Two samples of gasoline and six samples of jet fuel derived from coal tar sands or oil shale were subjected to accelerated storage stability tests at 43 3 and 93 3 C Two samples of commercial petroleum-based gasoline and one sample of a petroleum based jet fuel also were evaluated in this program for comparative purposes DOE

N79-24201# National Technical Information Service, Springfield Va

AIRCRAFT SONIC BOOM EFFECTS ON BUILDINGS A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, 1964 - Feb 1979

Guy E Habercom Jr Apr 1979 82 p Supersedes NTIS/PS-78/ 0239 NTIS/PS-77/0219 NTIS/PS-76/0176

(NTIS/PS-79/0265/3 NTIS/PS-78/0239 NTIS/PS-77/0219 NTIS/PS-76/0176) Avail NTIS HC \$28.00/MF \$28.00 CSCL 01C

Research findings are cited on the effects of sonic booms on buildings structural components forms, windows and walls Test-house investigations are included along with damage analysis and vibration response Documentation is made on residential buildings Other topics contained in the volume range from theory to failure analysis GRA

N79-24202# Advisory Group for Aerospace Research and Development Paris (France)

RESEARCH AND DEVELOPMENT ACTIVITIES IN ITALY IN THE FIELD OF AEROSPACE STRUCTURES AND MATERI-ALS

L Lazzarino (Piss Univ , Italy) Mar 1979 27 p refs Presented at the 47th Meeting of the AGARD Structures and Mater Panel Florence Italy, 25 Sep 1978

(AGARD-R-675, ISBN-92-835-1315-0) Avail NTIS HC A03/MF A01

The activities concerned with metallic and nonmetallic aerospace materials along with the fields of stress analysis, vibrations and aeroelasticity fatigue and crack propagation and particularly, interesting work aimed at resolving design problems and at facilitating the introduction of new technologies The main facilities developed are indicated M M M M

N79-24214# Ohio State Univ Columbus Electroscience Lab

HIGH FREQUENCY NEAR FIELD SCATTERING BY AN ELLIPTIC DISK

Eric D Greer and W D Burnside Dec 1976 64 p refs (Contract N62269-76-C-0554)

(AD-A065586, ESL-4583-1, NADC-79041-30) Avail NTIS HC A04/MF A01 CSCL 09/5

The analysis of the high frequency radiation pattern of an antenna mounted near an elliptic disk is the object of this research. This is an analytic study of basic antenna types using GTD (ray optical) techniques. The elliptic disk is modelled as a perfectly conducting flat plate and patterns are taken in the far field. An equivalent current modification is introduced to correct caustic and pseudo-caustic regions where the GTD solution fails. The validity of the solution is shown by comparing the predicted pattern against measured results. The elliptic disk solution can be used to approximate antenna patterns of antenna mounted near arbitrary cross-section flat plates. This solution for aircraft and ship models.

N79-24215# Ohio State Univ, Columbus Electroscience Lab

FUSELAGE-MOUNTED ANTENNA CODE USER'S MAN-UAL

W D Burnside, R J Marhefka, and E L Pelton Jul 1977 75 p refs

(Contract N62269-76-C-0554)

(AD-A065587 ESL-4583-2, ESL-784583 NADC-79042-30) Avail NTIS HC A04/MF A01 CSCL 09/5

This manual describes the input and output data associated with the volumetric computer code which has been delivered to the Naval Air Development Center The input data is defined in general terms and applied to the Boeing 737 aircraft Numerous examples are included to illustrate the various features of the computer code Author (GRA) N79-24216# Ohio State Univ Columbus Electroscience

WING-MOUNTED ANTENNA CODE USER'S MANUAL R J Marhefka and W D Burnside May 1978 86 p refs (Contract N62269-76-C-0554)

(AD-A065589 ESL-(78)4583-5 NADC-79044-30) Avail NTIS HC A05/MF A01 CSCL 09/5

This report provides the necessary information to run a FORTRAN IV computer code which is used to analyze antenna patterns The antenna can be in the presence of various structures which can be simulated by finite flat plates an infinite ground plane and a finite elliptic cylinder. For example the radiation pattern of an antenna mounted on the wing of an aircraft can be analyzed. The computer code is theoretically based on the Geometrical Theory of Diffraction approach. Various examples are presented to illustrate the versatility of the code as well as its subtleties.

N79-24217# Ohio State Univ, Columbus Electroscience Lab

AN ITERATIVE APPROACH FOR COMPUTING AN ANTEN-NA APERTURE DISTRIBUTION FROM GIVEN RADIATION PATTERN DATA

E L Pelton R J Marhefka, and W D Burnside Jun 1978 45 p refs

(Contract N62269-76-C-0554)

(AD-A065590 ESL-(78)4583-6 NADC-79045-30) Avail NTIS HC A03/MF A01 CSCL 09/5

An iterative synthesis procedure is presented and applied to the problem of computing the complex aperture distribution of an antenna given its far field magnitude pattern. The methods employed are applicable to antennas composed of either discrete or continuously distributed apertures flush-mounted in a finite or infinite ground plane. The solutions obtainable with the procedure are particularly useful for subsequent numerical computation of an antenna situation pattern performance when introduced into a different structural environment. Several example solutions are presented to demonstrate the procedure and to point out specific techniques found useful in its implementation.

N79-24220# Ohio State Univ Columbus Electroscience Lab

OPTIMUM FREQUENCIES FOR AIRCRAFT CLASSIFICA-TION

Lin Heng-Cheng and A A Ksienski Jan 1979 124 p refs (Grant AF-AFOSR-2611-74 AF Proj 2304)

(AD-A065697 ESL-(78)3815-6 AFOSR-79-0255TR) Avail NTIS HC A06/MF A01 CSCL 17/9

The results are presented of a search for optimum frequencies to classify eight aircraft types by means of their radar returns. The performance in terms of misclassification probabilities as a function of SNR is presented for different feature sets ranging from amplitude returns for a single frequency through amplitude and phase for various frequency pairs. Author (GRA)

N79-24229# Ohio State Univ Columbus Electroscience Lab

AN ASYMPTOTIC RESULT FOR THE SCATTERING OF A PLANE WAVE BY A SMOOTH CONVEX CYLINDER

P H Pathak Mar 1978 41 p refs (Contract N62269-76-C-0554)

(AD-A065588 ESL-(78)4583-3 NADC-79043-30) Avail

NTIS HC A03/MF A01 CSCL 20/14

An approximate asymptotic high frequency result which is convenient for engineering applications is obtained for the field scattered by a smooth perfectly-conducting convex cylinder when it is illuminated by a plane wave This result is uniform in the sense that it remains valid within the transition regions adjacent to the shadow boundaries where the pure ray optic (or GTD) solution fails and it automatically reduces to the ray optic solution exterior to the transition regions where the latter solution becomes valid Furthermore this result is expressed in the convenient format of the GTD and it employs the same ray paths as in the GTD solution This uniform result is not valid in the close neighborhood of the cylinder hence a separate asymptotic result is presented for this special case in a form which is also convenient for applications. The asymptotic results presented here are useful for predicting the patterns of antennas radiating in the presence of convex conducting cylindrical structures. Author (GRA)

N79-24232# STI International Corp., Menlo Park Calif NAP-OF-THE-EARTH COMMUNICATION PROGRAM FOR US ARMY HELICOPTERS Final Report, 1 Mar 1976 -31 Mar 1978

Bruce C Tupper and George H Hagn Jun 1978 331 p refs (Contract DAAB07-76-C-0868 SRI Proj 4979) (AD-A063089 USAAVRADCOM-76-0868-F) Avail NTIS HC A15/MF A01 CSCL 17/2

The communication problem, requirements and solutions for helicopters flying nap-of-the-earth (NOE) in the modern battlefield are given A model for predictions of communication ranges in irregular terrain (terrain noise environment and radio system parameters as variables) was developed. Model inputs are median basic transmission loss man-made atmospheric and galactic noise, candidate radio system parameters (Transmitter ERP and required SNR at receiver), and the standard deviations of these parameters The model output is the probability of successful communication at a given range in irregular terrain. The model was used in the European SCORES scenario to predict communication and mission effectiveness in the Fulda region for candidate radio systems Limited model validation data are given Quantitative test results for the TCATA FM-320 NOE communication test are given and discussed. These tests compared the AN/ARC-117 Baseline radio with other radio candidates 40-W VHF Retransmission and HF/SSB In addition quantitative results are given for VHF/FM HF/SSB and satellite NOE systems tests JMS

N79-24342 British Library Lending Div. Boston Spa (England) TWO-STAGE SUPERCHARGER SETS EFFICIENCY AND HEAD DISTRIBUTION UNDER FULL- AND PART-LOAD CONDITIONS

Hanns-Guenther Bozung Mar 1979 26 p refs Transl into ENGLISH from Motortech Z (West Germany) v 39 no 5 1978 p 209-215

(RTS-11613) Avail British Library Lending Div Boston Spa Engl

The following topics are discussed (1) exhaust gas turbocharger requirements (2) limits of single-stage exhaust gas turbocharging (3) possibilities of two-stage exhaust gas turbocharging (4) efficiency and (5) part-load performance G Y

N79-24350*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio

DIAGNOSTICS OF WEAR IN AERONAUTICAL SYSTEMS L D Wedeven 1979 5 p refs Presented at the 15th State-of-the-Art Symp on Corrosion and Wear Washington D C, 4-6 Jun 1979, sponsored by the Am Chem Soc (NASA-TM-79185 E-052) Avail NTIS HC A02/MF A01 CSCL 20K

Maintenance costs associated with the transmissions and drive train greatly increase the maintenance burden and failure risk Detection measurements fall under two general categories of vibration and particle detectors. The latter are more amenable to tracking wear. Wear debris analysis can supply a great deal of information such as particle concentration rate of change in concentration composition particle size and shape principal metals etc. It is not economically feasible to monitor all variables At least one role of the lubrication and wear specialist is to provide guidance in selecting the most appropriate variables to monitor. RES

N79-24378# Iowa Univ Iowa City Materials Engineering Div

DYNAMIC STRUCTURAL ANALYSIS WITH SUBSTRUC-TURES Interim Technical Report, Sep - Dec 1978 Jasbir S Arora and Duc T Nguyen Dec 1978 34 p refs (Contract DAAK11-77-C-0023) (AD-A065937 TR-46) Avail NTIS HC A03/MF A01 CSCL 13/13

A method for dynamic structural analysis with substructures and the subspace iteration is developed. The method does not use component mode synthesis concepts Therefore eigenproblem for each substructure is not solved. The method uses only substructural stiffness matrices and the mass matrix for each finite element of the system. The mass matrix for the entire structure or any of its substructures need not be computed However efficiency of the method is improved when mass matrix for the entire structure is computed and saved in the computer core Unlike component mode substitution methods, no approximating assumptions are made. Thus natural frequencies and mode shapes for the finite element model employed are the same with or without the substructuring algorithm. This is demonstrated by computing first ten natural frequencies and the corresponding mode shapes for an open truss helicopter tail-boom structure Author (GRA)

N79-24379# Air Force Flight Dynamics Lab Wright-Patterson AFB Ohio

ANALYZE ANALYSIS OF AEROSPACE STRUCTURES WITH MEMBRANE ELEMENTS Final Report, May - Aug 1978

Vipperla B Venkayya and Victoria A Tischler Dec 1978 117 p refs

(AD-A065633 AFFDL-TR-78-170) Avail NTIS HC A06/MF A01 CSCL 13/13

This report contains documentation for the program ANALYZE The program library consists of a bar a membrane triangle a quadrilateral and a shear panel. The equations of finite element analysis element formulations program organization and subroutine descriptions provide a comprehensive theoretical background for the program. The input and output instructions together with the sample problem and the results should provide adequate information for the use of this program ANALYZE' is an in-house program and can be used on INTERCOM for problems up to 150 to 200 degrees of freedom and a comparable number of elements This program is extremely useful in training engineers in the use of finite element programs in the development of finite element models of large aerospace structures and in research in structural analysis and optimization Author (GRA)

N79-24773*# National Aeronautics and Space Administration Langley Research Center Hampton Va

STATISTICAL COMPARISONS OF AIRCRAFT FLYOVER NOISE ADJUSTMENT PROCEDURES FOR DIFFERENT WEATHER CONDITIONS

Arnold W Mueller and David A Hilton May 1979 35 p refs (NASA-TP-1430 L-12626) Avail NTIS HC A03/MF A01 CSCL 20A

Aircraft flyover noise spectra and effective perceived noise level (EPNL) values obtained under widely different weather conditions were adjusted according to a proposed national standard. The results were statistically compared with the same measured spectra adjusted according to an alternate procedure and with reference spectra and EPNL values obtained under almost ideal weather conditions. Three different ways to represent the weather condition through which the sound propagated were also evaluated _______ J M S

N79-24779# Forschungsinstitut fuer Hochfrequenzphysik Werthhoven (West Germany)

DETECTION OF LOW FLYING AIRCRAFT BY ACOUSTICAL MEANS

J Schiller Jul 1978 52 p refs in GERMAN ENGLISH summary Sponsored by Bundesmin fuer Verteidigung (Rept-8-78) Avail NTIS HC A04/MF A01

Detection and location of very low flying aircraft is often impossible or at least very difficult to achieve by radar. The idea of filling this detection gap by making use of the acoustic noise radiated from an aircraft is considered. Some general thought is given to the problem of acoustically measuring parameters of targets that move with speeds close to sonic speed Some preliminary experiments allow a rough estimate of the detection range and bearing measurement errors to be made Author (ESA)

N79-24780# National Technical Information Service Springfield Va

AIRCRAFT SONIC BOOM STUDIES ON AIRCRAFT FLIGHT, AIRCRAFT DESIGN, AND MEASUREMENT A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, 1964 - Feb 1979

Guy E Habercom Jr Apr 1979 197 p Supersedes NTIS/PS-78/0238, NTIS/PS-77/-0218 NTIS/PS-76/0175 (NTIS/PS-79/0264/6 NTIS/PS-78/0238 NTIS/PS-77/0218, NTIS/PS-76/0175) Avail NTIS HC \$28 00/MF \$28 00 CSCL 20A

The reports discuss aerodynamic design of aircraft and wings flight characteristics and maneuvers, supersonic transport characteristics acoustic fields and noise measurement government policies and regulations meteorological parameters shock waves, and supersonic and hypersonic wind tunnel tests along with other theoretical and general investigations. This updated bibliography contains 188 abstracts 7 of which are new entries to the previous edition.

N79-24940# Joint Publications Research Service, Arlington Va

APPLICATION OF ELECTRON-BEAM WELDING TO AVIA-TION PRODUCTION

Henryk Zatyka In Its Transl on Eastern Europe Sci Affairs, No 625 (JPRS-73266) 20 Apr 1979 p 22-36 refs Transl into ENGLISH from Tekhn Lotniczna i Astronautyczna (Warsaw) no 1 Jan 1979 p 29-33

Avail NTIS HC A03/MF A01

An electron beam furnace used in the serial production of small turbines and turbocompressors for nonaviation production in Poland, was modified to melt the metal required for welding aircraft turbines engine parts Technical parameters of the welding process were established and instrumentation to insure high output was developed and executed Metallurgical and strength tests were conducted on welded joints and conditions for welding a turbine were established which would insure a weld without faults and of the required strength Five turbine disks were welded and after further mechanical working were subjected to long term tests (2,000 hours) A R H

 $\textbf{N79-24951}^{\#}$ National Aeronautics and Space Administration Washington D C

ADVANCED ROTORCRAFT TECHNOLOGY TASK FORCE REPORT

15 Oct 1978 189 p

(NASA-TM-80541) Avail NTIS HC A09/MF A01 CSCL 02A

The technological needs and opportunities related to future civil and military rotorcraft were determined and a program plan for NASA research which was responsive to the needs and opportunities was prepared In general the program plan places the pinmary emphasis on design methodology where the development and verification of analytical methods is built upon a sound data base. The four advanced rotorcraft technology elements identified are aerodynamics and structures flight control and avionic systems propulsion and vehicle configurations Estimates of the total funding levels that would be required to support the proposed program plan are included. A R H

N79-24955*# National Aeronautics and Space Administration Langley Research Center Hampton Va

STATUS OF KNOWLEDGE OF SONIC BOOMS

Domenic J Maglieri, Harry W Carlson, and Harvey H Hubbard Jun 1979 20 p refs Presented at the 97th Tech Meeting of the Acoustical Soc of America Cambridge, Mass 12-16 Jun 1979

(NASA-TM-80113) Avail NTIS HC A02/MF A01 CSCL 01A

The status of sonic boom technology with emphasis on the recent research results is summarized included are definitions

of the boom carpets both primary and secondary a discussion of existing experience with primary booms including the status of overpressure predictions and boom minimization methodology through airplane design an indication of the boom waveforms and audibility and a discussion of focus booms resulting from aircraft maneuvers as well as the effect of abnormal atmospheric conditions on these maneuver booms MMM

N79-24956*# National Aeronautics and Space Administration Langley Research Center Hampton Va A VECTOR-CONTINUOUS LOADING CONCEPT FOR AERODYNAMIC PANEL METHODS

William B Kemp Jr May 1979 39 p refs

(NASA-TM-80104) HC A03/MF A01 CSCL 01A

An approach to the reduction of discretization errors in aerodynamic panel methods is presented. The approach is based on preventing the occurrence of induced velocity singularities at panel slope discontinuities by maintaining continuity of the velocity jump vector across the panels. The approach was implemented in a two-dimensional incompressible panel method formulation and evaluated by application to several external and internal flow problems. The method is shown to exhibit a second order accuracy trend and to produce smaller errors with velocity component boundary conditions imposed on the real flow than with equipotential boundary conditions imposed on the imaginary flow behind the panels. For flows around airfoil sections with either sharp or blunt trailing edges the method gives excellent agreement with results from a well developed finite difference method The method is well behaved and is insensitive to irregularities in panel size distribution SES

N79-24958*# National Aeronautics and Space Administration Langley Research Center Hampton Va

HELICOPTER ROTOR AIRFOIL Patent Application Gene J Bingham inventor (to NASA) Filed 6 Mar 1979 21 p

(NASA-Case-LAR-12396-1 US-Patent-Appl-SN-017889) Avail NTIS HC A02/MF A01 CSCL 01A

An airfoil which has particular application to the blade or blades of rotor aircraft and aircraft propellers is presented. The airfoil thickness distribution camber and leading edge radius are shaped to locate the airfoil crest at a more aft position along the chord and to increase the freestream Mach number at which sonic flow is attained at the airfoil crest. The reduced slope of the airfoil causes a reduction in velocity at the airfoil crest at lift coefficients from zero to the maximum lift coefficient. The leading edge radius is adjusted so that the maximum local Mach number at 1.25 percent chord and at the designed maximum lift coefficient is limited to about 0.48 when the Mach number normal to the leading edge is approximately 0.20. The lower surface leading edge radius is shaped so that the maximum local Mach number at the leading edge is limited to about 0.29 when the Mach number normal to the leading edge is approximately 0.20 The drag divergence Mach number associated with the airfoil is moved to a higher Mach number over a range of lift coefficients resulting in superior aircraft performance

NASA

N79-24959*# National Aeronautics and Space Administration Hugh L Dryden Flight Research Center Edwards Calif

AN ANNULAR WING Patent Application

Harold J Walker inventor (to NASA) Filed 30 May 1979 25 p

(NASA-Case-FRC-11007-2 US-Patent-Appl-SN-043911) Avail NTIS HC A02/MF A01 CSCL 01A

An annular wing suitable for supporting in flight an aircraft characterized by the absence of directional stabilizer surfaces is described The wing comprises an annular body of a substantially uniformly symmetrical configuration characterized by an annular positive lifting surface and a chord line coincident with a segment of a line radiating along the surface of an inverted truncated cone whereby a decalage is established for the leading and trailing semicircular portions of the body relative to instantaneous line of flight and a dihedral is established for the laterally opposed semicircular portions of the body relative to the line of flight. The direction of flight and the climb angle or glide slope are established by selectively positioning the center of mass of the wing ahead of the aerodynamic center along a radius coincident with an axis for a selected line of flight NASA

N79-24960*# National Aeronautics and Space Administration Langley Research Center Hampton Va

LOW-SPEED WIND TUNNEL RESULTS FOR A MODIFIED 13-PERCENT-THICK AIRFOIL

Robert J McGhee and William D Beasley May 1977 41 p refs

(NASA-TM-X-74018) Avail NTIS HC A03/MF A01 CSCL 01A

Wind-tunnel tests were conducted to evaluate the effects on performance of modifying a 13-percent-thick low-speed airfoil The airfoil contour was altered to reduce the aft upper surface pressure gradient and hence delay boundary layer separation at typical lift coefficients for light general aviation airplanes. The tests were conducted at a Mach number of 0 15 or less over a Reynolds number range from about 1 000 000 to 9 000 000 Author

N79-24961*# National Aeronautics and Space Administration Langley Research Center Hampton Va

LOW SPEED WIND TUNNEL INVESTIGATION OF WING FINS AS TRAILING-VORTEX-ALLEVIATION DEVICES ON A TRANSPORT AIRPLANE MODEL

Delwin R Croom and G Thomas Holbrook Jun 1979 30 p refs

(NASA-TP-1453 L-12776) Avail NTIS HC A03/MF A01 CSCL 01A

The trailing-vortex-alleviation effectiveness of both a oneand a two-fin configuration (semicircular with a radius of 0.043 semispan) on a jumbo-jet transport airplane model in its landing configuration was investigated in the Langley V/STOL tunnel by the trailing-wing sensor technique. The fins were located on the upper surface of the transport model wing along the 30-percent-chord line The fin configurations were effective in reducing the vortex-induced rolling moment by amounts varying from 28 to 60 percent on the trailing wing model located at a distance of 7.8 transport model wing spans downstream of the transport model The flow over the fins and over the transport airplane model wing downstream of the fins was observed to be separated and turbulent. All fin configurations caused a reduction in maximum lift coefficient a positive increment in drag coefficient and an increment in nose-up pitching-moment coefficient on the transport airplane model J M S

N79-24963# Naval Postgraduate School Monterey Calif THEORETICAL ANALYSIS OF TRANSONIC FLOW PAST UNSTAGGERED OSCILLATING CASCADES M S Thesis Peter Carlton Olsen Sep 1978 135 p refs (AD-A063083) Avail NTIS HC A07/MF A01 CSCL 20/4

An independent verification of the collocation method as a technique for calculating the lift on an oscillating airfoil in an unstaggered cascade immersed in transonic flow is presented Two formulations are shown one is purely numerical the second employs an analytic expansion for small frequency Author (GRA)

N79-24965# Boeing Aerospace Co Seattle Wash

FACTORS INFLUENCING THE ACCURACY OF AERODY-NAMIC HINGE-MOMENT PREDICTION Final Report, Apr 1977 - Apr 1978

Wen-Fan Lin and Michael D Clarke Aug 1978 107 p refs (Contract F33615-76-C-3170 AF Proj 2403)

(AD-A066606 D180-24604-1 AFFDL-TR-78-72) Avail NTIS HC A06/MF A01 CSCL 01/3

This report is concerned with factors influencing the accuracy of aerodynamic hinge-moment analyses. The formulation and coding of the hinge-moment analysis in the FLEXSTAB system of computer programs are reviewed. The investigation is centered on the sensitivity of the hinge moments of the YF-16 airplane to paneling configuration, including the near-field/far-field techniques The results are compared with test data. The effect of elasticity is also considered. The other existing aerodynamic methods for predicting control-surface loading are also reviewed and discussed These methods include Datcom RHO 4 higher order lifting-surface methods such as TEA 230 and the PAN AIR pilot program and new theoretical approaches employing asymptotic expansion methods to account for local hinge-line corner and side-edge effects Recommendations are made as to the best approach currently to employ in the panel methods as well as future research areas related to hinge-moment analysis Author (GRA)

N79-24966# Boeing Vertol Co Philadelphia Pa

INTERACTIONAL AERODYNAMICS OF THE SINGLE ROTOR HELICOPTER CONFIGURATION VOLUME 3B FLOW ANGLE AND VELOCITY WAKE PROFILES IN LOW FRE-QUENCY BAND, AIR EJECTOR SYSTEMS AND OTHER DEVICES Final Report, 15 Mar 1977 - 13 Feb 1978

Philip F Sheridan Sep 1978 203 p (Contract DAAJ02-77-C-0020 DA Proj 1L2-62209-AH-76) (AD-A061767 USARTL-TR-78-23C-Vol-3B) Avail NTIS HC A10/MF A01 CSCL 01/3

This is the second of the two sub-volumes comprising Volume III These documents present profiles of the RMS values of the wake flow angles and velocities in the 1 Omega to 2 Omega range The format is waterline on the ordinate and velocity or flow angle on the abscissa. Each graph shows a comparison of the baseline flow to the flow modified by some device or condition This sub-volume covers air ejector systems air ejectors and hub caps in same configuration wings fairings and miscellaneous Author (GRA) devices

N79-24967# Boeing Vertol Co Philadelphia, Pa INTERACTIONAL AERODYNAMICS OF THE SINGLE ROTOR HELICOPTER CONFIGURATION VOLUME 2B HARMONIC ANALYSIS OF AIRFRAME SURFACE PRESSURE DATA, RUNS 7-14, MID SECTION Final Report, Mar 1977 - Feb 1978

Philip F Sheridan Sep 1978 219 p (Contract DAAJ02-77-C-0020 DA Proj 1L2-62209-AH-76) (AD-A061860 USARTL-TR-78-238-Vol-28) Avail NTIS

HC A10/MF A01 CSCL 01/3 This is the second of the nine sub-volumes of Volume II These documents contain harmonic analyses of the waveforms generated by each of the 53 pressure transducers which covered the surface of the model fuselage and empennage. This sub-volume covers the first eight of the twenty-seven runs devoted to surface pressure testing. The analyses encompass the transducers in the middle section of the model. Test conditions and configurations include baseline data climb and descent, disk loading variation and application of strakes Author (GRA)

N79-24968# Boeing Vertol Co Philadelphia Pa INTERACTIONAL AERODYNAMICS OF THE SINGLE ROTOR HELICOPTER CONFIGURATION VOLUME 6B ONE-THIRD OCTAVE BAND SPECTROGRAMS OF WAKE SINGLE FILM DATA, BASIC CONFIGURATION WAKE EXPLORATIONS

Final Report, Mar 1977 - Feb 1978 Philip F Sheridan Sep 1978 374 p

(Contract DAAJ02-77-C-0020 DA Proj 1L2-62209-AH-76)

(AD-A061861 USARTL-TR-78-23F-Vol-6B) Avail NTIS A16/MF A01 CSCL 01/3 нс

This is the second of the three volumes of Volume VI containing one-third octave band spectrographs of the model helicopter hub/rotor wake velocities derived from the single-film velocity transducer data. This sub-volume deals with the wake characteristics of the baseline configuration Author (GRA)

N79-24970# Messerschmitt-Boelkow-Blohm G m b H Ottobrunn (West Germany) Unternehmensbereich Flugzeuge-Entwicklung

THE COMPUTATION OF TRANSONIC FLOW IN WIND TUNNELS AT INLETS AND CASCADES USING THE FINITE ELEMENT METHOD

Albrecht Eberle 5 Apr 1978 55 p refs in GERMAN ENGLISH

(MBB-UFE-1421-O) Avail NTIS HC A04/MF A01

A very flexible finite element/volume approach to the solution of classical potential transonic flow problems was developed to

be used with computer methods for calculating theoretical flow past airfoil profiles. The solution assumes quasi two-dimensional flow Since orthogonal meshgrids are not needed the computer codes are extremely simple As examples of applications the computation of transonic ducted flow in nozzles wind tunnels inlets and plane cascades is shown Author (ESA)

N79-24971 British Library Lending Div Boston Spa (England) FORCASTING THE QUANTITATIVE CHARACTERISTICS OF AIRCRAFT ICING

K G Abramovich G V Vasil yeva and V M Prokhorova 2 Jun 1978 17 p refs Transl into ENGLISH from Tr Gidromet Nauch -Issled Tsent SSSR (Leningrad) v 176, 1977 p 76-85 In ENGLISH and RUSSIAN

(BLL-Trans-1364-(9022 549)) Avail British Library Lending Div, Boston Spa Engl

The quantitative characteristics of aircraft icing from data on the condition of the atmosphere in cloud layers with the aid of statistical analysis by computer are presented. The differences between the computed and actual intensities are relatively small for moderate using. For slight using the computed values were enhanced while for severe icing they were depressed. The temperature and height of cloud base varied considerably within the limits of each class of intensity resulting in high mean MMM values

N79-24974# National Aviation Facilities Experimental Center Atlantic City, N. J.

AN EVALUATION OF TURN ANTICIPATION TECHNIQUES AND OFFSET FLYING PROCEDURES USING A SINGLE. WAYPOINT RNAN SYSTEM Final Report, May - Nov 1977

Bernard Goldberg Donald Eldredge, and William Crimbring Jan 1979 88 p refs

(FAA Proj 044-326-350)

(AD-A066555 FAA-NA-78-41, FAA-RD-78-114) Avail NTIS HC A05/MF A01 CSCL 17/7

The purpose is to document the results of a three-phased cockpit simulation which was conducted to evaluate turn application techniques applicable for use with a single-waypoint, general aviation type area navigation system. Techniques were evaluated for both centerline and offset tracking Performance was measured for two variables total system crosstrack error and flight technical error. The major findings were (1) all turn anticipation techniques tested could be used for centerline tracking (2) no significant differences could be discovered between steady state and offset turn data, (3) a useable technique for turn anticipation during offset tracking is complex and contributes greatly to the pilot workload **JAM**

N79-24976* National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio

SELF STABILIZING SONIC INLET Patent

Brent A Miller inventor (to NASA) Issued 15 May 1979 5 p Filed 29 Mar 1978

(NASA-Case-LEW-11890-1 US-Patent-4,154 256

US-Patent-Appl-SN-891244, US-Patent-Class-137-15 1

US-Patent-Class-244-53B) Avail US Patent and Trademark Office CSCL 01C

An inlet suitable for a turbine engine in a STOL VTOL or CTOL aircraft is described A circumferentially extended slot is provided in the inner surface of the air inlet at the windward side and downstream of the throat region. The slot communicates with a circumferential plenum chamber formed in the front of the air inlet just behind the lip. Circumferentially extending rows of apertures are provided on the lip establishing two sets of apertures spaced circumferentially away from the slot in opposite directions. The slot removes the boundary layer from the critical portion of the diffuser to minimize or eliminate flow pressure loss or separations resulting from diffusion or tuning. The apertures are in a region of low static pressure on the lip of the inlet and serve as a source of suction to cause air flow into the slot

Official Gazette of the U.S. Patent and Trademark Office

N79-24977 Stanford Univ Calif A VARIATIONAL THEOREM FOR LAMINATED COMPOSITE PLATES OF NONLINEAR MATERIALS AND APPLICATIONS TO POSTBUCKLING Ph D Thesis Robert Elon Anderson 1979 206 p

Avail Univ Microfilms Order No 7912335

A prediction capability for the response under edge loading of anisotropic layered flat plates composed of orthotropic laminae possessing nonlinear stress-strain characteristics was investigated Confidence in the results presented for the prediction of laminated plate stress-strain response and the elasto-plastic postbuckling of one type of simply supported square laminated plate under axial compression loading is obtained by comparison of predictions based on current theory analysis and solution procedures with reliable experimental data and limiting case (isotropic and orthotropic) solution results. It was concluded that advanced composite laminates consisting of arbitrarily oriented orthotropic filamentary laminae are tractable by variational analysis and that such laminates acting as uniaxially compressed postbuckled plates are as fundamentally sensitive to material nonlinearity as their conventional metal counterparts Dissert Abstr

N79-24978*# Douglas Aircraft Co Inc Long Beach Calif CARGO LOGISTICS AIRLIFT SYSTEMS STUDY (CLASS) VOLUME 2 CASE STUDY APPROACH AND RESULTS

R J Burby and W H Kuhlman Oct 1978 98 p Prepared in cooperation with Flying Tiger Line

(Contract NAS1 14948)

(NASA-CR-158913) Avail NTIS HC A05/MF A01 CSCL 01C

Models of transportation mode decision making were developed The users view of the present and future air cargo systems is discussed. Issues summarized include (1) organization of the distribution function (2) mode choice decision making (3) air freight system and (4) the future of air freight SES

N79-24980*# National Aeronautics and Space Administration Langley Research Center Hampton, Va

A COOLING SYSTEM FOR AN AIRCRAFT HAVING A CRUISE RANGE FROM MACH 2 TO MACH 8 Patent Application

Pierce L Lawing and Laverne L Pagel inventors (to NASA) (McDonnell Arcraft Co) Filed 31 Jan 1979 21 p (NASA-Case-LAR-12406-1 US-Patent-Appl-SN-008210) Avail

NTIS HC A02/MF A01 CSCL 01C

The necessity of shielding an aircraft airframe constructed of material such as aluminum is eliminated by using a system which provides total cooling for an airframe designed to fly in the speed range of Mach 2 to Mach 8 Cooling is accomplished by passing a coolant through the aircraft airframe the coolant acting as a carrier to remove heat from the airframe. The coolant is circulated through a heat pump and a heat exchanger which together extract essentially all of the added heat from the coolant The heat is transferred to the aircraft fuel system via the heat exchanger and the heat pump. The heat extracted from the coolant is utilized to power the heat pump. The heat pump is associated with a power turbine mechanism which is also driven by the extracted heat. The power turbines are utilized to drive various aircraft subsystems the compressor of the heat pump and provide engine cooling This system is accomplished with a small increase in aircraft weight and a total result of a small increase in performance NASA

N79-24981# Douglas Aircraft Co Inc Long Beach Calif FEASIBILITY AND COST EFFECTIVENESS OF AIRBORNE TIRE PRESSURE INDICATING SYSTEMS Final Report, Sep 1977 - Sep 1978

R Suiter Oct 1979 122 p refs (Contract DOT-FA77WA-4070) (AD-A065513 FAA-RD-78-134-1) NTIS Avail HC A06/MF A01 CSCL 01/3

The wheel mounted pressure readout gauges and devices and cockpit tire pressure warning indicators for air carrier transports having 6 10 and 18 wheels are studied Typical wheel mounted readout devices and eleven conceptual cockpit indicating systems are discussed. Information on accuracy temperature compensation requirements weight installation cost system cost and system maintenance cost is provided. A study of tire failures is made for 1973-1976 identifying rate of tire failures and aircraft damage costs resulting from tire failures Sixty-five percent of airframe damage cost is related to underinflation - induced or related tire failures which may be avoided by a property designed tire pressure indicating system Average airframe damage cost per departure for each study aircraft based on actual airline data is presented with comments on delay and cancellation costs Aircraft damage costs and tire maintenance costs may be avoided are compared to tire pressure indicating system life cycle costs to shot that tire pressure systems are basically feasible but marginally cost effective aircraft testing of promising systems is recommended M M M

N79-24982# Air Force Flight Dynamics Lab Wright-Patterson AFB Ohio

PROCEEDINGS OF AFFDL FLYING QUALITIES SYMPOSI-

UM Interim Report, Aug 1973 - Sep 1978 G Thomas Black David J Moorhouse and Robert J Woodcock Dec 1978 639 p refs Symp held at Dayton, Ohio 12-15 Sep 1978

AFFDL-TR-78-171) NTIS (AD-A066493 Avail HC A99/MF A01 CSCL 01/2

The symposium was sponsored by the Air Force Flight Dynamics Laboratory as part of an effort to revise MIL-F-8785B Military Specification Flying Qualities of Piloted Airplanes Flying Qualities specialists were brought together from industry government agencies and university Topics for discussion were (1) experience and problems with MIL-F-8785B (2) revisions to MIL-F-8785B currently proposed by AFFDL/FGC (3) a new format for the flying qualities requirements, and (4) future requirements in general Full-length and informal papers were solicited to address any of the preceding topics. In addition, working sessions were organized to discuss the current revisions and future requirements from the viewpoints of different technical disciplines This report contains the papers and summaries of the working sessions as submitted by the authors GRA

N79-24983# Boeing Vertol Co Philadelphia Pa

HELICOPTER TRANSMISSION VIBRATION AND NOISE REDUCTION PROGRAM VOLUME 3 EVALUATION OF FIBER FP METAL-MATRIX HOUSING SPECIMENS Final Report, Mar - Oct 1978

Joseph W Lenski Jr Jan 1979 100 p refs

(Contract DAAJ02-74-C-0040 DA Proj 1G2-62207-AH-89) (AD-A066794 D210-11442-1-Vol-3

USARTL-TR-78-2C-Vol-3) Avail NTIS HC A05/MF A01 CSCL 01/3

The objective of the work performed under this contract was to demonstrate selective reinforcement of a cast magnesium housing by the use of high-modulus FP fibers via casting technology A series of housing element specimens were designed fabricated and tested to evaluate the application of state-of-theart technology to the fabrication of a full-scale, fiber-reinforced metallic transmission housing. Several typical housing section specimens were fabricated and tested to determine material properties These properties were compared with predicted values to develop the technology and analytical capability for the application of selective reinforcement of a full-scale helicopter transmission housing, with the final objective of reducing system deflections, noise, and vibration Author (GRA)

N79-24984# General Dynamics/Fort Worth Tex COMPOSITE FORWARD FUSELAGE SYSTEMS INTEGRA-TION, VOLUME 2 Final Report, Apr 1977 - May 1978 B J Wallace, B J C Burrows, R T Zeitler A J Ledwig, and

K G Wiles Sep 1978 149 p refs (Contract F33615-76-C-5439)

NTIS

(AD-A066560, AFFDL-TR-78-110-Vol-2) Avail HC A07/MF A01 CSCL 01/3

The Composite Forward Fuselage Systems Integration program has performed the development necessary to guide the integration of avionic and electrical systems into composite aircraft structure. This volume of the report presents one phase of the program, it presents that phase in which the induced effects of lightning are identified and modeled GRA

N79-24985# Sikorsky Aircraft Stratford Conn AEROELASTICALLY CONFORMABLE ROTOR MISSION ANALYSIS Final Report

Robert H Blackwell and Sebastian J Cassarino Mar 1979 76 p refs

(Contract DAAJ02-77-C-0041 DA Proj 1L2-62209-AH-76) (AD-A067338 SER-510017, USARTL-TR-79-5) Avail NTIS HC A05/MF A01 CSCL 01/3

An analytic study was conducted to assess the suitability of a conformable rotor for satisfying the requirements of a typical Army mission. A conformable rotor blade is a blade designed to produce changes in blade twist with azimuth and flight condition which improve performance and reduce rotor loads. This study quantified the performance advantages and rotor system load reductions possible with a conformable rotor by designing blades suited for the UH-60A mission and comparing calculated rotor behavior with that of the UH-60A rotor Relative to the UH-60A design the conformable blade employs a four-to-one reduction in torsional stiffness over the outer half of the blade a reduction in built-in twist from -16 to -12 degrees an increase from 20 to 30 degrees in tip sweep and reflex tab deflection inboard of the 80-percent radial position. This design produces elastic response which increase twist in hover and reduces advancing blade twist in forward flight GRA

N79-24986# Messerschmitt-Boelkow-Blohm G m b H Ottobrunn (West Germany) Unternehmensbereich Flugzeuge-Entwicklung

POLAR LIFT AND DRAG DETERMINATION DURING FLIGHT TESTS (ERMITTLUNG VON AUFTRIERS UND WIDERSTANDSPOLAREN IM FLUGVERSUCH

A Knaus 1 Mar 1978 70 p In GERMAN Presented at DGLR-Colloq Flugversuchserfahren im Milit Bereich Manching West Ger, 20-21 Apr 1978

(MBB-UFE-1410-0) Avail NTIS HC A04/MF A01

The various measurements and equipment necessary to determine the aerodynamic performance of an aircraft (stationary, normal flight maneuvering) are discussed. Techniques developed for the Tornado test flight program are presented Measurements corresponding measurement parameters, and theoretical considerations are given. For this aircraft, lift and drag characteristics. were determined over a complete range of attack angles with an accuracy of between 4 percent and 5 percent. Fully automated data handling techniques permit the results to be analyzed in minimum time Author (ESA)

N79-24987# General Accounting Office Washington, D C Procurement and Systems Acquisition Div

IS THE AV-88 ADVANCED HARRIER AIRCRAFT READY FOR FULL-SCALE DEVELOPMENT

30 Jan 1979 29 p

(PB-290826/7, PSAD-79-22) Avail NTIS HC A03/MF A01 CSCL 01C

The AV-8B Advanced Harrier aircraft reach the decision milestone for going into fullscale development. GAO was advised by Department of Defense officials that the President and the Secretary of Defense decided not to request any funds for the AV-8B program and that the Under Secretary of Defense for Research and Engineering also refused to permit the Navy to obligate \$108 million of the \$123 million in full-scale development funds that was appropriated Unless this action is reversed by the Congress the AV-8B program will effectively be termi-GRA nated

N79-24988*# National Aeronautics and Space Administration Hugh L. Dryden Flight Research Center, Edwards, Calif

A SYSTEM FOR PROVIDING AN INTEGRATED DISPLAY OF INSTANTANEOUS INFORMATION RELATIVE TO AIRCRAFT ATTITUDE, HEADING, ALTITUDE, AND HORIZONTAL SITUATION Patent Application

Robert James inventor (to NASA) (James and Assoc Lancaster Calif) Filed 30 May 1979 45 p (Contract NAS4-2199)

(NASA-Case-FRC-11005-1 US-Patent-Appl-SN-043942) Avail NTIS HC A03/MF A01 CSCL 01D

A display device is described which provides an aircraft pilot with combined inflight attitude heading, altitude and horizontal situation information. This invention combines a commonly used and commercially available flight director-type devices for a display in combination with a miniature aircraft supported for angular displacement from a vertical orientation to indicate heading error or heading offset. An extended course deviation indicator bar is also provided which projects into juxtaposition with the miniature aircraft for providing a true picture of the aircraft's horizontal situation relative to a selected VOR ILS or MLS course NASA

N79-24989# Lockheed-California Co Burbank Advanced Avionics Dept

ANALYSIS OF THE IMPACT OF A 270 VDC POWER SOURCE ON THE AVIONIC POWER SUPPLIES IN THE S-3A AIRCRAFT Final Report, Nov. 1977 - Nov 1978

27 Nov 1978 232 p refs (Contract N62269-78-C-0007)

(AD-A066526 LR-28780 NADC-79012-60) Avail NTIS HC A11/MF A01 CSCL 09/5

The objective of this analysis was to determine the total platform impact on an S-3A avionic suite outfitted with 270 V DC switched mode regulators in lieu of standard 115/200 V 400 Hz transformer coupled series regulators and to quantify the resulting impact in terms of changes to aircraft weight mission performance fuel usage, reliability and LCC

Author (GRA)

N79-24990# Draper (Charles Stark) Lab Inc Cambridge Mass A REVIEW OF THE 3M DATA BASE FOR FAULT-TOLERANT SYSTEM INCENTIVES Final Report, Jul 1977 - Dec 1978 Albert L Hopkins Jr Jan 1979 37 p refs

(Contract N00014-76-C-0502)

(AD-A066697 R-1244) Avail NTIS HC A03/MF A01 CSCL 17/2

This report covers the second phase of the subject contract whose first phase was the study of a hierarchical form of a fault-tolerance data communication network. The second phase task involved an examination of the Navy's 3-M (maintenance material management) data base to see if any evidence was readily available or easily extractable to affirm or refute the hypotheses underlying fault-tolerant system design. A large volume of aggregate data was examined for three aircraft types the E-2C the P-3C, and the S-3A Several broad conclusions were reached with respect to the fault-tolerant system design hypotheses. Some observations and interferences are presented to conclude this report Author (GRA)

N79-24991# Honeywell Inc Minneapolis Minn Systems and Research Center

COLOR DISPLAY DESIGN GUIDE Final Report, 15 Apr 1977 - 31 Dec 1978

Marjorie J Krebs James D Wolf, and John H Sandvig Oct 1978 224 p refs

(Contract N00014-77-C-0349)

(AD-A066630 HONEYWELL-78SRC79 ONR-CR-213-136-2F) Avail NTIS HC A10/MF A01 CSCL 01/3

The objective was to develop a design guide for the use of color in advanced avionics displays. Study results are presented in two parts Part I presents principles for use of color, plus supporting data where such data exist Principles of Part I are general and can be applied in virtually any application involving color coding of display information. Part II represents the application of these principles to real-world cockpit displays Recommended color codes are developed for application to electronic displays in fighter/attack aircraft. Examples of representative display formats incorporating the recommended coding are provided Author (GRA)

N79-24992# Vought Corp Dallas Tex

AAES/TA-7C CONTROL AND DISPLAY INTERFACE Final Report, May - Oct 1978

J R Perkins D E Lautner, and A J Marek Oct 1978 62 p refs

(Contract N62269-78-C-0126)

(AD-A067219 Rept-2-54-00/8R-3512 NADC-77326-60) Avail NTIS CSCL 09/3

This program was conducted for establishing requirements and developing specific design data for a hot bench mockup (simulator) The simulator system being developed is based on the AAES Prototype Design evolved by the Vought corporation under contract N62269-75-C-0391 The simulator system will ulitimately be used by NADC to provide a laboratory verification of the operation and performance of the AAES in an aircraft weapon system environment. The evolved simulator design is formulated around the TA-7C aircraft electrical and avionic systems and the general physical/installation constraints of the TA-7C forward and mid fuselage sections. The designs developed under this contract were limited to electrical-avionic system definition and design primarily in the control and display areas Simulator structural system installation and wire harness designs are planned for development under a follow-up contract. The designs developed under this contract include the full application of the AADS technologies to the TA-7C electrical and avionic subsystems and systems The AAES technologies include HVDC (High Voltage DC) Power Generation SOSTEL (Solid State Electrical Logic) Power Distribution and Management and AMUX (Avionic Multiplexing) Author (GRA)

N79-24993# Advisory Group for Aerospace Research and Development Paris (France)

PROCESSING OF AIRBORNE RECONNAISSANCE DATA FOR IN-FLIGHT DISPLAY AND NEAR REAL-TIME TRANS-MISSION

G vanKeuk (Forschungsinst fuer Funk und Math.) Mar 1979 67 p refs

(AGARD-AR-135, ISBN-92-835-1310-X) Avail NTIS HC A04/MF A01

Communication on aircraft beyond the horizon is discussed The fundamental relationships between several parameters and interactions and between human factors and technology to assist operational and technical users were examined SES

N79-24994*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio

PREMIXED PREVAPORIZED COMBUSTOR TECHNOLOGY FORUM

1979 262 p refs Conf held at Cleveland, Ohio, 9-10 Jan 1979

(NASA-CP-2078 E-9933) Avait NTIS HC A12/MF A01 CSCL 21E

The Forum was held to present the results of recent and current work intended to provide basic information required for demonstration of lean, premixed prevaporized combustors for aircraft gas turbine engine application Papers are presented which deal with the following major topics (1) engine interfaces (2) fuel-air preparation (3) autoignition (4) lean combustion, and (5) concept design studies

N79-24995*# Pratt and Whitney Aircraft Group East Hartford Conn

TURBULENCE CHARACTERISTICS OF COMPRESSOR DISCHARGE FLOWS

Howard P Grant /n NASA Lewis Res Center Premixed Prevaporized Combustor Technol Forum 1979 p 5-31

Avail NTIS HC A12/MF A01 CSCL 21E

Turbulence measurements were conducted in a large gas turbine engine (JT9D) at the entrance to the diffuser duct joining the compressor discharge to the combustor inlet Hot film probe and hot wire probe measurements were obtained at temperatures from 450K (350F) (idle) to 608K (635F) (rich approach) At I D (25 percent span) and mid-span locations the turbulence intensity increased slightly from 6 + or - percent at idle condition to 7 or - 1 percent at rich approach At O D (75 percent span) the turbulent intensity increased more rapidly, from 7 5 + or - 05 percent at idle to 15 + or - 05 percent at rich approach The spectra showed turbulent energy distributed uniformly over a 0 1 to 5 KHz bandwidth (down 3db) at all operating conditions

corresponding to random turbulence with velocity wave lengths of 2 cm to 1 meter travelling at the mean velocity of 100 m/sec Tests results are given in tables and graphs A R H

N79-24996*# General Electric Co Cincinnati Ohio TURBULENCE MEASUREMENTS IN THE COMPRESSOR EXIT FLOW OF A GENERAL ELECTRIC CF6-50 ENGINE Jack R Taylor /n NASA Lewis Res Center Premixed Prevaporized Combustor Technol Forum 1979 p 33-45

Avail NTIS HC A12/MF A01 CSCL 21E

Ruggedized cooled film probes were used to measure CF6-50 compressor exit turbulence properties at three different engine idle condition test points. The turbulence probe was coupled to a constant temperature anemometer and signal conditioning system An on-line readout system connected to the anemometer was used to check the data as it was acquired. At engine idle conditions the turbulence intensity ranged from 48 percent to 5.6 percent and the length scale ranged from 5.64 cm to 6 95 cm The length scale values are somewhat larger than the passage height at the measurement plane (5 54 cm) which indicates that the shape of the turbulent eddies are elongated in the axial direction. The microscale values range from about 0.73 cm to about 0.98 cm. Power spectral density distributions show that a large proportion of the turbulent energy at the measurement plane is concentrated at frequencies below one kilohertz ARH

N79-25001*# United Technologies Research Center East Hartford Conn

AUTOIGNITION OF FUELS

Louis J Spadaccini In NASA Lewis Res Center Premixed Prevaporized Combustor Technol Forum 1979 p 95-107 ref

Avail NTIS HC A12/MF A01 CSCL 21E

An autoignition test section and a premixing fuel injector developed to determine the autoignition characteristics of a variety of aircraft fuels are described Parametric tests to map the ignition delay characteristics of Jet-A fuel were conducted at pressures of 10 15 20 25 and 30 atm inlet air temperatures up to 900K and fuel-air equivalence ratios of 0.3 0.5 0.7 and 1.0 Residence times in the range of 1 to 50 msec were obtained by interchanging spool pieces to create six different mixer/ vaporizer lengths (6, 23 53 84 99 and 130 cm) and by testing at two different airflow rates (0.5 and 1.0 kg/sec) The resulting free-stream velocities were in the range 20 to 100 m/sec As expected the results indicate that the ignition delay times decrease with increasing air temperature and pressure Also the data show that for lean mixtures ignition delay times decrease with increasing activations of A.R.H.

N79-25004*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio EFFECT OF FUEL/AIR NONUNIFORMITY ON NITRIC OXIDE EMISSIONS

Valerie J Lyons *In its* Premixed Prevaporized Combustor Technol Forum 1979 p 131-134

Avail NTIS HC A12/MF A01 CSCL 21E

A flame tube combustor holding jet A fuel was used in experiments performed at a pressure of 3 Mpa and a reference velocity of 25 meters/second for three inlet air temperatures of 600 700 and 800 K. The gas sample measurements were taken at locations 18 cm and 48 cm downstream of the perforated plate flameholder. Nonuniform fuel/air profiles were produced using a fuel injector by separately fueling the inner five fuel tubes and the outer ring of twelve fuel tubes. Six fuel/air profiles were produced for nominal overall equivalence ratios of 5 and 6 An example of three of three of these profiles and their resultant nitric oxide NOx emissions are presented. The uniform fuel/air profile cases produced uniform and relatively low profile levels. When the profiles were either center-peaked or edgepeaked the overall mass-weighted nitric oxide levels increased A R H

N79-25011*# General Electric Co Cincinnati Ohio ADVANCED LOW EMISSIONS CATALYTIC COMBUSTOR PROGRAM AT GENERAL ELECTRIC

W J Dodds /n NASA Lewis Res Center Premixed Prevaporized Combustor Technol Forum 1979 p 215-227 refs

Avail NTIS HC A12/MF A01 CSCL 21E

The Advanced Low Emissions Catalytic Combustors Program (ALECC) is being undertaken to evaluate the feasibility of employing catalytic combustion technology in aircraft gas turbine engines as a means to control emission of oxides of nitrogen during subsonic stratospheric cruise operation. The ALECC Program is being conducted in three phases. The first phase which was completed in November 1978 consisted of a design study to identify catalytic combustor designs having the greatest potential to meet the emissions and performance goals specified. The primary emissions goal of this program was to obtain cruise NO emissions of less than 1g/kg (compared with levels of 15 to 20 g/x obtained with current designs)/ However, good overall performance and feasibility for engine development were heavily weighted in the evaluation of combustor designs.

N79-25012*# Pratt and Whitney Aircraft Group East Hartford, Conn

ADVANCED LOW EMISSIONS CATALYTIC COMBUSTOR PROGRAM AT PRATT AND WHITNEY

G J Sturgess In NASA Lewis Res Center Premixed Prevaporized Combustor Technol Forum 1979 p 229-245

Avail NTIS HC A12/MF A01 CSCL 21E

The feasibility of employing catalytic combustion technology to control the emissions of oxides of nitrogen for subsonic stratospheric cruise aircraft operations is the objective of this NASA contract The existing Envormmental Protection Agency standards for the landing and takeoff cycle were also required to be satisfied Work for the first phase of a proposed three phase effort is reported and is concerned with analytical design studies GY

N79-25013*# Pratt and Whitney Aircraft Group East Hartford Conn

LEAN, PREMIXED, PREVAPORIZED COMBUSTOR CON-CEPTUAL DESIGN STUDY

Anthony J Fiorentino In NASA Lewis Res Center Premixed Prevaporized Combustor Technol Forum 1979 p 247-254

Avail NTIS HC A12/MF A01 CSCL 21E

The seven month study program has the objective to identify and evaluate promising lean premixed prevaporized combustor concepts utilizing variable geometry and/or other flow control techniques. The general approach taken to accomplish this objective is outlined and consists of combustor design design analysis and design ranking. The schedule being taken to achieve this program is shown. Although the ultimate goal of this program is the significant reduction of cruise oxides of nitrogen both the EPA emission standards and combustor performance levels outlined are retained as goals as well.

N79-25014*# General Electric Co Cincinnati Ohio

LEAN, PREMIXED, PREVAPORIZED COMBUSTOR CON-CEPTUAL DESIGN STUDY

E E Ekstedt /n NASA Lewis Res Center Premixed Prevaporized Combustor Technol Forum 1979 p 255-263

Avail NTIS HC A12/MF A01 CSCL 21E

Phase 1 of the Lean Premixed-Prevaporized Comubstor Design Study is a nine month analytical study effort with no experimental or testing activities included. The program has the objective to design and analyze advanced combustor concepts with features for fuel premixing and prevaporization upstream of the combustion zone for use in future subsonic aircrafts with features for fuel premixing and prevaporization upstream of the combustion zone for use in future subsonic aircraft engines. All of the designs also embody some form of variable geometry for combustor flow modulation. The primary criterion for these designs is low oxides of nitrogen emissions at stratospheric cruise conditions Four combustor concepts are being designed for the NASA/GE Energy Efficient Engine (EEE) envelope and cycle Current status of the program is that the four concepts sized for the EEE were designed and are currently undergoing analysis and evaluation

GΥ

N79-25015*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio

MULTIVARIABLE CONTROL ALTITUDE DEMONSTRATION ON THE F100 TURBOFAN ENGINE

B Lehtinen R L DeHoff (Systems Control Inc Palo Alto Calif) and R D Hackney (Pratt and Whitney Aircraft Group West Palm Beach Fla) 1979 31 p refs Presented at the 15th Joint Propulsion Conf Las Vegas Nev 18-20 Jun 1979 sponsored by AIAA Soc of Automotive Engr. and ASME (NASA-TM-79183 E-050) Avail NTIS HC A03/MF A01 CSCL

21E

The F100 Multivariable control synthesis (MVCS) program was aimed at demonstrating the benefits of LGR synthesis theory in the design of a multivariable engine control system for operation throughout the flight envelope The advantages of such procedures include (1) enhanced performance from cross-coupled controls (2) maximum use of engine variable geometry and (3) a systematic design procedure that can be applied efficiently to new engine systems The control system designed under the MVCS program, for the Pratt & Whitney F100 turbofan engine is described Basic components of the control include (1) a reference value generator for deriving a desired equilibrium state and an approximate control vector, (2) a transition model to produce compatible reference point trajectories during gross transients (3) gain schedules for producing feedback terms appropriate to the flight condition and (4) integral switching logic to produce acceptable steady-state performance without engine operating limit exceedance I A M

N79-25016*# National Aeronautics and Space Administration Lewis Research Center Cleveland, Ohio

FUNDAMENTALS OF GAS TURBINE COMBUSTION

Melvin Gerstein (Univ of Southern Calif Los Angeles) 1979 52 p Workshop held at Cleveland, 6-7 Feb 1979 (NASA-CP-2087 E-026) Avail NTIS HC A04/MF A01 CSCL 21E

Combustion problems and research recommendations are discussed in the areas of atomization and vaporization combustion chemistry combustion dynamics and combustion modelling. The recommendations considered of highest priority in these areas are presented.

N79-25017^{*}# Williams Research Corp Walled Lake Mich ADVANCED GENERAL AVIATION TURBINE ENGINE (GATE) CONCEPTS Final Report

E J Lays and G L Murray 26 Jun 1979 189 p refs (Contract NAS3-20758)

(NASA-CR-159603 WRC-78-113-15) Avail NTIS HC A09/MF A01 CSCL 21E

Concepts are discussed that project turbine engine cost savings through use of geometrically constrained components designed for low rotational speeds and low stress to permit manufacturing economies Aerodynamic development of geometrically constrained components is recommended to maximize component efficiency Conceptual engines airplane applications airplane performance engine cost and engine-related life cycle costs are presented. The powerplants proposed offer encouragement with respect to fuel efficiency and life cycle costs and make possible remarkable airplane performance gains. M.M.M.

N79-25018*# Solar Turbines International San Diego Calif INTERNALLY COATED AIR-COOLED GAS TURBINE BLADING Final Report, Aug 1977 - Dec 1978 L Hsu W G Stevens and A R Stetson Mar 1979 102 p

refs

(NASA-CR-159574 SR79-R-4655-15) Avail NTIS HC A06/MF A01 CSCL 21E

Ten candidate modified nickel-aluminide coatings were developed using the slip pack process. These coatings contain additives such as silicon chromium and columbium in a nickel-aluminum coating matrix with directionally solidified MAR-M200 + Hf as the substrate alloy Following a series of screening tests which included strain tolerance dynamic oxidation and hot corrosion testing the Ni-19A1-1Cb (nominal composition) coating was selected for application to the internal passages of four first-stage turbine blades. Process development results indicate that a dry pack process is suitable for internal coating application resulting in 18 percent or less reduction in air flow Coating uniformity based on coated air-cooled blades was within + or - 20 percent Test results show that the presence of additives (silicon chromium or columbium) appeared to improve significantly the ductility of the NiA1 matrix. However, the environmental resistance of these modified nickel-aluminides were generally inferior to the simple aluminides. A R H

N79-25019*# Notre Dame Univ Ind

TIME OPTIMAL CONTROL OF A JET ENGINE USING A QUASI-HERMITE INTERPOLATION MODEL M S Thesis John G Comiskey May 1979 171 p refs (Grant NsG-3048)

(NASA-CR-158711 EE-791) Avail NTIS HC A08/MF A01 CSCL 21E

This work made preliminary efforts to generate nonlinear numerical models of a two-spooled turbofan jet engine and subject these models to a known method of generating global nonlinear time optimal control laws. The models were derived numerically directly from empirical data as a first step in developing an automatic modelling procedure.

N79-25020*# General Electric Co Cincinnati Ohio Aircraft Engine Group

DESIGN STUDY AND PERFORMANCE ANALYSIS OF A HIGH-SPEED MULTISTAGE VARIABLE GEOMETRY FAN FOR A VARIABLE CYCLE ENGINE Final Report

T J Sullivan and D E Parker Mar 1979 228 p refs (Contract NAS3-20041 R79AEG288)

(NASA-CR-159545) Avail NTIS HC A11/MF A01 CSCL 21E

A design technology study was performed to identify a high speed multistage variable geometry fan configuration capable of achieving wide flow modulation with near optimum efficiency at the important operating condition A parametric screening study of the front and rear block fans was conducted in which the influence of major fan design features on weight and efficiency was determined. Key design parameters were varied systematically to determine the fan configuration most suited for a double bypass variable cycle engine. Two and three stage fans were considered for the front block A single stage core driven fan was studied for the rear block Variable geometry concepts were evaluated to provide near optimum off design performance. A detailed aerodynamic design and a preliminary mechanical design predictions were made for the front and rear block fans. Author

N79-25021*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif

INTERFERENCE EFFECTS OF AIRCRAFT COMPONENTS ON THE LOCAL BLADE ANGLE OF ATTACK OF A WING-MOUNTED PROPELLER

J P Mendoza Jun 1979 43 p refs

(NASA-TM-78587 A-7812) Avail NTIS HC A03/MF A01 CSCL 01C

The aerodynamic interference effects on a propeller operating in the presence of different wing-body-nacelle combinations was studied. The unsteady blade angle of attack variation with azimuth angle by varying the pitch and yaw of the nacelle was minimized. Results indicate for the particular configuration of interest the minimum blade angle of attack variation occurred with the nacelle pitched downward 4.5 deg and yawed inward 3.0 deg SES

N79-25022*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio

OPERATING CONDITION AND GEOMETRY EFFECTS ON LOW-FREQUENCY AFTERBURNER COMBUSTION INSTA-BILITY IN A TURBOFAN AT ALTITUDE Richard R Cullom and Roy L Johnsen Jun 1979 31 p refs (NASA-TP-1475 E-9886) Avail NTIS HC A03/MF A01 CSCL 21E

Three afterburner configurations were tested in a low-bypassratio turbofan engine to determine the effect of various fuel distributions inlet conditions flameholder geometry and fuel injection location on combustion instability. Tests were conducted at simulated flight conditions of Mach 0.75 and 1.3 at altitudes from 11.580 to 14.020 m (38.000 to 46.000 ft). In these tests combustion instability with frequency from 28 to 90 Hz and peak-to-peak pressure amplitude up to 46.5 percent of the afterburner inlet total pressure level was encountered Combustion instability was suppressed in these tests by varying the fuel distribution in the afterburner.

N79-25023*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio

INDUSTRY TESTS OF NASA CERAMIC THERMAL BARRIER COATING

Curt H Liebert and Francis S Stepka Jun 1979 26 p refs Presented at 6th Intern Vacuum Metallurgy Conf San Diego Calif 23-27 Apr 1979 Sponsored by Am Vacuum Soc

(NASA-TP-1425 E-9846) Avail NTIS HC A03/MF A01 CSCL 21E

Ceramic thermal barrier coating (TBC) system was tested by industrial and governmental organizations for a variety of aeronautical marine and ground-based gas turbine engine applications This TBC is a two-layer system with a bond coating of nickel-chromium-aluminum-yttrium (Ni-16Cr-6AI-0 6Y in wt percent) and a ceramic coating of yttria-stabilized zirconia (ZrO2-12Y2O3 in wt percent) Seven tests evaluated the system s thermal protection and durability. Five other tests determined thermal conductivity vibratory fatigue characteristics and corrosion resistance of the system. The information presented includes test results and photographs of the coated parts Recommendations are made for improving the coating procedures. J M S

N79-25024^{*}# Douglas Aircraft Co Inc Long Beach Calif SIMULATED PROPELLER SLIPSTREAM EFFECTS ON A SUPERCRITICAL WING

H Robert Welge and James P Crowder Jun 1978 72 p refs

(Contract NAS2-9472)

(NASA-CR-152138) Avail NTIS HC A04/MF A01 CSCL 21E

To quantify the installed performance of high speed (M = 08) turboprop propulsion systems an experimental program designed to assess the magnitude of the aerodynamic interference of a propeller slipstream on a supercritical wing has been conducted The test was conducted in the NASA Ames 14-foot wind tunnel An ejector-nacelle propeller slipstream simulator was used to produce a slipstream with characteristics typical of advanced propellers presently being investigated. A supercritical wing-body configuration was used to evaluate the interference effects A traversing total pressure rake was used to make flow field measurements behind the wing and to calibrate the slipstream simulator The force results indicated that the interference drag amounted to an increase of ten counts or about 3% of the wing-body drag for a two engine configuration at the nominal propeller operating conditions. However, at the higher swirl angles (11 deg vs 7 deg nominally) the interference drag was favorable by about the same magnitude Author

N79-25025# ARO Inc Arnold Air Force Station, Tenn OPTICAL IN SITU VERSUS PROBE MEASUREMENTS OF NITRIC OXIDE CONCENTRATION AS A FUNCTION OF AXIAL POSITION IN A COMBUSTOR EXHAUST Final Report, 21 Jul - 27 Aug 1977

J D Few R J Bryson and H S Lowry III AEDC Mar 1979 37 p refs

(AD-A067329 AEDC-TR-78-32) Avail NTIS HC A03/MF A01 CSCL 21/2

Nitric oxide (NO) concentration was measured at three axial stations (6.5, 1.2 and 2.5 nozzle diameters downstream of a combustor nozzle exit) in a jet engine combustor exhaust by a

gas-sampling probe in conjunction with conventional gas analyzers and an optical resonance absorption technique. The gas analyzer system permitted measurements of NO, NO sub x, CO CO sub 2 and C sub x H sub y (total hydrocarbons) whereas the optical absorption technique permitted measurement of NO only The combustor was exhausted into a test cell of slightly less than atmospheric pressure and was operated at an inlet air temperature of 589 K a total pressure of 344 3 kPa, and a fuel-to-air ratio (f/a) of 0.02 A multiprobe rake was used to acquire emissions total pressure and temperature and static pressure data at the measurement stations. The measurements of total pressure total temperature and measured static pressure were used to determine static temperature and pressure profiles at each measurement station which are required for determining NO concentration by the optical absorption technique GRA

N79-25026# Calspan Corp Buffalo N Y

BLAST INDUCED DISTORTION EXPERIMENTS ON AN ENGINE INLET Final Report, Feb 1977 - Jan 1978

Albert O Davis and Michael G Dunn 30 Jan 1978 73 p refs

(Contract DNA001-77-C-0097)

(AD-A066811, AD-E300477 DNA-4513F) Avail NTIS HC A04/MF A01 CSCL 20/4

This report briefly reviews the results of the Kaman AviDyne/AEDC experimental program funded by DNA. The purpose of this program was to develop an experimental technique that could be used to define the nuclear-blast-induced distortion at the inlet/engine interface of aircraft and air-breathing missiles. The results of the test program have been evaluated as has the potential impact of these results on other air-breathing engines with inlets having different L/D values.

N79-25027# Pratt and Whitney Aircraft West Paim Beach Fla Government Products Div

REGRESSION SIMULATION OF TURBINE ENGINE PER-FORMANCE ACCURACY IMPROVEMENT (TASK 4) Final Technical Report, 30 Sep 1977 - 30 Sep 1978

Joseph A Sabatella Jr and James S Johnson 30 Sep 1978 96 p refs

(Contract F33615-77-C-2109)

(AD-A066398, PWA-FR-10608 AFAPL-TR-78-103) Avail NTIS HC A06/MF A01 CSCL 21/5

The Regression Simulation of Turbine Engine Performance (RSTEP) Task IV program was an analytical study to identify and evaluate approaches to improve the accuracy of regression surfaces for use in TEVCS/ARES procedures The Central Composite Design (CCD) data selection pattern was studied and found to be a flexible accurate and economical alternative to the orthogonal Latin Square design selector. The impact of the number of independent variables and the number of data points was systematically investigated. Two methodologies which provided significant improvement in the accuracy of the regression surfaces were also identified.

N79-25029# Ford Motor Co Dearborn, Mich

BRITTLE MATERIALS DESIGN, HIGH TEMPERATURE GAS TURBINE CERAMIC TURBINE ROTOR TECHNOLOGY Interim Report, 1 Oct 1977 - 31 Mar 1978

Arthur F McLean and Robert R Baker Feb 1979 87 p refs (Contract DAAG46-71-C-0162)

(AD-A067176 AMMRC-TR-79-11 IR-13) Avail NTIS HC A05/MF A01 CSCL 11/2

This report contains progress during the last six months and a summary of earlier progress on the DOE supported programs within the joint DARPA/DOE Brittle Materials Design High Temperature Gas Turbine Program and constitutes the final report of work under DOE funds A separate report will cover the progress on the DARPA supported Ceramic Turbine Testing Program The summary of previous work supported by DOE includes progress on reaction bonded and hot pressed silicon nitride materials technology Several NDE techniques were considered for the detection of flaws in complex-shaped silicon nitride components Improvements to the hot press bonding process resulted in a significant improvement in the yield of flaw-free hot press bonded rotors MOR and cold spin tests of rotor blade rings revealed the presence of undetected subsurface flaws in both the blades and the rim. Blade bend testing indicated that blade strength degraded during hot press bonding. During this reporting period an investigation of hot press bonding temperatures and time at temperature defined a region of zero microstructural and strength degradation. This study involved 19 hot press bondings from which curves were generated defining the changes in color porosity hardness phase and strength as a function of time and temperature. GRA

N79-25033*# Oklahoma State Univ Stillwater HANDLING QUALITIES OF LARGE FLEXIBLE CONTROL-CONFIGURED AIRCRAFT Semiannual Status Report, 1 Jan - 30 Jun 1979

Robert L Swaim 22 Jun 1979 10 p refs

(Grant NsG-4018)

(NASA-CR-158694) Avail NTIS HC A02/MF A01 CSCL 01C

The approach to an analytical study of flexible airplane longitudinal handling qualities was to parametrically vary the natural frequencies of two symmetric elastic modes to induce mode interactions with the rigid body dynamics. Since the structure of the pilot model was unknown for such dynamic interactions the optimal control pilot modeling method is being applied and used in conjunction with pilot rating method. JAM

N79-25034*# National Aeronautics and Space Administration Langley Research Center Hampton Va

CAPTURING AND TRACKING PERFORMANCE OF THE HORIZONTAL GUIDANCE AND CONTROL SYSTEMS OF THE TERMINAL CONFIGURED VEHICLE

Charles E Knox Jun 1979 35 p refs (NASA-TM-80068 L-11442) Avail NTIS HC A03/MF A01

CSCL 01C

A twin-jet commercial transport equipped with digital navigation guidance and control systems and advanced electronic display system was used for airborne operational research. The results of flight tests which evaluated a second-order horizontalpath guidance control law and the autopilot and airplane response are presented. This evaluation was accomplished through analysis of recorded flight data and through pilot opinion of the airplane maneuvers during automatic path-capture scenarios and path tracking Four different path captures were flown at a ground speed of approximately 160 knots and repeated at approximately 300 knots Path tracking tracking error was measured in terms of cross track error along two paths one pat at cruise speeds and one at airport-terminal-area speeds. The path tracking accuracy and the smoothness of the airplane maneuvers were judged satisfactory for high speeds however at lower speeds the control law design should be improved so that tracking will be more accurate for operations in the airport terminal area

JMS

N79-25035# Systems Technology, Inc Hawthorne Calif ANALYSIS OF DIGITAL FLIGHT CONTROL SYSTEMS WITH FLYING QUALITIES APPLICATIONS VOLUME 1 EXECU-TIVE SUMMARY Final Report, Mar 1977 - Jun 1978 Richard F Whitbeck Sep 1978 28 p

(Contract F33615-77-C-3026 AF Proj 2307)

(AD-A066809 STI-TR-1101-1-Vol-1 AFFDL-TR-78-115-Vol-1) Avail NTIS HC A03/MF A01 CSCL 01/3

Revisitation and extension of classical sampled data approaches for the analysis of discretely controlled continuous systems is the focus of this report A review of basic linear analysis topics required to support later developments is given These topics include Laplace z- and advanced z-transform facts, partial fraction expansion data holds and the switch decomposition technique Extension of switch decomposition for the vector signal case is given A new direct transform domain approach for analyzing two-rate sampled systems is developed. This approach also applies for multi-rate sampled systems in restricted circumstances. Utility of this approach resides in its operator notation and conventions for manipulation in connection with vector block diagram algebra.

for multivariable closed-loop systems This is accomplished without resorting to the more complicated switch decomposition method. Multi-rate sampling analysis procedures are used to sharpen the concept of frequency response for discretely excited, continuous systems. All methods of analysis presented in this report are closed-form and exact in that no approximation is required in the mathematical development of any result. GRA

N79-25036# Systems Technology Inc Hawthorne Calif ANALYSIS OF DIGITAL FLIGHT CONTROL SYSTEMS WITH FLYING QUALITIES APPLICATIONS VOLUME 2 TECH-NICAL REPORT Final Report, Mar 1977 - Jun 1978 Richard F Whitbeck and L G Hofmann Sep 1978 230 p

refs (Contract F33615-77-C-3026)

(AD-A067177 STI-TR-1101-1-Vol-2 AFFDL-TR-78-115-Vol-2) Avail NTIS HC A11/MF A01 CSCL 01/3

Revisitation and extension of classical sampled data approaches for the analysis of discretely controlled continuous systems is the focus of this report. A review of basic linear analysis topics required to support later developments is given These topics include Laplace, z- and advanced z-transform facts partial fraction expansion data holds and the switch decomposition technique Extension of switch decomposition for the vector signal case is given. The w-domain is defined by a bilinear transformation of the z-domain Properties of the w-domain are developed A new direct transform domain approach for analyzing two-rate sampled systems is developed This approach also applies for multi-rate sampled systems in restricted circumstances. Utility of this approach resides in its operator notation and conventions for manipulation in connection with vector block diagram algebra This in turn expedites development of pulse transfer functions and of response recursion relations for multivariable, closed-loop systems This is accomplished without resorting to the more complicated switch decomposition method. Multi-rate sampling analysis procedures are used to sharpen the concept of frequency response for discretely excited, continuous systems. Frequency response in this case pertains to steady-state responses at the input frequency and its positive aliases. All methods of analysis presented in this report are closed-form and exact in that no approximation is required in the mathematical development of any result GRA

N79-25037# Advisory Group for Aerospace Research and Development Paris (France)

TECHNICAL EVALUATION REPORT ON THE 25TH GUID-ANCE AND CONTROL PANEL SYMPOSIUM ON GUIDANCE AND CONTROL DESIGN CONSIDERATIONS FOR LOW ALTITUDE AND TERMINAL AREA FLIGHT

M A Ostgaard (AFFDL Wright-Patterson AFB Ohio) Mar 1979 13 p Symp held at Dayton Ohio 17-20 Oct 1977 (AGARD-AR-129 ISBN-92-835-1316-9) Avail NTIS

Lack of well defined operational concepts and requirements are outlined for the development efforts to fulfill low altitude operational needs and stimulate concepts that are cost effective Crew workload which is the predominant factor in low altitude operation is discussed. The application of control technology to provide gust alleviation is presented.

N79-25038# Committee on Commerce Science and Transportation (U S Senate)

AIRCRAFT AND AIRPORT NOISE REDUCTION

Washington GPO 1978 402 p refs Hearings on S 747 S 3064 and H R 8729 before the Subcomm on Aviation of the Comm on Commerce Sci and Transportation 95th Congr 2d Sess, 24-25 May 13-14 17 Jun 1978

(GPO-29-661) Avail Subcomm on Aviation

Aircraft and airport noise was investigated at a Congressional hearing to try to provide mechanisms through which air carriers could comply with FAA noise reduction regulations. The possibility of guarantees was discussed as a mechanism. Airport planning and land acquisition were also discussed RES

N79-25039*# Royal Aircraft Establishment Bedford (England) Structures Dept

SOME REMARKS ON THE DESIGN OF TRANSONIC TUNNELS WITH LOW LEVELS OF FLOW UNSTEADINESS Dennis G Mabey Washington NASA Aug 1976 20 p refs (NASA Order L-32158-A)

(NASA-CR-2722) Avail NTIS HC A02/MF A01 CSCL 01E The principal sources of flow unsteadiness in the circuit of a transonic wind tunnel are presented Care must be taken to avoid flow separations acoustic resonances and large scale turbulence Some problems discussed are the elimination of diffuser separations the aerodynamic design of coolers and the unsteadiness generated in ventilated working sections SES

N79-25040# Transportation Systems Center Cambridge Mass THE AIRPORT PERFORMANCE MODEL VOLUME 1 EXTENSIONS, VALIDATIONS, AND APPLICATIONS Final Report, Jan 1975 - Jun 1976

J Bellantoni H Condell I Englander L Fuertes and J Schwenk Oct 1978 285 p refs

(AD-A062863 TSC-FAA-78-21-1) Avail NTIS HC A13/MF A01 CSCL 01/5

A computer simulation of airport delay and congestion was prepared to help evaluate the benefit of capacity-related investments in the nations airports. The model which has a data base comprising 31 high density airports estimates dollar benefits to passengers and aircraft operators or delay reduction in landing takeoff and gate docking and reduction in fuel consumed and pollutants emitted as well as required groundside facilities. The delay estimate from the model showed reasonably good agreement with data taken at JFK LGA and EWR. It was used to evaluate proposed investments for Honolulu Detroit and Charlotte N C GRA

N79-25041# Vought Corp Dallas Tex

AAES LABORATORY SIMULATOR REQUIREMENTS (A-7 AIRCRAFT) Final Report, 27 Sep 1977 - 27 Dec 1978

J R Perkins, D E Lautner J L Jones and A J Marek Sep 1978 126 p refs

(Contract N62269-77-C-0377)

(AD-A066393 Rept-2-54100/8R-3510 NADC-77277-30) Avail NTIS HC A07/MF A01 CSCL 01/3

This program was conducted for establishing requirements and developing specific design data for a hot bench mockup (simulator) The simulator system being developed is based on the Advanced Aircraft Electrical System (AAES) Prototype Design evolved by the Vought Corp under contract N62269-75-C-0391 The simulator system will ultimately be used by NADC to provide a laboratory verification of the operation and performance of the AAES in an aircraft weapon system environment. The evolved simulation design is formulated around the TA-7C aircraft electrical and avionic systems and the general physical/installation constraints of the TA-7C forward and mid fuselage sections The designs developed under this contract were limited to electrical-avionic system definition and design. Simulator structural system installation and wire harness designs will be developed under a follow-on contract. The designs developed under this contract include the full application of the AAES technologies to the TA-7C electrical and avionic subsystem and systems The AAES technologies include HVDC (High Voltage DC) power generation SOSTEL (Solid State Electric Logic) power distribution and management and AMUX (Avionic Multiplexing) GRA

N79-25042# Naval Training Equipment Center Orlando Fla MOTION IN FLIGHT SIMULATION AN ANNOTATED BIBLIOGRAPHY Final Report, 30 Sep 1977 - 30 Jun 1978

Joseph A Puig William T Harris and Gilbert L Ricard Jul 1978 753 $p\$ refs

(AD-A061687 NAVTRAEQUIPC-IH-298) Avail NTIS HC A99/MF A01 CSCL 05/9

In support of Project 7744 - Motion Drive Signals for Flight Simulators a review of the literature concerning motion simulation was conducted Abstracts were included for 682 references A primary objective of this review was to compare data from the various studies to identify general trends on the effects of motion on performance and training The publications were listed alphabetically by author chronologically, and also grouped into eight major categories as follows reviews and bibliographies, equipment descriptions requirements algorithms and drive techniques effects of motion evaluation vertical motion and cost effectiveness Author (GRA)

N79-25043# Air Force Inst of Tech Wright-Patterson AFB Ohio School of Systems and Logistics

OPTIMAL PLACEMENT OF REGIONAL FLIGHT SIMULA-TORS M S Thesis

David R VanDenburg and Jon D Veith Sep 1978 98 p refs (AD-A060450 AFIT-LSSR-18-78B) Avail NTIS HC A05/MF A01 CSCL 05/9

Due to the depletion of petroleum resources and increasing aircraft operating costs inflight simulators are assuming a larger role in aircrew training Simultaneously increased simulator acquisition and support costs have resulted in fewer simulator systems Consequently a regional simulator deployment plan is often used. This plan involves the placement of simulator systems. at a number of central locations and transporting students to these locations to accomplish their required training. This research attempted to develop a mathematical model to assist in the placement decision. The model was developed however, a suitable computer algorithm could not be found to solve the resulting equations Consequently a model was developed and used to provide suggested student allocation schedules for predetermined simulator location plans. It was concluded that mathematical techniques could be employed to assist in the placement decisions. In addition, it is believed that future improvements in computer software could produce an algorithm capable of solving the model originally developed. Author (GRA)

N79-25044# Naval Air Development Center Warminster Pa Systems Directorate

DESIGN OF AN OFF-AXIS WIDE FIELD-OF-VIEW VISUAL DISPLAY SYSTEM FOR FLIGHT SIMULATORS Final Report

G Terry Thomas and Robert L Jones 1 Jan 1979 126 p refs

(AD-A066530, NADC-79023-20) Avail NTIS HC A07/MF A01 CSCL 01/4

This report describes the analysis and design of an off-axis wide field-of-view visual display system including component specifications and structural drawings A fabrication cost and schedule estimate is also presented Author (GRA)

N79-25046# Bunker-Ramo Corp Wright-Patterson AFB Ohio MULTIFUNCTION KEYBOARD IMPLEMENTATION STUDY Final Report, 1 Apr 1976 - 11 Feb 1977

Robert P Bateman John M Reising Emmett L Herron and Gloria L Calhoun Dec 1978 193 p refs

 (Contract F33615-76-C-0013 AF Proj 6190 AF Proj 2049)

 (AD-A066140 AFFDL-TR-78-197)
 Avail NTIS

 HC A09/MF A01 CSCL 05/9
 State

An aircraft which utilizes digital computers will require the use of multifunction controls and displays Four different multifunction keyboard configurations were examined by pilots flying a simulated mission Two of the configurations were located on the left side of the front instrument panel while the remaining two were located on the right side console and/or the right side of the front instrument panel. The pilots performed communications navigation and stores tasks using each configuration. The configurations also utilized two different types of hardware projection switches and cathode ray tubes.

N79-25236# Systems Research Labs Inc Dayton Ohio Research Applications Div

DYNAMIC EVALUATION OF EXPERIMENTAL INTEGRAL FUEL-TANK SEALANTS, PART 2 Final Technical Report, Jul 1977 - Jun 1978

William R Mallory Wright-Patterson AFB Ohio AFML Nov 1978 41 p

(Contract F33615-76-C-5253 AF Proj 2421 AF Proj 7340) (AD-A066592 SRL-6901-Pt-2 AFML-TR-77-152-Pt-2) Avail NTIS HC A03/MF A01 CSCL 11/1

An exploratory development program has been performed to investigate and evaluate experimental integral fuel-tank sealant materials under laboratory conditions which closely simulate those of actual aircraft integral fuel tanks during flight. As part of this effort a unique facility has been designed and fabricated for the evaluation of a variety of joint configurations. The facility consists primarily of a biaxial stress machine in which temperature pressure, and vibrational strain can be programmed for automatic operation. Specimens can be strained longitudinally and torsionally to simulate actual flight conditions. Frequency and amplitude of the strains can be independently set and recorded Simulated fuel-tank and environmental pressure can also be adjusted independently. Early difficulties with sealant-failure detection and with undesirable thermal strains have been largely resolved and partial evaluation of continuous-fillet specimens utilizing one sealant material has been performed. A second evaluation apparatus is now under construction Author (GRA)

N79-25244# Rockwell International Corp Los Angeles, Calif THE IMPACT OF ALTERNATE FUELS ON AIRCRAFT CONFIGURATION CHARACTERISTICS Final Report, Dec 1977 - Oct 1978

 Douglas A Robinson Oct 1978 139 p refs

 (Contract F33615-77-C-3155 AF Proj 2404)

 (AD-A066983, AFFDL-TR-78-152)

 Avail

 NTIS

 HC A07/MF A01

The study dealt with the effect of alternate fuel usage for three classifications of advanced technology vehicles for a post-2000 time period Alternate fuel design vehicles were configured to optimum thrust loading and wing loading based on hydrocarbon JP-4 fuel and found to offer 35 to 45 percent weight reduction Life-cycle cost savings were estimated as a function of fuel cost and showed fuels 10 to 15 times the basepoint resulted in breakeven LCC with the more exotic fuels Author (GRA)

N79-25245# Mobil Research and Development Corp Paulsboro, N J

FACTORS AFFECTING ELECTROSTATIC HAZARDS Final Technical Report, 15 Apr 1977 - 15 Jul 1978

P W Kırklın and D L Rhynard Dec 1978 91 p (Contract F33615-77-C-2047 AF Proj 3048) (AD-A066927. AFAPL-TR-78-89) Avail

(AD-A066927, AFAPL-TR-78-89) Avail NTIS HC A05/MF A01 CSCL 21/4

Conductivity additives ASA-3 and Stadis 450 have been found to significantly reduce static electricity in JP-4 containing approved additives when fuel conductivity is at least 100 CU at use temperatures. In the absence of conductivity additives some additives caused increased charge accumulation which may have contributed to previous static ignited aircraft fires. Tests were performed in a Mobil Research small-scale electrification unit modified to simulate USAF fueling velocities and aircraft fuel tank configurations.

N79-25247# Air Force Aero Propulsion Lab Wright-Patterson AFB Ohio

A FILTERABILITY STUDY OF CORROSION INHIBITED JP-4 Summary Report, Aug 1974 - Jun 1976

Paul C Hayes, Jr Jun 1978 68 p refs (AF Proj 3048) (AD-A066887 AFAPL-TR-78-44) Avail NTIS

HC A04/MF A01 CSCL 21/4

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The filterability of JP-4 fuel indicates the extent of contamination with solid particulate matter refinery carry-overs and/or reaction products generated from the mixing of inhibited fuel and water bottoms. This report examines the creation of filter-plugging precipitants via the interaction of a fuel corrosion inhibitor with entrained water. Further work revealed methods to prevent the formation of the reaction product and steps to reclaim such a synthetically created high filtration time JP-4 Author (GRA) N79-25251# Civil and Environmental Engineering Development Office Tyndall AFB Fla

EVALUATION OF MATERIALS FOR POST-ATTACK PAVE-MENT REPAIR Final Report, Sep 1976 - Dec 1977 C L Rone and A L Sullivan III Sep 1978 107 p refs

(AF Proj 2104) (AD-A066516 CEEDO-TR-78-16) Avail NTIS HC A06/MF A01 CSCL 01/3

This study was conducted to evaluate the performance of candidate materials used to repair small damaged areas in pavement when subjected to traffic by an F4C aircraft loading. The study consisted of preparing simulated damaged areas in portland cement concrete pavement and flexible pavement and repairing the areas with selected materials. The evaluation was based on the performance of the repaired areas when subjected to accelerated traffic with a loading equivalent to one main gear of the F4C aircraft. Author (GRA)

N79-25278# Army Materiel Systems Analysis Activity Aberdeen Proving Ground, Md

A COMPUTER PROGRAM FOR DOUBLE SWEEP OPTIMAL SMOOTHING

NTIS

Avail

 Robert A
 Scheder
 Jan
 1979
 74 p
 refs

 (DA Proj
 1R7-65706-M-541)
 (AD-A066512
 AMSAA-TR-246)
 (AD-A0466512
 AMSAA-TR-246)
 (AD-A04/MF A01
 CSCL
 17/9
 (AD-A04/MF A01
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 (AD-A04/MF A01
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This report documents the double sweep smoothing program used at AMSAA to determine an aircraft's position velocity and acceleration from radar tracking data. It includes a tutorial guide to the underlying mathematics. A quadratic programming problem with linear constraints is formulated reduced to a system of difference equations with initial and endpoint boundary conditions and solved using Bryson's double sweep method. The iterative solution is programmed in simple machine independent FORTRAN with top down structured programming A listing is supplied and card decks are available.

N79-25310^{*}# National Aeronautics and Space Administration Lyndon B Johnson Space Center Houston Tex

ANALYTICAL MODELING OF THE DYNAMICS OF BRUSH-LESS dc MOTORS FOR AEROSPACE APPLICATIONS A CONCEPTUAL FRAMEWORK

Nabeel A O Demerdash 18 Aug 1976 102 p refs

(NASA-TM-80445 IN-76-EG-18 JSC-11552) Avail NTIS HC A06/MF A01 CSCL 09A

The modes of operation of the brushless d c machine and its corresponding characteristics (current flow torque-position etc.) are presented. The foundations and basic principles on which the preliminary numerical model is based are discussed M M M.

N79-25408# General Research Corp Santa Barbara Calif LIFE CYCLE COST ANALYSIS CONCEPTS AND PRO-CEDURES

Edward N Dodson *In* AGARD Methodology for Control of Life Cycle Costs for Avionics Systems Apr 1979 28 p refs

Avail NTIS HC A07/MF A01

The principles and procedures of parametric cost analysis based upon aggregate relationships between cost and the physical/performance characteristics of high technology equipment are presented M M M M

N79-25410# Rome Air Development Center Griffiss AFB N Y RECENT EXPERIENCE IN THE DEVELOPMENT AND APPLICATION OF LCC MODELS

Jerome Klion and Anthony Coppola In AGARD Methodology for Control of Life Cycle Costs for Avionics Systems Apr 1979 150 p refs

Avail NTIS HC A07/MF A01

A description of various models which incorporate acquisition costs and operation support costs as they apply to avionics procurements are presented. The methods by which the models are developed along with their shortcomings and sensitivities are reported.

N79-25412# Advisory Group for Aerospace Research and Development Neuilly-Sur-Seine (France)

NON-DESTRUCTIVE INSPECTION METHODS FOR PRO-PULSION SYSTEMS AND COMPONENTS

Apr 1979 70153 p refs In ENGLISH and partly in FRENCH Lecture series held at London 23-24 Apr 1979 and Milan 26-27 Apr 1979

(AGARD-LS-103 ISBN-92-835-0237-X) Avail NTIS HC A08/MF A01

The state-of-the-art and the foreseeable or hoped progress of the nondestructive inspection methods applied to the turbine and pistons engine are examined and discussed. The following topics are discussed (1) nondestructive inspection of aircraft engines (2) high resolution radiography in the aero-engine industry (3) wear debris analysis (4) high resolution ultrasonic nondestructive testing of complex geometry components (5) nondestructive methods for the early detection of fatigue damage in aircraft components (6) in situ inspection of electron beam weld by acoustic emission and (7) broadband ultrasonic transducers for nondestructive inspection of aeronautical components

N79-25413# General Electric Co Cincinnati Ohio STATE-OF-THE-ART OF NONDESTRUCTIVE INSPECTION OF AIRCRAFT ENGINES

D M Comassar /n AGARD Non-destructive Inspection Methods for Propulsion Systems and Components Apr 1979 12 p refs

Avail NTIS HC A08/MF A01

There are five basic nondestructive inspection disciplines which are more commonly applied to engine components namely ultrasonic, eddy current fluorescent penetration radiographic and magnetic particle inspection. There are a number of recent advancements in the ultrasonic and eddy current processes as well as improvements in the fluorescent penetration process. These are discussed. These advancements are primarily in the equipment area and in the automation of the inspection process. The discussion focuses on improvements in the ultrasonic eddy current and fluorescent penetration processes. Several nonconventional techniques used for inspection of development hardware are also discussed.

N79-25414# Atomic Energy Research Establishment Harwell (England) Material Physics Div

HIGH RESOLUTION RADIOGRAPHY IN THE AERO-ENGINE INDUSTRY

R W Parish *In* AGARD Non-Destructive Inspection Methods for Propulsion Systems and Components Apr 1979 38 p refs

Avail NTIS HC A08/MF A01

Microfocal X-ray equipment which in certain circumstances can achieve considerably enhanced resolution is discussed and emphasis is placed on the application of these small X-ray sources to aero-engine components These techniques allow small defects to be resolved which hitherto were undetectable when using conventional X-ray techniques G Y

N79-25417# Johns Hopkins Univ Baltimore Md Dept of Mechanics and Materials Science

NON-DESTRUCTIVE METHODS FOR THE EARLY DETEC-TION OF FATIGUE DAMAGE IN AIRCRAFT COMPO-NENTS

Robert E Green Jr /n AGARD Non-Destructive Inspection Methods for Propulsion Systems and Components Apr 1979 31 p refs

Avail NTIS HC A08/MF A01

The various nondestructive techniques which are used or which are potentially useful for detection of fatigue damage in aircraft components are described and discussed Included among the nondestructive techniques which are considered are radiography penetrant inspection eddy current ultrasonics acoustic emission magnetic particle and Barkhausen noise analysis and more exotic techniques such as exoelectron emission positron annihilation and other atomic nuclear or solid state physics reactions G Y

N79-25419# Office National d'Etudes et de Recherches Aerospatiales, Paris (France)

BROAD-BAND TRANSDUCERS FOR NONDESTRUCTIVE INSPECTION OF AERONAUTICAL COMPONENTS

Jean-Francois deBelleval *In* AGARD Non-Destructive Inspection Methods for Propulsion Systems and Components Apr 1979 10 p refs In FRENCH ENGLISH summary

Avail NTIS HC A08/MF A01

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For ultrasonic nondestructive inspection of aeronautical components it is mandatory to detect defects both smaller and smaller and nearer and nearer the surface of these components The quantitative evaluation of these defects allowing a definition of their mechanical consequences must also be improved This requires the use of more sensitive ultrasonic transducers, with a larger bandwidth. The main method used at present to increase the bandwidth of piezoelectric transducers entails an important decrease of their sensitivity it is based on the damping of the piezoelectric wafer on its rear face. Suggested to use instead damping by a multilayer front face which allows a simultaneous increase of both sensitivity and bandwidth. In order to study the feasibility of this process a computing program was developed to calculate the propagation of a wave through several layers of different thicknesses. This program makes it possible to optimize the characteristics (impedance and thickness) of the various layers making up the transducer. Comparisons with actual transducers allowed the validation of this theoretical model G V

N79-25426*# Rockwell International Corp Los Angeles Calif Aircraft Div

DETERMINATION OF SUBCRITICAL FREQUENCY AND DAMPING FROM B-1 FLIGHT FLUTTER TEST DATA Final Report

S K Dobbs and C H Hodson Jun 1979 87 p refs (Contract NAS4-2278)

(NASA-CR-3152) Avail NTIS HC A05/MF A01 CSCL 01C The application of the time-lag products correlation/frequency analysis procedure to determine subcritical frequency and damping from structural response measurements made during flight flutter test of the B-1 prototype airplane is described. The analysis procedure the test airplane and flight test procedures are discussed. Summary frequency and damping results are presented for six transonic flight conditions. Illustrative results obtained by applying various options and variations of the analysis method are included for one flight condition. A R H

N79-25428# Army Engineer Waterways Experiment Station Vicksburg Miss

USER'S GUIDE COMPUTER PROGRAM WITH INTERAC-TIVE GRAPHICS FOR ANALYSIS OF PLANE FRAME STRUCTURES (CFRAME) Final Report

Joseph P Hartman and John J Jobst Mar 1979 60 p (AD-A067349 WES-INSTRUCTION-0-79-2) Avail NTIS HC A04/MF A01 CSCL 13/13

This report documents the usage of the general purpose computer program CFRAME for the analysis of plane frame structures. The intent was to develop an easy-to-use program incorporating the best features of many similar programs and to provide the many additional capabilities required by a diverse group of users CFRAME utilizes the stiffness methods of structural analysis. The Cholesky decomposition method is used to solve the resulting matrix equation. Automatic generation routines are available to simplify the data input Graphical display of this input data is also available. The output may be printed or displayed with graphics.

N79-25433# Boeing Co Wichita Kans THE INFLUENCE OF FLEET VARIABILITY ON CRACK GROWTH TRACKING PROCEDURES FOR TRANSPORT/ BOMBER AIRCRAFT Final Technical Report, 1 Nov 1976 - 1 Jun 1978

David F Bryan and Gordon E Lambert Nov 1978 208 p refs

(Contract F33615-76-C-3130) (AD-A066596 AFFDL-TR-78-158) Avail NTIS HC A10/MF A01 CSCL 01/3

The purpose of this program is to provide generalized crack growth tracking procedures for transport/bomber aircraft. The study was composed of three major tasks (1) an evaluation of the effects of usage parameters on crack growth (2) the development of generalized tracking procedures and (3) an evaluation of the techniques for implementing the individual aircraft tracking program. The KC-135A tanker was selected as the baseline aircraft for this study Approximately thirty tests were conducted to experimentally verify predictions made from analyses and to determine the crack growth rate characteristics of the specimen material. The results of the parametric and variability studies were used to develop analysis schemes for predicting the effects of usage variations on crack growth Four tracking procedures were evaluated (1) pilot logs with the use of parametric crack growth rate data (2) pilot logs with the use of parametric stress exceedance data (3) the Mechanical Strain Recorder (MSR) and (4) the crack growth gauge The implementation of each tracking procedure was evaluated by developing a cost model to study relative life cycle costs Author (GRA)

N79-25496*# Arizona Public Service Co Phoenix PHOTOVOLTAICS AND ENVIRONMENTAL IMPACT CONSIDERATIONS Airport Solar Photovoltaic Concentrator Project

Eric R Weber In OAO Corp Proc of the US DOE Photovoltaics Technol Develop and Appl Program Rev 1978 p 1-225 -1-267

Avail NTIS HC A15/MF A01 CSCL 10A

An analysis and description is presented for the proposed Airport Solar Photovoltaic Concentrator Project The environmental effects and potential impacts of the test facilities are discussed SES

N79-25544# National Aviation Facilities Experimental Center Atlantic City N J EXHAUST EMISSIONS CHARACTERISTICS FOR A

EXHAUST EMISSIONS CHARACTERISTICS FOR A GENERAL AVIATION LIGHT-AIRCRAFT AVCO LYCOMING 10-360-A186D PISTON ENGINE Final Report Eric E Becker Feb 1979 94 p refs

(FAA Proj 201-521-100)

(AD-A066556 FAA-NA-78-49 FAA-RD-78-142) Avail NTIS HC A05/MF A01 CSCL 13/2

A steady state exhaust emissions data base was developed This data base consisted of current production baseline emissions characteristics lean-out emissions data effects of leaning-out the fuel schedule on cylinder head temperatures and data showing ambient effects on exhaust emissions and cylinder head temperatures. The engine operating with its current full-rich production fuel schedule did not meet the proposed Environmental Protection Agency (EPA) standard for carbon monoxide (CO) under sea level standard-day conditions. The engine did however meet the proposed EPA standards for unburned hydrocarbons (HC) and oxides of nitrogen (NOx) under the same sea level test conditions. The results of testing the engine under different ambient conditions (hot day) were also presented and these results showed a trend toward higher levels of emissions output for CO and HC while producing slightly lower levels of NOx

Author

N79-25545# National Aviation Facilities Experimental Center Atlantic City N J

EXHAUST EMISSIONS CHARACTERISTICS FOR A GENERAL AVIATION LIGHT-AIRCRAFT AVCO-LYCOMING 10-360-BIBD PISTON ENGINE Final Report

Eric E Becker Feb 1979 91 p refs

(FAA Proj 201-521-100)

(AD-A066589 FAA-NA-78-28 FAA-RD-78-129) Avail NTIS HC A05/MF A01 CSCL 13/2

A steady state exhaust emissions data base was developed This data base consisted of current production baseline emissions characteristics lean-out emissions data effects of leaning-out the fuel schedule on cylinder head temperatures and data showing ambient effects on exhaust emissions and cylinder head temperatures The engine operating with its current full-rich production fuel schedule did not meet the proposed Environmental Protection Agency (EPA) standard for carbon monoxide (CO) and unburned hydrocarbons (HC) under sea level standard-day conditions The engine did however meet the proposed EPA standards for oxides of nitrogen (NOx) under the same sea level conditions The results of engine testing under different ambient conditions were also presented and these results showed a trend toward higher levels of emissions output for CO and HC while producing slightly lower levels of NOx RES

N79-25550# Civil and Environmental Engineering Development Office Tyndall AFB Fla Detachment 1 ADTC

AIRCRAFT AIR POLLUTION EMISSION ESTIMATION TECHNIQUES, ACEE Final Report, Aug 1977 - Aug 1978 Harold A Scott, Jr and Dennis F Naugle 1 Sep 1978 12 p refs (AF Proj 2103)

(AD-A067262 CEEDO-TR-78-33) Avail NTIS HC A02/MF A01 CSCL 13/2

A five-step analytical methodology is presented that can be adapted to nearly any aircraft related air quality assessment problem. The methodology is for use by base level environmental personnel to calculate (1) annual aircraft emissions and (2) downfield pollutant concentrations. The latest individual engine emission factors and other information required for the methodology are contained in this report.

N79-25567# Lockheed Missiles and Space Co Huntsville, Ala Research and Engineering Center

AIR POLLUTANT EMISSION FACTORS FOR MILITARY AND CIVIL AIRCRAFT Final Report, Aug 1977 - Apr 1978 D Richard Sears Oct 1978 91 p refs

(Contract EPA-68-02-2614)

(PB-292520/4 LMSC-HREC-TR-D568208

EPA-450/3-78-117) Avail NTIS HC A05/MF A01 CSCL 13B

Tables of military aircraft fuel characteristics aircraft classifications, military and civil times in mode, engine modal emission rates and aircraft emission factors per landing-takeoff cycle are calculated and compiled The data encompass 59 engines and 89 aircraft Information related to benzo(a)pyrene emissions and to hydrocarbon emissions (volatile organic) with potential to produce photochemical oxidant is discussed GRA

N79-25662*# National Aeronautics and Space Administration John F Kennedy Space Center Cocca Beach Fla

GROUND WINDS FOR KENNEDY SPACE CENTER, FLORIDA, 1979 REVISION

D L Johnson and S C Brown Jun 1979 192 p refs Revised

(NASA-TM-78229) Avail NTIS HC A09/MF A01 CSCL 04B

Revised ground-level runway wind statistics for the Kennedy Space Center Florida area are presented Crosswind headwind tailwind, and headwind reversal percentage frequencies are given with respect to month and hour for the Kennedy Space Center Space Shuttle runway GY

N79-25840*# National Aeronautics and Space Administration Lewis Research Center, Cleveland Ohio

TONE NOISE OF THREE SUPERSONIC HELICAL TIP SPEED PROPELLERS IN A WIND TUNNEL

James H Dittmar Robert J Jeracki and Bernard J Blaha 1979 66 p refs Presented at 97th Meeting of the Acoustical Soc of Am, Cambridge Mass 11-15 Jun 1979 (NASA-TM-79167 E-030) Avail NTIS HC A04/MF A01 CSCL

(NASA-TM-79167 E-030) Avail NIIS HC A04/MF A01 CSCL 20A

Three supersonic helical tip speed propellers were tested in the NASA Lewis 8- by 6-foot wind tunnel. This is a perforated-wall

wind tunnel but it does not have acoustic damping material on its walls The propellers were tested at tunnel through flow Mach numbers of 0.6 0.7 0.75 0.8 and 0.85 with different rotational speeds and blade setting angles The three propellers which had approximately the same aerodynamic performance incorporated different plan forms and different amounts of sweep and yielded different near field noise levels The acoustically designed propeller had 45 deg of tip sweep and was significantly quieter at M = 0.8 cruise than the straight bladed propeller The intermediate 30 deg tip sweep propeller which was sweet for aerodynamic purposes, exhibited noise that was between the other two propellers Noise trends with varying helical tip Mach number and blade loading were also observed Author

N79-25841*# National Aeronautics and Space Administration Lewis Research Center, Cleveland Ohio

ASSESSMENT AT FULL SCALE OF NOZZLE/WING GEOMETRY EFFECTS ON OTW AERO-ACOUSTIC CHARAC-TERISTICS

D Groesbeck and U vonGlahn 1979 31 p refs

(NASA-TM-79168 E-031) Avail NTIS HC A03/MF A01 CSCL 20A

The effects on acoustic characteristics of nozzle type and location on a wing for STOL engine over-the-wing configurations are assessed at full scale on the basis of model-scale data Three types of nozzle configurations are evaluated a circular nozzle with external deflector mounted above the wing a slot nozzle with external deflector mounted on the wing and a slot nozzle mounted on the wing Nozzle exhaust plane locations with respect to the wing leading edge are varied from 10 to 46 percent chord (flaps retracted) with flap angles of 20 (takeoff altitude) and 60 (approach attitude) Perceived noise levels (PNL) are calculated as a function of flyover distance at 152 m altitude From these plots static EPNL values defined as flyover relative noise levels are calculated and plotted as a function of lift and thrust ratios From such plots the acoustic benefits attributable to variations in nozzle/deflector/wing geometry at full scale are assessed for equal aerodynamic performance Author

N79-25843*# Douglas Aurcraft Co Inc Long Beach Calif VALIDATION OF AIRCRAFT NOISE PREDICTION PRO-GRAM Final Report, 21 Jun 1978 - 21 Jan 1979 C Y Kapper Jun 1979 84 p refs

(Contract NAS1-15471)

(NASA-CR-159047) Avail NTIS HC A05/MF A01 CSCL 20A

Predictions made with NASA's aircraft noise prediction program (ANOPP) were compared with flyover noise data A data base of six flyover noise runs for the DC-10-40/JT9D-59A configuration was used For all power settings, ANOPP consistently underpredicted the low frequency spectral levels overpredicted high frequency spectral levels and consequently overpredicted the inlet and aft PNLT time histories ARH

N79-25844*# National Aeronautics and Space Administration Langley Research Center Hampton Va

AN EXPERIMENTAL INVESTIGATION OF THE EFFECT OF ROTOR TIP SHAPE ON HELICOPTER BLADE-SLAP NOISE Danny R Hoad May 1979 464 p refs Prepared in cooperation with Army Res and Technol Labs Hampton Va

(NASA-TM-80066) Avail NTIS HC A20/MF A01 CSCL 20A

The effect of tip-shape modification on blade-vortex interaction-induced helicopter blade-slap noise was investigated. The general rotor model system (GRMS) with a 3.148 m (10.33 ft) diameter four-bladed fully articulated rotor was installed in the Langley V/STOL wind tunnel. The tunnel was operated in the open-throat configuration with treatment to improve the semi-anechoic characteristics of the test chamber. Based on previous investigation four promising tips (ogee sub-wing 60 deg swept-tapered and end-plate) were used along with a standard square tip as a baseline configuration.

data concerning the relative applicability of the various tip configurations for blade-slap noise reduction are presented without analysis or discussion A R H

N79-25855# Naval Research Lab Washington D C THERMOSPHERIC PROPAGATION OF SONIC BOOMS FROM THE CONCORDE SUPERSONIC TRANSPORT Final Report

John H Gardner and Peter H Rogers 14 Feb 1979 83 p refs

(AD-A067201 NRL-MR-3904) Avail NTIS HC A05/MF A01 CSCL 20/1

A nonlinear theory for the long-range propagation of sonic booms through the thermosphere has been developed. A realistic atmosphere is employed and consideration is given to such factors as nonlinear stretching and decay of the wave the effects of the caustic the linear acoustic attenuation and the increase in Mach number due to the decreasing density at high altitudes Detailed results are presented for the case of the I Concorde SST in straight level and steady flight at 17.5 km and a velocity of Mach 2 We predict maximum ground level pressures of 0.3 Pa with an N-wave period of about 10 seconds. The sound level is a minimum along the flight track with the maximum signal strength occurring about 300 km off the flight track. The strongest received signal travels initially downward and reflects off the surface of the ocean to thermosphere. The wave turns around at an altitude of 160 km and is returned back to the ground at a horizontal distance of 320 km from the launch point The acoustic Mach number of the wave never exceeds 0.2 Ninety percent of the wave's energy is attenuated below 100 km with 99% attenuated by the time the wave reaches the turning point GRA

N79-25979# Naval Air Systems Command Washington, D C AVIONICS TECHNOLOGY FOR TACTICAL DATA HAN-DLING

E B Beggs In AGARD Tech for Data Handling in Tactical Systems 2 Apr 1979 8 p

Avail NTIS HC A16/MF A01

Trends emerging in Naval Aviation are discussed along with their impact on avionics community New avionics concepts are discussed with emphasis on the technical and managerial challenges which must be met to assure their successful implementation These challenges include the software implementation of distributed network control and fault tolerance NATO interoperability and standards and logistic support JAM

N79-25991# Naval Air Development Center, Warminster Pa THE APPLICATION OF STRUCTURED DESIGN AND DISTRIBUTED TECHNIQUES TO AVIONICS INFORMATION PROCESSING ARCHITECTURES

Louis A Naglak and William M Norr In AGARD Tech for Data Handling in Tactical Systems, 2 Apr 1979 17 p refs

Avail NTIS HC A16/MF A01

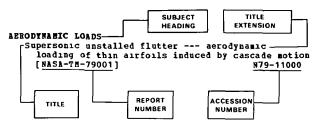
Structured design principles were used in the formulation of a methodology for systems design and applied to the definition of avionics processing architectures. The task was an effort to take advantage of technology advances in the computer field and structured support in software to reduce life cycle costs of avionics. A core avionics was defined and the design constraint imposed upon it discussed. The structured procedure and the way in which it was meant to take advantage of technology was explained Impact of standard is presented and also a specified scheme for implementation. Alternatives for development and acquisition methods and contracting for a generic avionics score are presented. J A M

SUBJECT INDEX

AERONAUTICAL ENGINEERING / A Continuing Bibliography (Suppl 113)

SEPTEMBER 1979





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The title is used to provide a description of the subject matter. When the title is insufficiently descriptive of the document content a title extension is added separated from the title by three hyphens. The NASA or AIAA accession number is included in each entry to assist the user in locating the abstract in the abstract section of this supplement. If applicable, a report number is also included as an aid in identifying the document.

Α

~ ~	
A-7 AIRCRAFT	
AAES/TA-7C control and display interface	
[AD-A067219]	N79-24992
AAES laboratory simulator requirements (A-	
allocraft)	•
[AD-A066393]	N79-25041
A-10 AIRCRAFT	N/9-23041
The Fairchild can-opener - Shturmovik of t	h.a.
eighties	ue
ergueres	A79-36773
Night/Adverse Weather A-10 evaluator progra	
Right, Ravelse weather R-10 evaluator progra	A79-38479
ABLATION	A/9-304/3
Transient ablation of Teflon in intense rat	diatima
and convective environments	utative
and convective environments	A79-38123
ABSORPTION	A/9-38123
Water absorption of fluids/oils contam:	ination
of all craft engine oils and inhibitors	
[AD-A065915]	N79-24158
ACCELERATION (PHYSICS)	-
Recent results obtained with a new method i	
measuring aircraft power and drag in flig	
[SAE PAPER 790616]	A79-36744
Effect of forward acceleration on aerodyna	BiC
characteristics of wings	
	A79-38124
ACCELERATION PROTECTION	
NASA general aviation crashworthiness seat	
development	
[SAE PAPER 790591]	A79-36725
ACOUSTIC FATIGUE	
Installation for studying fatigue strength	of
materials in acoustic loading for an	rcraft
skins	
	A79-39070
ACOUSTIC HEASUREMENTS	
Detection of low flying aircraft by acoust:	
[REPT-8-78]	₩79-24779
Aircraft sonic boom: Studies on aircraft :	flight,
aircraft design, and measurement. A	
bibliography with abstracts	
	N79-24780
ACOUSTIC PROPERTIES	
Noise characteristics of heated high veloc:	Lty
rectangular jets jet engine applicat:	Lon
	A79-38399
ACTUATOR S	_
Electromechanical actuation for business a	ircraft
[SAE PAPER 790622]	A79-36750

A comparison of hydraulic, pneumatic, and electro-mechanical actuators for general	
aviation flight controls [SAE PAPER 790623] ADDITIVES	A79-36751
ADDITIVES	
A filterability study of corrosion inhibite	ed JP-4
[AD-A066887] Adhesive Bonding	N79-25247
Bonding and durability for airframe st	nctures
FSAR PAPER 7905611	A79-36702
Adhesive bonded structure of new pressurize	eđ
Adhesive bonded structure of new pressurize piston twin aircraft [SAE PAPER 790563]	
[SAE PAPER 790563]	A79-36704
Structural properties of adhesives, volume	N79-24155
[AD-A065500] Evaluation of new bonding systems for depot maintenance of aircraft honeycomb panels (AD-A066117]	t-level
maintenance of aircraft honeycomb panels	
Definition and non-destructive detection of critical adhesive bond-line flaws	Ē
critical adhesive bond-line flaws	
[AD-A065584] Adhesives	N79-24163
Structural properties of adhesives, volume	1
[AD-A065500]	N79-24155
ABRIAL RECONNAISSANCE	
Propelled lighter-than-air vehicles	
[GPO-43-457] Processing of airborne reconnaissance data	N79-23925
Processing of airborne reconnaissance data	IOL
<pre>in-flight display and near real-time trai [AGARD-AR-135]</pre>	¥79-24993
AEROACOUSTICS	AVJ 24993
Effects of forward velocity on sound radiat	:10h
Effects of forward velocity on sound radiat from convecting monopole and dipole source	es 10
jet flow subsonic aircraft model	
11- satis of town Danalas lassaster to	A79-38393
Application of Laser Doppler Anemometry to aeroacoustic research	
aeroacouscie research	A79-39500
Assessment at full scale of nozzle/wing geo	metry
effects on OTW aeroacoustic characteristi	CS
Over The Wing STOL engine configurations	
	A79-39802
An improved method for predicting the effect	A79-39802
	A79-39802 ts of
An improved method for predicting the effect flight on jet mixing noise Advanced rotorcraft technology: Task force	A79-39802 ts of A79-39803 e report
An improved method for predicting the effect flight on jet mixing noise Advanced rotorcraft technology: Task force	A79-39802 ts of A79-39803 e report
 An improved method for predicting the effect flight on jet mixing noise Advanced rotorcraft technology: Task force [NASA-TM-80541] Assessment at full scale of nozzle/wing ged 	A79-39802 ts of A79-39803 e report N79-24951 ometry
An improved method for predicting the effect flight on jet mixing noise Advanced rotorcraft technology: Task force [NASA-TM-80541] Assessment at full scale of nozzle/wing geo effects on OTW aero-acoustic characterist	A79-39802 ts of A79-39803 e report N79-24951 ometry
In improved method for predicting the effect flight on jet mixing noise Advanced rotorcraft technology: Task force [NASA-TM-80541] Assessment at full scale of nozzle/wing get effects on OTW aero-acoustic characterist short takeoff aircraft noise	A79-39802 cts of A79-39803 e report N79-24951 ometry clcs
 An improved method for predicting the effect flight on jet mixing noise Advanced rotorcraft technology: Task force [NASA-TM-80541] Assessment at full scale of nozzle/wing geo effects on OTW aero-acoustic characterist short takeoff aircraft noise [NASA-TM-79168] 	A79-39802 ts of A79-39803 e report N79-24951 ometry
An improved method for predicting the effect flight on jet mixing noise Advanced rotorcraft technology: Task force [NASA-TM-80541] Assessment at full scale of nozzle/wing get effects on OTW aero-acoustic characterist short takeoff aircraft noise [NASA-TM-79168] AERODYNAUC BALANCE	A79-39802 ts of A79-39803 e report N79-24951 Smetry clcs N79-25841
An improved method for predicting the effect flight on jet mixing noise Advanced rotorcraft technology: Task force [NASA-TM-80541] Assessment at full scale of nozzle/wing geo effects on OTW aero-acoustic characterist short takeoff aircraft noise [NASA-TM-79168] ABEODYNAMIC BALANCE Balance and sting design for cryogenic wind [ONERA, TP NO. 1979-40]	A79-39802 ts of A79-39803 e report N79-24951 Smetry clcs N79-25841
 An improved method for predicting the effect flight on jet mixing noise Advanced rotorcraft technology: Task force [NASA-TM-80541] Assessment at full scale of nozzle/wing ged effects on OTW aero-acoustic characterist short takeoff aircraft noise [NASA-TM-79168] MEBODYNAMIC BALANCE Balance and sting design for cryogenic wind [ONERA, TP NO. 1979-40] AERODYNAMIC CHARACTERISTICS 	A79-39802 tts of A79-39803 ereport N79-24951 ometry Lics N79-25841 l tunnels A79-39089
<pre>In improved method for predicting the effect flight on jet mixing noise Advanced rotorcraft technology: Task force [NASA-TM-80541] Assessment at full scale of nozzle/wing gec effects on OTW aero-acoustic characterist short takeoff aircraft noise [NASA-TM-79168] ABEODYNAMIC BALAWCE Balance and sting design for cryogenic wind [ONERA, TP NO. 1979-40] ABEODYNAMIC CHARACTERISTICS Practical design of minimum induced loss pr</pre>	A79-39802 tts of A79-39803 e report N79-24951 metry tts s N79-25841 t tunnels A79-39089 copellers
<pre>An improved method for predicting the effect flight on jet mixing noise Advanced rotorcraft technology: Task force [NASA-TM-80541] Assessment at full scale of nozzle/wing ged effects on OTW aero-acoustic characterist short takeoff aircraft noise [NASA-TM-79168] AEBCOJNAMIC BALANCE Balance and sting design for cryogenic wind [ONERA, TP NO. 1979-40] AEBCOJNAMIC CHARACTERISTICS Practical design of minibum induced loss pr [SAE PAPER 790585]</pre>	A79-39802 tts of A79-39803 s report N79-24951 metry tlcs N79-25841 tunnels A79-39089 copellers A79-36720
 An improved method for predicting the effect flight on jet mixing noise Advanced rotorcraft technology: Task force [NASA-TN-80541] Assessment at full scale of nozzle/wing geo effects on OTW aero-acoustic characterist short takeoff aircraft noise [NASA-TH-79168] AERODYNAMIC BALANCE Balance and sting design for cryogenic wind [ONERA, TP NO. 1979-40] AERODYNAMIC CHARACTERISTICS Practical design of minimum induced loss pr [SAE PAPER 790585] Full-scale wind-tunnel investigation of an 	A79-39802 tts of A79-39803 s report N79-24951 metry tlcs N79-25841 tunnels A79-39089 copellers A79-36720
<pre>In improved method for predicting the effect flight on jet mixing noise Advanced rotorcraft technology: Task force [NASA-TM-80541] Assessment at full scale of nozzle/wing gec effects on OTW aero-acoustic characterist short takeoff aircraft noise [NASA-TM-79168] AEBODYNAMIC BALAWCE Balance and sting design for cryogenic wind [ONERA, TP NO. 1979-40] AEBODYNAMIC CHARACTERISTICS Practical design of minimum induced loss pr [SAE PAPER 790585] Full-scale wind-tunnel investigation of an s2R-800 Thrush Agricultural Airplane</pre>	A79-39802 tts of A79-39803 e report N79-24951 metry ttcs N79-25841 t tunnels A79-39089 copellers A79-36720 Ayres
 An improved method for predicting the effect flight on jet mixing noise Advanced rotorcraft technology: Task force [NASA-TN-80541] Assessment at full scale of nozzle/wing geo effects on OTW aero-acoustic characterist short takeoff aircraft noise [NASA-TH-79168] AERODYNAMIC BALANCE Balance and sting design for cryogenic wind [ONERA, TP NO. 1979-40] AERODYNAMIC CHARACTERISTICS Practical design of minimum induced loss pr [SAE PAPER 790585] Full-scale wind-tunnel investigation of an 	A79-39802 its of A79-39803 e report N79-24951 mmetry itcs N79-25841 i tunnels A79-39089 copellers A79-36720 Ayres A79-36746
<pre>An improved method for predicting the effect flight on jet mixing noise Advanced rotorcraft technology: Task force [NASA-TM-80581] Assessment at full scale of nozzle/wing ged effects on OTW aero-acoustic characterist short takeoff aircraft noise [NASA-TM-79168] AEBCOYNAMIC BALANCE Balance and sting design for cryogenic wind [ONERA, TP NO. 1979-40] AEBCOYNAMIC CHARACTERISTICS Practical design of minibum induced loss pr [SAE PAPER 790585] Full-scale wind-tunnel investigation of an S2R-800 Thrush Agricultural Airplane [SAE PAPER 790618]</pre>	A79-39802 tts of A79-39803 e report W79-24951 Dmetry tlcs W79-25841 I tunnels A79-39089 copellers A79-36720 Ayres A79-36746 chniques
<pre>An improved method for predicting the effect flight on jet mixing noise Advanced rotorcraft technology: Task force [NASA-TM-80584] Assessment at full scale of nozzle/wing ged effects on OTW aero-acoustic characterist short takeoff aircraft noise [NASA-TM-79168] AEBCOYNAMIC BALANCE Balance and sting design for cryogenic wind [ONERA, TP NO. 1979-40] AEBCOYNAMIC CHARACTERISTICS Practical design of minimum induced loss pr [SAE PAPER 790585] Full-scale wind-tunnel investigation of an S2R-800 Thrush Agricultural Airplane [SAE PAPER 790618] Application of parameter identification tec to analysis of flight data</pre>	A79-39802 its of A79-39803 e report N79-24951 mmetry itcs N79-25841 i tunnels A79-39089 copellers A79-36720 Ayres A79-36746
 An improved method for predicting the effect flight on jet mixing noise Advanced rotorcraft technology: Task force [NASA-TM-80541] Assessment at full scale of nozzle/wing ged effects on OTW aero-acoustic characterist short takeoff aircraft noise [NASA-TM-79168] ABEODYNAMIC BALANCE Balance and sting design for cryogenic wind [ONZRA, TP NO. 1979-40] AERODYNAMIC CHARACTERISTICS Practical design of minimum induced loss pr [SAE PAPER 790585] Full-scale wind-tunnel investigation of an S2R-800 Thrush Agricultural Airplane [SAE PAPER 790618] Application of parameter identification teed 	A79-39802 tts of A79-39803 ereport N79-24951 Dmetry Lics N79-25841 l tunnels A79-39089 copellers A79-36720 Ayres A79-36746 chniques A79-37735
<pre>In improved method for predicting the effect flight on jet mixing noise Advanced rotorcraft technology: Task force [NASA-TH-80541] Assessment at full scale of nozzle/wing gec effects on OTW aero-acoustic characterist short takeoff aircraft noise [NASA-TH-79168] BEBODYNAMIC BALAWCE Balance and sting design for cryogenic wind [ONERA, TP NO. 1979-40] AERODYNAMIC CHARACTERISTICS Practical design of minimum induced loss pr [SAE PAPER 790585] Full-scale wind-tunnel investigation of an s2R-800 Thrush Agricultural Airplane [SAE PAPER 790618] Application of parameter identification tec to analysis of flight data Radial equilibrium in axial turbomachines</pre>	A79-39802 tts of A79-39803 ereport W79-24951 Dmetry tics W79-25841 tunnels A79-39089 copellers A79-36720 Ayres A79-36746 chniques A79-37735 A79-37828
<pre>An improved method for predicting the effect flight on jet mixing noise Advanced rotorcraft technology: Task force [NASA-TM-80584] Assessment at full scale of nozzle/wing ged effects on OTW aero-acoustic characterist short takeoff aircraft noise [NASA-TM-79168] AEBCOYNAMIC BALANCE Balance and sting design for cryogenic wind [ONERA, TP NO. 1979-40] AEBCOYNAMIC CHARACTERISTICS Practical design of minimum induced loss pr [SAE PAPER 790585] Full-scale wind-tunnel investigation of an S2R-800 Thrush Agricultural Airplane [SAE PAPER 790618] Application of parameter identification tec to analysis of flight data</pre>	A79-39802 tts of A79-39803 ereport W79-24951 Dmetry tics W79-25841 tunnels A79-39089 copellers A79-36720 Ayres A79-36746 chniques A79-37735 A79-37828
 An improved method for predicting the effect flight on jet mixing noise Advanced rotorcraft technology: Task force [NASA-TM-80584] Assessment at full scale of nozzle/wing geo effects on OTW aero-acoustic characterist short takeoff aircraft noise [NASA-TM-79168] AEBCOJNAMIC BALANCE Balance and sting design for cryogenic wind [ONERA, TP NO. 1979-40] AEBCOJNAMIC CHARACTERISTICS Practical design of minimum induced loss pr [SAE PAPER 790585] Full-scale wind-tunnel investigation of an S2E-800 Thrush Agricultural Airplane [SAE PAPER 790618] Application of parameter identification tect to analysis of flight data Radial equilibrium in axial turbomachines Effect of forward acceleration on aerodynamic 	A79-39802 tts of A79-39803 ereport W79-24951 Dmetry tics W79-25841 tunnels A79-39089 copellers A79-36720 Ayres A79-36746 chniques A79-37735 A79-37828
<pre>An improved method for predicting the effect flight on jet mixing noise Advanced rotorcraft technology: Task force [NASA-TM-80541] Assessment at full scale of nozzle/wing geo effects on OTW aero-acoustic characterist short takeoff aircraft noise [NASA-TM-79168] AEBODYNAMIC BALANCE Balance and sting design for cryogenic wind [ONERA, TP NO. 1979-40] AEBODYNAMIC CHARACTERISTICS Practical design of minimum induced loss pr [SAE PAPER 790585] Full-scale wind-tunnel investigation of an S2R-800 Thrush Agricultural Airplane [SAE PAPER 790618] Application of parameter identification tec to analysis of flight data Radial equilibrium in axial turbomachines Effect of forward acceleration on aerodynamic characteristics of wings</pre>	A79-39802 cts of A79-39803 e report N79-24951 metry ctcs N79-25841 t tunnels A79-39089 copellers A79-36720 Ayres A79-36746 chniques A79-37828 hcc A79-38124 ce
<pre>An improved method for predicting the effect flight on jet mixing noise Advanced rotorcraft technology: Task force [NASA-TM-80581] Assessment at full scale of nozzle/wing ged effects on OTW aero-acoustic characterist short takeoff aircraft noise [NASA-TM-79168] AEBCOYNAMIC BALANCE Balance and sting design for cryogenic wind [ONERA, TP NO. 1979-40] AEBCOYNAMIC CHARACTERISTICS Practical design of minibum induced loss pr [SAE PAPER 790585] Full-scale wind-tunnel investigation of an S2R-800 Thrush Agricultural Airplane [SAE PAPER 790618] Application of parameter identification tect to analysis of flight data Radial equilibrium in axial turbomachines Effect of forward acceleration on aerodynat characteristics and flywheel effect of to the state of the state of</pre>	A79-39802 cts of A79-39803 e report N79-24951 metry ctcs N79-25841 t tunnels A79-39089 copellers A79-36720 Ayres A79-36746 chniques A79-37828 hcc A79-38124 ce
<pre>An improved method for predicting the effect flight on jet mixing noise Advanced rotorcraft technology: Task force [NASA-TM-80541] Assessment at full scale of nozzle/wing geo effects on OTW aero-acoustic characterist short takeoff aircraft noise [NASA-TM-79168] AEBODYNAMIC BALANCE Balance and sting design for cryogenic wind [ONERA, TP NO. 1979-40] AEBODYNAMIC CHARACTERISTICS Practical design of minimum induced loss pr [SAE PAPER 790585] Full-scale wind-tunnel investigation of an S2R-800 Thrush Agricultural Airplane [SAE PAPER 790618] Application of parameter identification tec to analysis of flight data Radial equilibrium in axial turbomachines Effect of forward acceleration on aerodynamic characteristics of wings</pre>	A79-39802 tts of A79-39803 ereport W79-24951 Dmetry tics W79-25841 i tunnels A79-39089 copellers A79-36720 Ayres A79-36746 chniques A79-37735 A79-37828 bic A79-38124 ce biblne
<pre>An improved method for predicting the effect flight on jet mixing noise Advanced rotorcraft technology: Task force [NASA-TM-80581] Assessment at full scale of nozzle/wing ged effects on OTW aero-acoustic characterist short takeoff aircraft noise [NASA-TM-79168] AEBCOYNAMIC BALANCE Balance and sting design for cryogenic wind [ONERA, TP NO. 1979-40] AEBCOYNAMIC CHARACTERISTICS Practical design of minibum induced loss pr [SAE PAPER 790585] Full-scale wind-tunnel investigation of an S2R-800 Thrush Agricultural Airplane [SAE PAPER 790618] Application of parameter identification tect to analysis of flight data Radial equilibrium in axial turbomachines Effect of forward acceleration on aerodynat characteristics and flywheel effect of to the state of the state of</pre>	A79-39802 cts of A79-39803 e report N79-24951 metry ctcs N79-25841 t tunnels A79-39089 copellers A79-36720 Ayres A79-36746 chniques A79-37828 hcc A79-38124 ce

.

ABRODYNAMIC COEFFICIENTS

Characteristics of the advanced supersonic technology AST-105-1 configured for transpacific range with Pratt and Whitney aircraft variable stream control engines [NASA-TM-78818] N79-23888 Some new airfoils N79-23896 A comparison of the aerodynamic characteristics of eight sailwing airfoil sections #79-23897 Investigation of aerodynamic characteristics of subsonic wings [NASA-CR-158661] N79-23921 Technical evaluation report on the Fluid Dynamics Panel Symposium on Dynamic Stability parameters [AGARD-AR-137] 179-23981 Aircraft sonic boom: Studies on aircraft flight, aircraft solic boom: Studies on aircr aircraft design, and measurement. A bibliography with abstracts [NTIS/PS-79/0264/6] [NTI5/PS-79/0264/6] Advanced rotorcraft technology: Task force report N79-24951 [NASA-TH-80541] Some remarks on the design of transonic tunnels with low levels of flow unsteadiness [NASA-CR-2722] N79-25039 ABRODINAMIC COBPFICIENTS Conversion of wing surface pressures into normalized lift coefficient [SAE PAPER 790567] Analysis of an unsteady aerodynamic force on a A79-36707 blade due to ununiform amplitude gusts A79-39059 Minimization theory of induced drag subject to constraint conditions [NASA-CE-3140] N79-239; ABRODYNAMIC CONFIGURATIONS Profile of a nozzle shaping the free-molecule flow intended to investigate air-intakes and cascades N79-23923 A79-36122 Numerical optimization techniques for bound circulation distribution for minimum induced drag of nonplanar wings: Basic formulations [NASA-CR-3154] N79-23924 Interactional aerodynamics of the single rotor helicopter configuration. Volume 68: One-third octave band spectrograms of wake single film data, basic configuration wake explorations [AD-A061861] N79 Interactional aerodynamics of the single rotor N79-23931 helicopter configuration. Volume 3A: Flow angle and velocity wake profiles in low frequency band, basic investigations and hub variations [AD-A061766] N79-23932 Interactional aerodynamics of the single rotor helicopter configuration. Volume 3B: Plow angle and velocity wake profiles in low frequency band, air ejector systems and other devices [AD-A061767] N79-23933 Interactional aerodynamics of the single rotor helicopter configuration. Volume 2B: Harmonic analyses of airframe surface pressure data, runs 7 - 14, midsection [AD-A061860] N79-239 N79-23934 Interactional aerodynamics of the single rotor helicopter configuration. Volume 6B: One-third octave band spectrograms of wake single film data, basic configuration wake explorations [AD-A061861] N7 N79-24968 ABRODYNANTC DRAG Evaluation of methods for prediction of propulsion system drag system drag [AIAA PAPER 79-1148] A79-3. An exploratory investigation of the effect of plastic coating on the profile drag of a practical-metal-construction sailplane airfoil A79-38961 N79-23891 Optimum tail plane design for sailplanes N79-23892 The effect of disturbance on a wing N79-23893 Polar lift and drag determination during flight tests [HBB-0PE-1410-0] N79-24986 ABRODYNAMIC PORCES Generation and breakdown of aerodynamic lift: Physical mechanism N79-23894

SUBJECT INDEX

ABRODYNAMIC HEATING Transient ablation of Teflon in intense radiative and convective environments A79-38123 AERODYNAMIC INTERFERENCE A novel correlation of centrifugal compressor performance for off-design prediction [AIAA PAPER 79-1159] A79 A79-38965 Aerodynamic problems in engine airframe integration on fighter airplanes [HBB-UPE-1359-0] N79-23936 Interference effects of aircraft components on the local blade angle of attack of a wing-mounted propeller [NASA-TM-78587] N79-25021 AERODYNAMIC LOADS The analysis of propellers including interaction effects --- for general aviation aircraft [SAE PAPER 790576] A79-3 A79-36712 Active control for the Total-In-Flight simulator (ACTIFS) [NASA-CR-3118] vector-continuous loading concept for N79-23978 aerodynamic panel methods [NASA-TH-80104] N79-: Factors influencing the accuracy of aerodynamic hinge-moment prediction N79-24956 [AD-A066606] N79-24965 LAD-BOOGOUS ABEODYNAHIC BOISE Design of quiet efficient propellers [SAE PAPER 790584] The impact of noise regulations on propeller design [SAE PAPER 790593] A79-3672 A79 x79-36719 179-36727 Propeller aircraft noise around general aviation airports [SAE PAPER 790594] A79-30 Effects of forward velocity on sound radiation from convecting monopole and dipole sources in jet flow --- subsonic aircraft model A79-36728 A79-38393 Noise characteristics of heated high velocity rectangular jets --- jet engine application A79-38399 Tone noise of three supersonic helical tip speed propellers in a wind tunnel A79-39801 ABRODYNAMIC STABILITY Rotor blade stability in turbulent flows. I A79-38118 An annular wing An annular wing [NASA-CASE-PRC-11007-2] AERODYNAMIC STALLING Spin flight research summary [SAE PAPER 790565] Conversion of wing surface pressures into normalized lift coefficient [SAE PAPER 790567] N79-24959 A79-36706 A79-36707 Some theoretical considerations of a stall proof airplane [SAE PAPER 790604] A79-36736 Turbulent wake measurements with a laser velocimeter [AIAA PAPER 79-1087] A79-38058 ARRODYNAMICS Lectures on hydroaeromechanics --- Russian book A79-36347 Aerodynamics [NASA-TT-P-765] N79-23908 ABROBLASTICITY Aeroelastic stability analysis of the AD-1 manned oblique-wing aircraft A79-38136 Aeroelastic models for cryogenic wind tunnels [ONERA, TP NO. 1979-39] A79-3 Vortex-induced oscillations - A selective review A79-39088 A79-39751 Active control for the Total-In-Flight simulator (ACTIFS) [NASA-CR-3118] 879-23978 Aeroelastically conformable rotor mission analysis [AD-A067338] N79-24985 ABROBAUTICAL ENGINBERING Diagnostics of wear in aeronautical systems [NASA-TM-79185] N79-24350 ABBOSPACE ENGINEERING Analytical modeling of the dynamics of brushless dc motors for aerospace applications: A conceptual framework [NASA-TH-80445] N79-25310

I.

1

AIRCHAFT BRAKES

ABROSPACE INDUSTRY Dry friction in the aerospace industry	
biy miceion in the delospace industry	A79-39873
AEROTHERHODYNAMICS	
Noise characteristics of heated high veloc	
rectangolar jets jet engine applicat	A79-38399
The role of three-dimensional flow analysi	
design of turbomachinery	
[AIAA PAPER 79-1231] Apterbodies	A79-38995
Evaluation of methods for prediction of pr	opulsion
system drag	-
[AIAA PAPER 79-1148]	A79-38961
A parametric study of support system inter effects on nozzle/afterbody throttle dep	endent
drag in wind tunnel testing	
[AIAA PAPER 79-1168] Apterburning	A79-38968
Test verification of a turbofan partial sw	111
afterburner	
[AIAA PAPER 79-1199]	A79-38981
Operating condition and geometry effects o low-frequency afterburner combustion ins	n tability
low-frequency afterburner combustion ins in a turbofan at altitude	1
[NASA-TP-1475]	N79-25022
AGRICULTURAL AIRCRAFT Full-scale wind-tunnel investigation of an	Avres
S2R-800 Thrush Agricultural Airplane	-1-00
[SAE PAPER 790618]	A79-36746
Model study of aircraft disk brakes	A79-38816
AIR BREATHING ENGINES	
Multivariable control altitude demonstrati	on on
the P100 turbofan engine [NASA-TH-79183]	N79-25015
AIR CARGO	
Cargo Logistics Airlift Systems Study (CLA	SS).
Volume 2: Case study approach and resul [NASA-CR-158913]	ts N79-24978
AIR CONDITIONING BOUIPHENT	115 24570
Formulation of empirical formulas for calc	
the hydraulic resistance of networks aircraft deicing and air-conditioning sy	
decorate deloting and dir conditioning Sy	A79-36593
The aircraft air conditioner data revisite	
The allCraft all conditioner data revisite for comparison of alternative system con	cepts
for comparison of alternative system con AIR COOLING Determination of cooling air mass flow for	cepts 179-39895 a
for comparison of alternative system con AIR COOLING Determination of cooling air mass flow for horizontally-opposed aircraft engine ins	cepts A79-39895 a tallation
for comparison of alternative system con AIR COOLING Determination of cooling air mass flow for	cepts A79-39895 a tallation A79-36740
for comparison of alternative system con AIR COOLING Determination of cooling air mass flow for horizontally-opposed aircraft engine ins [SAE PAPER 790609] Engine demonstration test of a cooled lami axial turbine	cepts A79-39895 a tallation A79-36740 nated
for comparison of alternative system con AIR COOLING Determination of cooling air mass flow for horizontally-opposed aircraft engine ins [SAE PAPER 790609] Engine demonstration test of a cooled lami axial turbine [AIAA PAPER 79-1229]	cepts A79-39895 a tallation A79-36740 nated A79-38993
for comparison of alternative system con AIR COOLING Determination of cooling air mass flow for horizontally-opposed aircraft engine ins [SAE PAPER 790609] Engine demonstration test of a cooled lami axial turbine	cepts A79-39895 a tallation A79-36740 nated A79-38993
for comparison of alternative system con AIR COOLING Determination of cooling air mass flow for horizontally-opposed aircraft engine ins [SAE PAPER 790609] Engine demonstration test of a cooled lami arial turbine [AIAA PAPER 79-1229] Internally coated air-cooled gas turbine b [NASA-CR-159574] AIR FLOW	cepts A79-39895 a tallation A79-36740 pated A79-38993 lading N79-25018
for comparison of alternative system con AIR COOLING Determination of cooling air mass flow for horizontally-opposed aircraft engine ins [SAE PAPER 790609] Engine demonstration test of a cooled lami arial turbine [AIAA PAPER 79-1229] Internally coated air-cooled gas turbine b [NASA-CR-159574] AIR FLOW Influence of the flow angle on the charact	cepts A79-39895 a tallation A79-36740 nated A79-38993 lading N79-25018 eristics
for comparison of alternative system con AIR COOLING Determination of cooling air mass flow for horizontally-opposed aircraft engine ins [SAE PAPER 790609] Engine demonstration test of a cooled lami arial turbine [AIAA PAPER 79-1229] Internally coated air-cooled gas turbine b [NASA-CR-159574] AIR FLOW	cepts A79-39895 a tallation A79-36740 nated A79-38993 lading N79-25018 eristics
<pre>for comparison of alternative system con AIR COOLING Determination of cooling air mass flow for horizontally-opposed aircraft engine ins [SAE PAPER 790609] Engine demonstration test of a cooled lami arial turbine [AIA PAPER 79-1229] Internally coated air-cooled gas turbine b [NASA-CR-159574] AIR FLOW Influence of the flow angle on the charact of an elbow-shaped air intake of gas engines</pre>	cepts A79-39895 a tallation A79-36740 nated A79-38993 lading N79-25018 eristics turbine A79-36585
<pre>for comparison of alternative system con AIB COOLING Determination of cooling air mass flow for horizontally-opposed aircraft engine ins [SAE PAPER 790609] Engine demonstration test of a cooled lami arial turbine [AIA PAPER 79-1229] Internally coated air-cooled gas turbine b [NASA-CR-159574] AIR FLOW Influence of the flow angle on the charact of an elbow-shaped air intake of gas engines Determination of cooling air mass flow for</pre>	cepts A79-39895 a tallation A79-36740 nated A79-38993 lading N79-25018 eristics turbine A79-36585 a
<pre>for comparison of alternative system con AIR COOLING Determination of cooling air mass flow for horizontally-opposed aircraft engine ins [SAE PAPER 790609] Engine demonstration test of a cooled lami arial turbine [AIA PAPER 79-1229] Internally coated air-cooled gas turbine b [NASA-CR-159574] AIR FLOW Influence of the flow angle on the charact of an elbow-shaped air intake of gas engines</pre>	cepts A79-39895 a tallation A79-36740 nated A79-38993 lading N79-25018 eristics turbine A79-36585 a
<pre>for comparison of alternative system con AIR COOLING Determination of cooling air mass flow for horizontally-opposed aircraft engine ins [SAE PAPER 790609] Engine demonstration test of a cooled lami arial turbine [AIA PAPER 79-1229] Internally coated air-cooled gas turbine b [NASA-CR-159574] AIR FLOW Influence of the flow angle on the charact of an elbow-shaped air intake of gas engines Determination of cooling air mass flow for horizontally-opposed aircraft engine ins [SAE PAPER 790609] A novel correlation of centrifugal compres</pre>	cepts A79-39895 a tallation A79-36740 nated A79-38993 lading N79-25018 eristics turbine A79-36585 a tallation A79-36740
<pre>for comparison of alternative system con AIR COOLING Determination of cooling air mass flow for horizontally-opposed aircraft engine ins [SAP PAPER 790609] Engine demonstration test of a cooled lami arial turbine [AIAN PAPER 79-1229] Internally coated air-cooled gas turbine b [NASA-CR-159574] AIR FLOW Influence of the flow angle on the charact of an elbow-shaped air intake of gas engines Determination of cooling air mass flow for horizontally-opposed aircraft engine ins [SAP PAPER 790609] A novel correlation of centrifugal compres performance for off-design prediction</pre>	cepts A79-39895 a tallation A79-36740 nated A79-38993 lading N79-25018 eristics turbine A79-36585 a tallation A79-36740 sor
<pre>for comparison of alternative system con AIR COOLING Determination of cooling air mass flow for horizontally-opposed aircraft engine ins [SAE PAPER 790609] Engine demonstration test of a cooled lami arial turbine [AIA PAPER 79-1229] Internally coated air-cooled gas turbine b [NASA-CR-159574] AIR FLOW Influence of the flow angle on the charact of an elbow-shaped air intake of gas engines Determination of cooling air mass flow for horizontally-opposed aircraft engine ins [SAE PAPER 790609] A novel correlation of centrifugal compres</pre>	cepts A79-39895 a tallation A79-36740 nated A79-38993 lading N79-25018 eristics turbine A79-36585 a tallation A79-36740 sor A79-38965
<pre>for comparison of alternative system con AIR COOLING Determination of cooling air mass flow for horizontally-opposed aircraft engine ins [SAE PAPER 790609] Engine demonstration test of a cooled lami arial turbine [AIAN PAPER 79-1229] Internally coated air-cooled gas turbine b [NASA-CR-159574] AIR FLOW Influence of the flow angle on the charact of an elbow-shaped air intake of gas engines Determination of cooling air mass flow for horizontally-opposed aircraft engine ins [SAE PAPER 790609] A novel correlation of centrifugal compres performance for off-design prediction [AIAN PAPER 79-1159] Engine demonstration test of a cooled lami arial turbine</pre>	cepts A79-39895 a tallation A79-36740 nated A79-38993 lading N79-25018 eristics turbine A79-36585 a tallation A79-36740 sor A79-38965 nated
<pre>for comparison of alternative system con AIR COOLING Determination of cooling air mass flow for horizontally-opposed aircraft engine ins [SAP PAPER 790609] Engine demonstration test of a cooled lami arial turbine [AIA PAPER 79-1229] Internally coated air-cooled gas turbine b [NASA-CR-159574] AIR PLOW Influence of the flow angle on the charact of an elbow-shaped air intake of gas engines Determination of cooling air mass flow for horizontally-opposed aircraft engine ins [SAP PAPER 790609] A novel correlation of centrifugal compres performance for off-design prediction [AIA PAPER 79-1159] Engine demonstration test of a cooled lami arial turbine [AIAA PAPER 79-1229]</pre>	cepts A79-39895 a tallation A79-36740 nated A79-38993 lading N79-25018 eristics turbine A79-36585 a tallation A79-36740 sor A79-38965
<pre>for comparison of alternative system con AIR COOLING Determination of cooling air mass flow for horizontally-opposed aircraft engine ins [SAE PAPER 790609] Engine demonstration test of a cooled lami arial turbine [AIA PAPER 79-1229] Internally coated air-cooled gas turbine b [NASA-CR-159574] AIR FLOW Influence of the flow angle on the charact of an elbow-shaped air intake of gas engines Determination of cooling air mass flow for horizontally-opposed aircraft engine ins [SAE PAPER 790609] A novel correlation of centrifugal compres performance for off-design prediction [AIA PAPER 79-1159] Engine demonstration test of a cooled lami arial turbine [AIA PAPER 79-1229] AIR FUMERS Profile of a nozzle shaping the free-molece</pre>	cepts A79-39895 a tallation A79-36740 nated A79-38993 lading N79-25018 eristics turbine A79-36585 a tallation A79-36740 sor A79-38965 nated A79-38993 ule flow
<pre>for comparison of alternative system con AIR COOLING Determination of cooling air mass flow for horizontally-opposed aircraft engine ins [SAE PAPER 790609] Engine demonstration test of a cooled lami arial turbine [AIAA PAPER 79-1229] Internally coated air-cooled gas turbine b [NASA-CR-159574] AIR FLOW Influence of the flow angle on the charact of an elbow-shaped air intake of gas engines Determination of cooling air mass flow for horizontally-opposed aircraft engine ins [SAE PAPER 790609] A novel correlation of centrifugal compress performance for off-design prediction [AIAA PAPER 79-1159] Engine demonstration test of a cooled lami arial turbine [AIAA PAPER 79-1229] AIR IMTAKES</pre>	cepts A79-39895 a tallation A79-36740 nated A79-38993 lading N79-25018 eristics turbine A79-36585 a A79-36585 a A79-36740 sor A79-38965 nated A79-38993 ule flow cascades
<pre>for comparison of alternative system con AIR COOLING Determination of cooling air mass flow for horizontally-opposed aircraft engine ins [SAP PAPER 790609] Engine demonstration test of a cooled lami arial turbine [AIA PAPER 79-1229] Internally coated air-cooled gas turbine b [NASA-CR-159574] AIR FLOW Influence of the flow angle on the charact of an elbow-shaped air intake of gas engines Determination of cooling air mass flow for horizontally-opposed aircraft engine ins [SAP PAPER 790609] A novel correlation of centrifugal compress performance for off-design prediction [AIA PAPER 79-1229] Engine demonstration test of a cooled lami arial turbine [AIA PAPER 79-1229] AIR INTAKES Profile of a nozzle shaping the free-molec intended to investigate air-intakes and</pre>	cepts A79-39895 a tallation A79-36740 nated A79-38993 lading N79-25018 eristics turbine A79-36585 a tallation A79-36740 sor A79-38965 nated A79-38993 ule flow cascades A79-36122
<pre>for comparison of alternative system con AIR COOLING Determination of cooling air mass flow for horizontally-opposed aircraft engine ins [SAE PAPER 790609] Engine demonstration test of a cooled lami arial turbine [AIA PAPER 79-1229] Internally coated air-cooled gas turbine b [NASA-CR-159574] AIR FLOW Influence of the flow angle on the charact of an elbow-shaped air intake of gas engines Determination of cooling air mass flow for horizontally-opposed aircraft engine ins [SAE PAPER 790609] A novel correlation of centrifugal compres performance for off-design prediction [AIA PAPER 79-1159] Engine demonstration test of a cooled lami arial turbine [AIA PAPER 79-1229] AIR FUMERS Profile of a nozzle shaping the free-molece</pre>	cepts A79-39895 a tallation A79-36740 nated A79-38993 lading N79-25018 eristics turbine A79-36585 a tallation A79-36740 sor A79-38965 nated A79-38993 ule flow cascades A79-36122 eristics
<pre>for comparison of alternative system con AIR COOLING Determination of cooling air mass flow for horizontally-opposed aircraft engine ins [SAE PAPER 790609] Engine demonstration test of a cooled lami arial turbine [AIAN PAPER 79-1229] Internally coated air-cooled gas turbine b [NASA-CR-159574] AIR FLOW Influence of the flow angle on the charact of an elbow-shaped air intake of gas engines Determination of cooling air mass flow for horizontally-opposed aircraft engine ins [SAE PAPER 790609] A novel correlation of centrifugal compres performance for off-design prediction [AIAN PAPER 79-1159] Engine demonstration test of a cooled lami arial turbine [AIAA PAPER 79-1229] AIR INFARES Profile of a nozzle shaping the free-molec intended to investigate air-intakes and Influence of the flow angle on the charact</pre>	cepts A79-39895 a tallation A79-36740 nated A79-36740 nated A79-38993 lading N79-25018 eristics turbine A79-36585 a tallation A79-36740 sor A79-38965 nated A79-38993 wle flow cascades A79-36122 eristics turbine
<pre>for comparison of alternative system con AIR COOLING Determination of cooling air mass flow for horizontally-opposed aircraft engine ins [SAP PAPER 790609] Engine demonstration test of a cooled lami arial turbine [AIAN PAPER 79-1229] Internally coated air-cooled gas turbine b [NASA-CR-159574] AIR FLOW Influence of the flow angle on the charact of an elbow-shaped air intake of gas engines Determination of cooling air mass flow for horizontally-opposed aircraft engine ins [SAP PAPER 79-0609] A novel correlation of centrifugal compres performance for off-design prediction [AIAN PAPER 79-1159] Engine demonstration test of a cooled lami arial turbine [AIAA PAPER 79-1229] AIR FUTARES Profile of a nozzle shaping the free-molec intended to investigate air-intakes and Influence of the flow angle on the charact of an elbow-shaped air intake of gas engines</pre>	cepts A79-39895 a tallation A79-36740 nated A79-38993 lading N79-25018 eristics turbine A79-36585 a tallation A79-36740 sor A79-38965 nated A79-38993 ule flow cascades A79-36122 eristics
<pre>for comparison of alternative system con AIR COOLING Determination of cooling air mass flow for horizontally-opposed aircraft engine ins [SAP PAPER 790609] Engine demonstration test of a cooled lami arial turbine [AIA PAPER 79-1229] Internally coated air-cooled gas turbine b [NASA-CR-159574] AIR FLOW Influence of the flow angle on the charact of an elbow-shaped air intake of gas engines Determination of cooling air mass flow for horizontally-opposed aircraft engine ins [SAE PAPER 790609] A novel correlation of centrifugal compres performance for off-design prediction [AIAA PAPER 79-1159] Engine demonstration test of a cooled lami arial turbine [AIAA PAPER 79-1229] AIR INTAKES Profile of a nozzle shaping the free-molec intended to investigate air-intakes and Influence of the flow angle on the charact of an elbow-shaped air intake of gas</pre>	cepts A79-39895 a tallation A79-36740 nated A79-36740 nated A79-38993 lading N79-25018 eristics turbine A79-36585 a tallation A79-36740 sor A79-38965 nated A79-38993 wle flow cascades A79-36122 eristics turbine
<pre>for comparison of alternative system con AIR COOLING Determination of cooling air mass flow for horizontally-opposed aircraft engine ins [SAP PAPER 790609] Engine demonstration test of a cooled lami arial turbine [AIAN PAPER 79-1229] Internally coated air-cooled gas turbine b [NASA-CR-159574] AIR FLOW Influence of the flow angle on the charact of an elbow-shaped air intake of gas engines Determination of cooling air mass flow for horizontally-opposed aircraft engine ins [SAP PAPER 790609] A novel correlation of centrifugal compres performance for off-design prediction [AIAN PAPER 79-1159] Engine demonstration test of a cooled lami arial turbine [AIAA PAPER 79-1229] AIR INTAKES Profile of a nozzle shaping the free-molec intended to investigate air-intakes and Influence of the flow angle on the charact of an elbow-shaped air intake of gas engines Self stabilizing sonic inlet [NASA-CASE-LEW-11890-1] AIR MARES</pre>	cepts A79-39895 a tallation A79-36740 nated A79-36740 nated A79-36593 lading N79-25018 eristics turbine A79-36585 a A79-38965 nated A79-38993 ule flow cascades A79-36122 eristics turbine A79-36585
<pre>for comparison of alternative system con AIR COOLING Determination of cooling air mass flow for horizontally-opposed aircraft engine ins [SAE PAPER 790609] Engine demonstration test of a cooled lami arial turbine [AIAN PAPER 79-1229] Internally coated air-cooled gas turbine b [NASA-CR-159574] AIR FLOW Influence of the flow angle on the charact of an elbow-shaped air intake of gas engines Determination of cooling air mass flow for horizontally-opposed aircraft engine ins [SAE PAPER 790609] A novel correlation of centrifugal compres performance for off-design prediction [AIAN PAPER 79-1159] Engine demonstration test of a cooled lami arial turbine [AIAN PAPER 79-1229] AIR INTAKES Profile of a nozzle shaping the free-molec intended to investigate air-intakes and Influence of the flow angle on the charact of an elbow-shaped air intake of gas engines Self stabilizing sonic inlet [NASA-CR-ELEW-11890-1] AIR WAVIGATIOW Internationalization of OMEGA</pre>	cepts A79-39895 a tallation A79-36740 nated A79-36740 rated A79-36740 eristics turbine A79-36585 a tallation A79-36740 sor A79-36740 sor A79-38965 nated A79-38993 wle flow cascades A79-36122 eristics turbine A79-36585 N79-24976 A79-36069
<pre>for comparison of alternative system con AIR COOLING Determination of cooling air mass flow for horizontally-opposed aircraft engine ins [SAE PAPER 790609] Engine demonstration test of a cooled lami arial turbine [AIAN PAPER 79-1229] Internally coated air-cooled gas turbine b [NASA-CR-159574] AIR FLOW Influence of the flow angle on the charact of an elbow-shaped air intake of gas engines Determination of cooling air mass flow for horizontally-opposed aircraft engine ins [SAE PAPER 790609] A novel correlation of centrifugal compres performance for off-design prediction [AIAN PAPER 79-1159] Engine demonstration test of a cooled lami arial turbine [AIAN PAPER 79-1229] AIR INTAKES Profile of a nozzle shaping the free-molec intended to investigate air-intakes and Influence of the flow angle on the charact of an elbow-shaped air intake of gas engines Self stabilizing sonic inlet [NASA-CR-ELEW-11890-1] AIR WAVIGATIOW Internationalization of OMEGA</pre>	cepts A79-39895 a tallation A79-36740 nated A79-36740 rated A79-36740 eristics turbine A79-36585 a tallation A79-36740 sor A79-36740 sor A79-38965 nated A79-38993 wle flow cascades A79-36122 eristics turbine A79-36585 N79-24976 A79-36069
<pre>for comparison of alternative system con AIR COOLING Determination of cooling air mass flow for horizontally-opposed aircraft engine ins [SAP PAPER 790609] Engine demonstration test of a cooled lami arial turbine [AIA PAPER 79-1229] Internally coated air-cooled gas turbine b [NASA-CR-159574] AIR FLOW Influence of the flow angle on the charact of an elbow-shaped air intake of gas engines Determination of cooling air mass flow for horizontally-opposed aircraft engine ins [SAE PAPER 790609] A novel correlation of centrifugal compres performance for off-design prediction [AIAA PAPER 79-1159] Engine demonstration test of a cooled lami arial turbine [AIAA PAPER 79-1229] AIR INTAKES Profile of a nozzle shaping the free-molec intended to investigate air-intakes and Influence of the flow angle on the charact of an elbow-shaped air intake of gas engines Self stabilizing sonic inlet [NASA-CASE-LEW-11890-1] AIR MAYGAFIOW Internationalization of OMEGA A navigation filter for an integrated GPS/JTIDS/INS system for a tactical airc</pre>	cepts A79-39895 a tallation A79-36740 nated A79-36740 nated A79-36740 eristics turbine A79-36585 a A79-38993 ule flow cascades A79-36122 eristics turbine A79-36585 N79-24976 A79-36069 raft
<pre>for comparison of alternative system con AIR COOLING Determination of cooling air mass flow for horizontally-opposed aircraft engine ins [SAE PAPER 790609] Engine demonstration test of a cooled lami arial turbine [AIAN PAPER 79-1229] Internally coated air-cooled gas turbine b [NASA-CR-159574] AIR FLOW Influence of the flow angle on the charact of an elbow-shaped air intake of gas engines Determination of cooling air mass flow for horizontally-opposed aircraft engine ins [SAE PAPER 790609] A novel correlation of centrifugal compres performance for off-design prediction [AIAN PAPER 79-1159] Engine demonstration test of a cooled lami arial turbine [AIAN PAPER 79-1229] AIR INTAKES Profile of a nozzle shaping the free-molec intended to investigate air-intakes and Influence of the flow angle on the charact of an elbow-shaped air intake of gas engines Self stabilizing sonic inlet [NASA-CR-ELEW-11890-1] AIR WAVIGATIOW Internationalization of OMEGA</pre>	cepts A79-39895 a tallation A79-36740 nated A79-36740 nated A79-36740 eristics turbine A79-36585 a A79-38993 ule flow cascades A79-36122 eristics turbine A79-36585 N79-24976 A79-36069 raft

Stability analysis of relative navigation TDMA system for multi-member aircraf communities	
	A79-36090
AIR POLLUTION Contribution to the development of motor e	1 1SSION
regulations [ONERA, TP WO. 1979-43] Aircraft air pollution emission estimation	A79-39092
techniques, ACBB [AD-A067262] Air pollutant emission factors for militar	N79-25550 y and
c1v11 aircraft [PB-292520/4]	N79-25567
AIR TO SUBPACE HISSILES Evaluation of ground-launch firings for th	e
<pre>improved 2.75-inch rocket [AIAA PAPER 79-1297] AIR TRAFFIC CONTROL</pre>	A79-39027
A family of air traffic control radars	170 30533
The time budget as a criterion for the wor	179-38532 kload of
air traffic controllers [NBB-OPE-1353-0] Diamata data and and a bablicar	N79-23943
Discrete address beacon system. A bibliogr with abstracts	
[NTIS/PS-79/0244/8] AIR TRANSPORTATION	N79-23945
Propelled lighter-than-air vehicles [GPO-43-457]	N79-23925
The airport performance model. Volume 1: Extensions, validations, and application	
[AD-A062863] AIRBORNE/SPACEBORNE COMPUTERS	N79-25040
Informativeness and effectiveness of digit command-generating devices flight ve	
onboard computers The effects of low-lewel wind shear on the	A79-36588
approach and go-around performance of a	
jet aırcraft [SAE PAPER 790568] A general aviation flight test application	A79-36708
on-board computer [SAE PAPER 790583]	A79-36718
Exploring team avionics systems by simulat	
Aerospace computer systems. Part 1: Avio applications, volume 2. A bibliography abstracts	nics
[NTIS/PS-79/0312/3] Aerospace computer systems. Part 1: Avio	N79-23959 nics
applications, volume 3. A bibliography abstracts	
[NTIS/PS-79/0313/1] AIRCRAFT	N79-23960
Polar lift and drag determination during f tests	lıght
[MBB-UPE-1410-0] Aircraft air pollution emission estimation	N79-24986
techniques, ACEE [AD-A067262]	N79-25550
AIRCRAFT ACCIDENT INVESTIGATION Crashworthiness analysis of field investig	ation of
business aircraft accidents [SAE PAPER 790587]	A79-36721
AIRCEAPT ACCIDENTS Crash-resistant fuel systems for general a	
aircraft [SAE PAPER 790592]	A79-36726
Safety hazard of aircraft 1cing	N79-23916
AIRCRAFT ANTENNAS Fuselage-mounted antenna code: Oser's man	
[AD-A065587] Wing-mounted antenna code: User's manual	N79-24215
[AD-A065589] An iterative approach for computing an ant aperture distribution from given radiati	
pattern data [AD-A065590]	N79-24217
AIRCRAFT BRAKES Advanced braking controls for business air	
[SAE PAPER 790599] Hodel study of aircraft disk brakes	A79-36731
	A79-38816

AIRCRAFT CARRIERS Air pollutant emission factors for military and civil aircraft [PB-292520/4] N79-2 AIRCRAFT COMMUNICATION ₩79-25567 An optical-fiber multiterminal data system for aircraft A79-36484 Some possible applications of identification theory techniques in telemetry --- for aircraft communication A79-36589 Air Force Space Laser Communications A79-38706 The F-16 RIW program --- Reliability Improvement Warranty A79-39889 Nap-of-the-earth communication program for US Army helicopters FAD-A0630891 N79-24232 AIRCRAFT COMPARTMENTS An experimental study of propeller-induced structural vibration and interior noise [SAE PAPER 790625] AIRCRAFT COMFIGURATIONS **1**79-36753 The Lockheed C-5: Case study in aircraft design --- Book A79-36646 Spin flight research summary [SAE PAPER 790565] A79-36706 The Learjet 'Longhorn' series - The first jets with winglets [SAE PAPER 790581] A79-36716 Project Sunrise --- solar-powered aircraft flight demonstration [AIAA PAPER 79-1264] A79-3 The impact of operational requirements on V/STOL propulsion concept selection A79-39010 [AIÀA PAPER 79-1283] A79-3 V/STOL aircraft configuration effects on exhaust A79-39018 gas ingestion [AIAA PAPER 79-1284] The impact of alternate fuels on aircraft A79-39019 configuration characteristics --- military aircraft [AD-A066983] N79-25244 AIRCRAPT CONSTRUCTION BATERIALS Development of an aircraft composite propeller [SAE PAPER 790579] A79 A79-36714 Installation for studying fatigue strength of materials in acoustic loading --- for aircraft skins A79-39070 AIRCRAFT CONTROL The results of synthesizing and evaluating potential solutions for Multi-Punction Inertial Reference Assembly /MIRA/ candidate configurations --- for transport and fighter aircraft A79-36082 Spin flight research summary [SAE PAPER 790565] Selection of aircraft turbocharger systems [SAE PAPER 790608] An aircraft simulation using a product of A79-36706 A79-36739 exponentials as matrizant A79-38885 AIRCRAFT DESIGN Industry seeks lighter aircraft weight ---aircraft design performance A79-36100 Boeing 757/767 - On-the-spot report A79-36374 Producing light aircraft - Three viability case studies **179-36376** Differential method of designing rational aircraft frames made of composite materials A79-36592 Formulation of empirical formulas for calculating the hydraulic resistance of networks aircraft deicing and air-conditioning systems A79-36593 The British Aerospace Harrier: Case study in aircraft design --- Book A79-36644 The Rockwell International Sabreliner-65: Case study in aircraft design --- Book A79-36645

SUBJECT INDEX

The Lockheed C-5: Case study in aircraft design Book	
A79-3664 Adhesive bonded structure of new pressurized piston twin aircraft	Ð
[SAZ PAPER 790563] A79-3670 Design description of a four-place business jet using two WR-19 engines	4
[SAE PAPER 790580] A79-3671 Improving business jet performance - The Mark Pive	5
Sabreliner A79-3671 [SAB PAPER 790582] A new light twin using bonded metal construction	7
[SAE PAPER 790603] A79-3673 General aviation aircraft design for performance	5
using small computers [SAB PAPER 790614] A79-3674 Development of the Beechcraft Model 77	
[SAE PAPER 790617] A79-3674 Designing with damping materials to reduce noise and structural fatigue of aircraft components	
[SAE PAPER 790631]	
A79-3677 Airbus picks up speed - and the junior A310 takes off	3
A79-3677 In Soviet service. V - Backfire	4
A79-3677	5
Dassault-Breguet - The Mirage 2000 A79-3697	4
Changing requirements in aircraft design A79-3704	4
Impact of advanced technologies on aircraft design A79-3704	5
Computer graphics create the new wave of design A79-3704	
Some main points about general-aviation design practice	
A79-3704 Design, meet production aircraft cost and performance tradeoff considerations	
A79-3704 A case study in design - The Gossamer Condor	
A79-3705 The 'cloud-in-cell' technique applied to the roll up of vortex sheets	0
۸79-3772 Westland unveils WG30 transport helicopter	5
A79-3809. Aircraft design and strength /2nd revised and enlarged edition/ Russian book	2
A79-3814 Pactors influencing nacelle design on the 747	0
[AINA PAPER 79-1236] Project Sunrise solar-powered aircraft flight	6
demonstration [AIBA PAPER 79-1264] A79-3901	0
Characteristics of the advanced supersonic technology AST-105-1 configured for transpacific	
range with Pratt and Whitney aircraft variable stream control engines	
[NASA-TH-78818] N79-23880 Aircraft sonic boom: Studies on aircraft flight,	8
aircraft design, and measurement. A	
bibliography with abstracts [NTIS/PS-79/0264/6] N79-24780	0
Helicopter rotor airfoil [NASA-CASE-LAR-12396-1] N79-2495	8
A variational theorem for laminated composite plates of nonlinear materials and applications	
to postbuckling N79-2497	7
AIRCRAFT DETECTION Detection of low flying aircraft by acoustical means	
[REPT-8-78] N79-2477 A computer program for double sweep optimal	
smoothing	9
[AD-A066512] N79-25278 AIRCRAFT BUGINES	0
Industry seeks lighter aırcraft weight aırcraft design performance	
A79-36100 Manufacturers developing fuel-efficient engines A79-36380	

AIRCHAPT HAZARDS

Optimal selection of the geometrical
characteristics of the reversing channel of a small-scale turbine with readmission of the gas
for aircraft auxiliary power systems
A79-36583
Effectiveness of readmission of the gas in
high-pressure-ratio small-scale turbines for aircraft auxiliary power systems
ATTOLATE ADMITTALLY POWER Systems
Preliminary QCGAT program test results Quiet,
Clean General Aviation Turbofan
[SAE PAPER 790596] A79-36729 Concepts for reducing exhaust emissions and fuel
Consumption of the aircraft piston engine
[SAE PAPER 790605] A79-36737
Dual breakerless aircraft magneto [SAE PAPER 790606] A79-36738
Selection of aircraft turbocharger systems
[SAE PAPER 790608] A79-36739
Determination of cooling air mass flow for a
horizontally-opposed aircraft engine installation [SAE PAPER 790609] A79-36740
New technologies for general aviation aircraft
[SAE PAPER 790613] A79-36742
Rolls-Royce RB.401-07 turbofan engine for business aircraft in the 1980's
[SAE PAPER 790620] A79-36748
A review of Curtiss-Wright rotary engine
developments with respect to general aviation
potential [SAE PAPER 790621] A79-36749
Engine induced structural-borne noise in a general
aviation aircraft
[SAE PAPER 790626] A79-36754
Wind tunnel performance of four energy efficient propellers designed for Mach 0.8 cruise
[SAE PAPER 790573] A79-36759
Effects of air injection on a turbocharged
Teledyne Continental Motors TSIO-360-C engine [SAE PAPER 790607] A79-36760
The evaluation of the weight of engine
installations on transport aircraft
A method of reducing aircraft turbine blade
A method of reducing arrcraft turbine blade Vibrations A79-38819 The multiple application core engine - Sizing and
A method of reducing arrcraft turbine blade Vibrations A79-38819 The multiple application core engine - Sizing and Usage criteria high-pressure rotors in jet
A method of reducing arrcraft turbine blade vibrations A79-38819 The multiple application core engine - Sizing and usage criteria high-pressure rotors in jet engines
A method of reducing aircraft turbine blade vibrations A79-38819 The multiple application core engine - Sizing and usage criteria high-pressure rotors in jet engines [ATAA PAPER 79-1123] A79-38953 The selection of materials technologies for
A method of reducing aircraft turbine blade vibrations A79-38819 The multiple application core engine - Sizing and usage criteria high-pressure rotors in jet engines [ATAA PAPER 79-1123] A79-38953 The selection of materials technologies for full-scale development aircraft engine
A method of reducing aircraft turbine blade vibrations A79-38819 The multiple application core engine - Sizing and usage criteria high-pressure rotors in jet engines [ATAA PAPER 79-1123] A79-38953 The selection of materials technologies for full-scale development aircraft engine applications
A method of reducing aircraft turbine blade vibrations A79-38819 The multiple application core engine - Sizing and usage criteria high-pressure rotors in jet engines [ATAA PAPER 79-1123] A79-38953 The selection of materials technologies for full-scale development aircraft engine applications [ATAA PAPER 79-1152] A79-38962 Cost benefits from improved hot section life
A method of reducing aircraft turbine blade vibrations A79-38819 The multiple application core engine - Sizing and usage criteria high-pressure rotors in jet engines [ATAA PAPER 79-1123] A79-38953 The selection of materials technologies for full-scale development aircraft engine applications [ATAA PAPER 79-1152] A79-38962 Cost benefits from improved hot section life prediction technology for aircraft engine
A method of reducing aircraft turbine blade vibrations A79-38819 The multiple application core engine - Sizing and usage criteria high-pressure rotors in jet engines [ATAA PAPER 79-1123] A79-38953 The selection of materials technologies for full-scale development aircraft engine applications [AIAA PAPER 79-1152] A79-38962 Cost benefits from improved hot section life prediction technology for aircraft engine Combustor and turbine parts
A method of reducing aircraft turbine blade vibrations A79-38819 The multiple application core engine - Sizing and usage criteria high-pressure rotors in jet engines [ATAA PAPER 79-1123] A79-38953 The selection of materials technologies for full-scale development aircraft engine applications [ATAA PAPER 79-1152] A79-38962 Cost benefits from improved hot section life prediction technology for aircraft engine
A method of reducing aircraft turbine blade vibrations A79-38819 The multiple application core engine - Sizing and usage criteria high-pressure rotors in jet engines [ATAA PAPER 79-1123] A79-38953 The selection of materials technologies for full-scale development aircraft engine applications [AIAA PAPER 79-1152] A79-38962 Cost benefits from improved hot section life prediction technology for aircraft engine combustor and turbine parts [AIAA PAPER 79-1154] A79-38963 General aviation turbine engine /GATE/ concepts [AIAA PAPER 79-1157] A79-38964
A method of reducing aircraft turbine blade vibrations A79-38819 The multiple application core engine - Sizing and usage criteria high-pressure rotors in jet engines [ATAA PAPER 79-1123] A79-38953 The selection of materials technologies for full-scale development aircraft engine applications [ATAA PAPER 79-1152] A79-38962 Cost benefits from improved hot section life prediction technology for aircraft engine combustor and turbine parts [ATAA PAPER 79-1154] A79-38963 General aviation turbine engine /GATE/ concepts [ATAA PAPER 79-1157] A79-38964 Aircraft engine design using experimental stress
A method of reducing aircraft turbine blade vibrations A79-38819 The multiple application core engine - Sizing and usage criteria high-pressure rotors in jet engines [ATAA PAPER 79-1123] A79-38953 The selection of materials technologies for full-scale development aircraft engine applications [ATAA PAPER 79-1152] A79-38962 Cost benefits from improved hot section life prediction technology for aircraft engine combustor and turbine parts [ATAA PAPER 79-1154] A79-38963 General aviation turbine engine /GATE/ concepts [ATAA PAPER 79-1157] A79-38964 Aircraft engine design using experimental stress analysis techniques
A method of reducing aircraft turbine blade vibrations A79-38819 The multiple application core engine - Sizing and usage criteria high-pressure rotors in jet engines [ATAA PAPER 79-1123] A79-38953 The selection of materials technologies for full-scale development aircraft engine applications [ATAA PAPER 79-1152] A79-38962 Cost benefits from improved hot section life prediction technology for aircraft engine combustor and turbine parts [ATAA PAPER 79-1154] A79-38963 General aviation turbine engine /GATE/ concepts [ATAA PAPER 79-1157] A79-38964 Aircraft engine design using experimental stress analysis techniques [ATAA PAPER 79-1193] A79-38978 A European view on gas turbine engine monitoring
A method of reducing aircraft turbine blade vibrations A79-38819 The multiple application core engine - Sizing and usage criteria high-pressure rotors in jet engines [ATAA PAPER 79-1123] A79-38953 The selection of materials technologies for full-scale development aircraft engine applications [ATAA PAPER 79-1152] A79-38962 Cost benefits from improved hot section life prediction technology for aircraft engine combustor and turbine parts [ATAA PAPER 79-1154] A79-38963 General aviation turbine engine /GATE/ concepts [ATAA PAPER 79-1157] A79-38964 Aircraft engine design using experimental stress analysis techniques [ATAA PAPER 79-1193] A79-38978 A European view on gas turbine engine monitoring of present and future civil aircraft
A method of reducing aircraft turbine blade vibrations A79-38819 The multiple application core engine - Sizing and usage criteria high-pressure rotors in jet engines [ATAA PAPER 79-1123] A79-38953 The selection of materials technologies for full-scale development aircraft engine applications [AIAA PAPER 79-1152] A79-38962 Cost benefits from improved hot section life prediction technology for aircraft engine Combustor and turbine parts [AIAA PAPER 79-1154] Const engine design using experimental stress analysis techniques [AIAA PAPER 79-1157] A79-38964 Aircraft engine design using experimental stress analysis techniques [AIAA PAPER 79-1193] A79-38978 A European view on gas turbine engine monitoring of present and future civil aircraft [AIAA PAPER 79-1200] A79-38982
A method of reducing aircraft turbine blade vibrations A79-38819 The multiple application core engine - Sizing and usage criteria high-pressure rotors in jet engines [ATAA PAPER 79-1123] A79-38953 The selection of materials technologies for full-scale development aircraft engine applications [ATAA PAPER 79-1152] A79-38962 Cost benefits from improved hot section life prediction technology for aircraft engine combustor and turbine parts [ATAA PAPER 79-1154] A79-38963 General aviation turbine engine /GATE/ concepts [ATAA PAPER 79-1157] A79-38964 Aircraft engine design using experimental stress analysis techniques [ATAA PAPER 79-1193] A79-38978 A European view on gas turbine engine monitoring of present and future civil aircraft
A method of reducing aircraft turbine blade vibrations A79-38819 The multiple application core engine - Sizing and usage criteria high-pressure rotors in jet engines [ATAA PAPER 79-1123] A79-38953 The selection of materials technologies for full-scale development aircraft engine applications [ATAA PAPER 79-1152] A79-38962 Cost benefits from improved hot section life prediction technology for aircraft engine combustor and turbine parts [ATAA PAPER 79-1154] Cost benefits from improved hot section life prediction technology for aircraft engine combustor and turbine parts [ATAA PAPER 79-1154] Seneral aviation turbine engine /GATE/ concepts [ATAA PAPER 79-1157] A79-38964 Aircraft engine design using experimental stress analysis techniques [ATAA PAPER 79-1193] A79-38978 A European view on gas turbine engine monitoring of present and future civil aircraft [ATAA PAPER 79-1200] A79-38982 Fault-tolerant, high reliability electronic engine control system [ATAA PAPER 79-1202] A79-38983
A method of reducing aircraft turbine blade vibrations A79-38819 The multiple application core engine - Sizing and usage criteria high-pressure rotors in jet engines [ATAA PAPER 79-1123] A79-38953 The selection of materials technologies for full-scale development aircraft engine applications [ATAA PAPER 79-1152] A79-38962 Cost benefits from improved hot section life prediction technology for aircraft engine combustor and turbine engine /GATE/ concepts [ATAA PAPER 79-1157] A79-38963 General aviation turbine engine /GATE/ concepts [ATAA PAPER 79-1157] A79-38964 Aircraft engine design using experimental stress analysis techniques [ATAA PAPER 79-1133] A79-38978 A European view on gas turbine engine monitoring of present and future civil aircraft [ATAA PAPER 79-1200] A79-38982 Fault-tolerant, high reliability electronic engine control system [ATAA PAPER 79-1202] A79-38983 Application of digital controls on the quiet clean
A method of reducing aircraft turbine blade vibrations A79-38819 The multiple application core engine - Sizing and usage criteria high-pressure rotors in jet engines [ATAA PAPER 79-1123] A79-38953 The selection of materials technologies for full-scale development aircraft engine applications [ATAA PAPER 79-1152] A79-38962 Cost benefits from improved hot section life prediction technology for aircraft engine combustor and turbine parts [ATAA PAPER 79-1154] A79-38963 General aviation turbine engine /GATE/ concepts [ATAA PAPER 79-1157] A79-38964 Aircraft engine design using experimental stress analysis techniques [ATAA PAPER 79-1193] A 79-38978 A European view on gas turbine engine monitoring of present and future civil aircraft [ATAA PAPER 79-1200] A79-38982 Fault-tolerant, high reliability electronic engine control system [ATAA PAPER 79-1202] A79-38983 Application of digital controls on the quiet clean short haul experimental engines
A method of reducing aircraft turbine blade vibrations A79-38819 The multiple application core engine - Sizing and usage criteria high-pressure rotors in jet engines [ATAA PAPER 79-1123] A79-38953 The selection of materials technologies for full-scale development aircraft engine applications [ATAA PAPER 79-1152] A79-38962 Cost benefits from improved hot section life prediction technology for aircraft engine combustor and turbine parts [ATAA PAPER 79-1154] Cost benefits from improved hot section life prediction technology for aircraft engine combustor and turbine parts [ATAA PAPER 79-1154] General aviation turbine engine /GATE/ concepts [ATAA PAPER 79-1157] A79-38964 Aircraft engine design using experimental stress analysis techniques [ATAA PAPER 79-1193] A79-38978 A European view on gas turbine engine monitoring of present and future civil aircraft [ATAA PAPER 79-1200] A79-38982 Fault-tolerant, high reliability electronic engine control system [ATAA PAPER 79-1202] A79-38983 Application of digital controls on the quiet clean short haul experimental engines [ATAA PAPER 79-1203] A79-38984
A method of reducing aircraft turbine blade vibrations A79-38819 The multiple application core engine - Sizing and usage criteria high-pressure rotors in jet engines [ATAA PAPER 79-1123] A79-38953 The selection of materials technologies for full-scale development aircraft engine applications [ATAA PAPER 79-1152] A79-38962 Cost benefits from improved hot section life prediction technology for aircraft engine combustor and turbine parts [ATAA PAPER 79-1154] A79-38963 General aviation turbine engine /GATE/ concepts [ATAA PAPER 79-1157] A79-38964 Aircraft engine design using experimental stress analysis techniques [ATAA PAPER 79-1193] A Furopean view on gas turbine engine monitoring of present and future civil aircraft [ATAA PAPER 79-1200] A79-38982 Fault-tolerant, high reliability electronic engine control system [ATAA PAPER 79-1202] A79-38983 Application of digital controls on the guiet clean short haul experimental engines [ATAA PAPER 79-1203] A79-38984 Electric propulsion for high performance light aircraft
A method of reducing aircraft turbine blade vibrations A79-38819 The multiple application core engine - Sizing and usage criteria high-pressure rotors in jet engines [ATAA PAPER 79-1123] A79-38953 The selection of materials technologies for full-scale development aircraft engine applications [ATAA PAPER 79-1152] A79-38962 Cost benefits from improved hot section life prediction technology for aircraft engine combustor and turbine parts [ATAA PAPER 79-1154] A79-38963 General aviation turbine engine /GATE/ concepts [ATAA PAPER 79-1157] A79-38964 Aircraft engine design using experimental stress analysis techniques [ATAA PAPER 79-1193] A79-38978 A European view on gas turbine engine monitoring of present and future civil aircraft [ATAA PAPER 79-1200] A79-38982 Pault-tolerant, high reliability electronic engine control system [ATAA PAPER 79-1203] A79-38984 Electric propulsion for high performance light aircraft [ATAA PAPER 79-1265] A79-38011
A method of reducing aircraft turbine blade vibrations A79-38819 The multiple application core engine - Sizing and usage criteria high-pressure rotors in jet engines [ATAA PAPER 79-1123] A79-38953 The selection of materials technologies for full-scale development aircraft engine applications [ATAA PAPER 79-1152] A79-38962 Cost benefits from improved hot section life prediction technology for aircraft engine combustor and turbine parts [ATAA PAPER 79-1154] A79-38963 General aviation turbine engine /GATE/ concepts [ATAA PAPER 79-1157] A79-38964 Aircraft engine design using experimental stress analysis techniques [ATAA PAPER 79-1193] A79-38978 A European view on gas turbine engine monitoring of present and future civil aircraft [ATAA PAPER 79-1200] Fault-tolerant, high reliability electronic engine control system [ATAA PAPER 79-1203] A79-38984 Electric progulsion for high performance light aircraft [ATAA PAPER 79-1265] A79-39011 Contribution to the development of motor emission
A method of reducing aircraft turbine blade vibrations A79-38819 The multiple application core engine - Sizing and usage criteria high-pressure rotors in jet engines [ATAA PAPER 79-1123] A79-38953 The selection of materials technologies for full-scale development aircraft engine applications [ATAA PAPER 79-1152] A79-38962 Cost benefits from improved hot section life prediction technology for aircraft engine combustor and turbine parts [ATAA PAPER 79-1154] A79-38963 General aviation turbine engine /GATE/ concepts [ATAA PAPER 79-1157] A79-38964 Aircraft engine design using experimental stress analysis techniques [ATAA PAPER 79-1193] A 79-38978 A European view on gas turbine engine monitoring of present and future civil aircraft [ATAA PAPER 79-1202] A79-38982 Fault-tolerant, high reliability electronic engine control system [ATAA PAPER 79-1202] A79-38983 Application of digital controls on the guiet clean short hal experimental engines [ATAA PAPER 79-1265] A79-38984 Electric propulsion for high performance light aircraft [ATAA PAPER 79-1265] A79-38984 Electric propulsion for high performance light aircraft [ATAA PAPER 79-1265] A79-39011 Contribution to the development of motor emission regulations [OREA, TP NO. 1979-43] A79-3802
A method of reducing aircraft turbine blade vibrations A79-38819 The multiple application core engine - Sizing and usage criteria high-pressure rotors in jet engines [ATAA PAPER 79-1123] A79-38953 The selection of materials technologies for full-scale development aircraft engine applications [ATAA PAPER 79-1152] A79-38962 Cost benefits from improved hot section life prediction technology for aircraft engine combustor and turbine parts [ATAA PAPER 79-1154] A79-38963 General aviation turbine engine /GATE/ concepts [ATAA PAPER 79-1157] A79-38964 Aircraft engine design using experimental stress analysis techniques [ATAA PAPER 79-1193] A79-38978 A European view on gas turbine engine monitoring of present and future civil aircraft [ATAA PAPER 79-1200] A79-38982 Pault-tolerant, high reliability electronic engine control system [ATAA PAPER 79-1203] A79-38984 Electric propulsion for high performance light aircraft [ATAA PAPER 79-1265] A79-39011 Contribution to the development of motor emission regulations [ONERA, TP NO. 1979-43] A79-38922 Payback period - An engineering cost/benefit method
A method of reducing aircraft turbine blade vibrations A79-38819 The multiple application core engine - Sizing and usage criteria high-pressure rotors in jet engines [ATAA PAPER 79-1123] A79-38953 The selection of materials technologies for full-scale development aircraft engine applications [ATAA PAPER 79-1152] A79-38962 Cost benefits from improved hot section life prediction technology for aircraft engine combustor and turbine parts [ATAA PAPER 79-1154] A79-38963 General aviation turbine engine /GATE/ concepts [ATAA PAPER 79-1157] A79-38964 Aircraft engine design using experimental stress analysis techniques [ATAA PAPER 79-1193] A furopean view on gas turbine engine monitoring of present and future civil aircraft [ATAA PAPER 79-1200] A79-38982 Pault-tolerant, high reliability electronic engine control system [ATAA PAPER 79-1203] A79-38984 Electric propulsion for high performance light aircraft [ATAA PAPER 79-1265] A79-39011 Contribution to the development of motor emission regulations [ONERA, TP NO. 1979-43] A79-38092 Payback period - An engineering cost/benefit method for aircraft engines
A method of reducing aircraft turbine blade vibrations A79-38819 The multiple application core engine - Sizing and usage criteria high-pressure rotors in jet engines [ATAA PAPER 79-1123] A79-38953 The selection of materials technologies for full-scale development aircraft engine applications [ATAA PAPER 79-1152] A79-38962 Cost benefits from improved hot section life prediction technology for aircraft engine combustor and turbine parts [ATAA PAPER 79-1154] A79-38963 General aviation turbine engine /GATE/ concepts [ATAA PAPER 79-1157] A79-38964 Aircraft engine design using experimental stress analysis techniques [ATAA PAPER 79-1193] A 79-38978 A European view on gas turbine engine monitoring of present and future civil aircraft [ATAA PAPER 79-1200] A 79-38982 Pault-tolerant, high reliability electronic engine control system [ATAA PAPER 79-1203] A79-38984 Electric propulsion for high performance light aircraft [ATAA PAPER 79-1265] A79-39011 Contribution to the development of motor emission regulations [OERA, TP NO. 1979-43] A79-38981 [ATA PAPER 79-1235] A79-38981 [ATA PAPER 79-1235] A79-38981
A method of reducing aircraft turbine blade vibrations A79-38819 The multiple application core engine - Sizing and usage criteria high-pressure rotors in jet engines [ATAA PAPER 79-1123] A79-38953 The selection of materials technologies for full-scale development aircraft engine applications [ATAA PAPER 79-1152] A79-38962 Cost benefits from improved hot section life prediction technology for aircraft engine combustor and turbine parts [ATAA PAPER 79-1154] A79-38963 General aviation turbine engine /GATE/ concepts [ATAA PAPER 79-1157] A79-38964 Aircraft engine design using experimental stress analysis techniques [ATAA PAPER 79-1133] A for assert and future civil aircraft [ATAA PAPER 79-1200] A furopean view on gas turbine engine monitoring of present and future civil aircraft [ATAA PAPER 79-1200] A79-38982 Pault-tolerant, high reliability electronic engine control system [ATAA PAPER 79-1203] A79-38984 Electric propulsion for high performance light aircraft [ATAA PAPER 79-1203] A79-38984 Electric propulsion for high performance light aircraft [ATAA PAPER 79-1205] A79-39011 Contribution to the development of motor emission regulations [ONERA, TP NO. 1979-43] A79-39817 Aircraft engine nozzle [MASA-CASE-ABC-10977-1] N79-23971
A method of reducing aircraft turbine blade vibrations A79-38819 The multiple application core engine - Sizing and usage criteria high-pressure rotors in jet engines [ATAA PAPER 79-1123] A79-38953 The selection of materials technologies for full-scale development aircraft engine applications [ATAA PAPER 79-1152] A79-38962 Cost benefits from improved hot section life prediction technology for aircraft engine Combustor and turbine parts [ATAA PAPER 79-1154] A79-38963 General aviation turbine engine /GATE/ concepts [ATAA PAPER 79-1157] A79-38964 Aircraft engine design using experimental stress analysis techniques [ATAA PAPER 79-1193] A F9-38978 A European view on gas turbine engine monitoring of present and future civil aircraft [ATAA PAPER 79-1202] A79-38982 Fault-tolerant, high reliability electronic engine control system [ATAA PAPER 79-1203] A79-38984 Electric propulsion for high performance light aircraft [ATAA PAPER 79-1265] A79-38984 Electric propulsion for high performance light aircraft engines [ATA PAPER 79-1265] A79-38987 Payback period - An engineering cost/benefit method ~ for aircraft engines [ATA PAPER 79-1235] A79-39817 Aircraft engine nozzle [NaSA-CASE-MEC-10977-1] N79-23971
A method of reducing aircraft turbine blade vibrations A79-38819 The multiple application core engine - Sizing and usage criteria high-pressure rotors in jet engines [ATAA PAPER 79-1123] A79-38953 The selection of materials technologies for full-scale development aircraft engine applications [ATAA PAPER 79-1152] A79-38962 Cost benefits from improved hot section life prediction technology for aircraft engine combustor and turbine parts [ATAA PAPER 79-1154] A79-38963 General aviation turbine engine /GATE/ concepts [ATAA PAPER 79-1157] A79-38964 Aircraft engine design using experimental stress analysis techniques [ATAA PAPER 79-1193] A79-38978 A European view on gas turbine engine monitoring of present and future civil aircraft [ATAA PAPER 79-1200] A79-38982 Pault-tolerant, high reliability electronic engine control system [ATAA PAPER 79-1203] A79-38984 Electric propulsion for high performance light aircraft [ATAA PAPER 79-1265] A79-39011 Contribution to the development of motor emission regulations [ONERA, TP NO. 1979-43] A79-39012 A79-39817 Aircraft engine nozzle [ATAA PAPER 79-1255] A79-39817 Aircraft engine nozzle [ATAA PAPER 79-125] A79-39817 Aircraft engine nozzle [MASA-CASE-AEC-10977-1] N79-23971 Water absorption of fluids/oils contamination of aircraft engine oils and inhibitors
A method of reducing aircraft turbine blade vibrations A79-38819 The multiple application core engine - Sizing and usage criteria high-pressure rotors in jet engines [ATAA PAPER 79-1123] A79-38953 The selection of materials technologies for full-scale development aircraft engine applications [ATAA PAPER 79-1152] A79-38962 Cost benefits from improved hot section life prediction technology for aircraft engine combustor and turbine parts [ATAA PAPER 79-1154] A79-38963 General aviation turbine engine /GATE/ concepts [ATAA PAPER 79-1157] A79-38964 Aircraft engine design using experimental stress analysis techniques [ATAA PAPER 79-1133] A79-38978 A European view on gas turbine engine monitoring of present and future civil aircraft [ATAA PAPER 79-1200] A79-38982 Pault-tolerant, high reliability electronic engine control system [ATAA PAPER 79-1202] A79-38983 Application of digital controls on the quiet clean short haul experimental engines [ATAA PAPER 79-1203] Contribution to the development of motor emission regulations [ONERA, TF NO. 1979-43] A79-39011 Contribution to the development of motor emission regulations [ONERA, TF NO. 1979-43] A79-39817 Aircraft engine nozzle [ATAA PAPER 79-1235] A79-39817 Aircraft engine nozzle [MASA-CASE-ARC-10977-1] N79-2458
A method of reducing aircraft turbine blade vibrations A79-38819 The multiple application core engine - Sizing and usage criteria high-pressure rotors in jet engines [ATAA PAPER 79-1123] A79-38953 The selection of materials technologies for full-scale development aircraft engine applications [ATAA PAPER 79-1152] A79-38962 Cost benefits from improved hot section life prediction technology for aircraft engine combustor and turbine parts [ATAA PAPER 79-1154] A79-38963 General aviation turbine engine /GATE/ concepts [ATAA PAPER 79-1157] A79-38964 Aircraft engine design using experimental stress analysis techniques [ATAA PAPER 79-1193] A79-38978 A European view on gas turbine engine monitoring of present and future civil aircraft [ATAA PAPER 79-1200] A79-38982 Pault-tolerant, high reliability electronic engine control system [ATAA PAPER 79-1203] A79-38984 Electric propulsion for high performance light aircraft [ATAA PAPER 79-1265] A79-39011 Contribution to the development of motor emission regulations [ONERA, TP NO. 1979-43] A79-389817 Aircraft engine nozzle [ATAA PAPER 79-125] A79-39817 Aircraft engine nozzle [ATAA PAPER 79-125] A79-39817 Aircraft engine nozzle [ATAA PAPER 79-125] A79-39817 Aircraft engine oils and inhibitors [AD-A065915] A79-24158 Aircraft engine oils and inhibitors [AD-A065915] A79-24158 Aircraft engine oils and inhibitors
A method of reducing aircraft turbine blade vibrations A79-38819 The multiple application core engine - Sizing and usage criteria high-pressure rotors in jet engines [ATAA PAPER 79-1123] A79-38953 The selection of materials technologies for full-scale development aircraft engine applications [ATAA PAPER 79-1152] A79-38962 Cost benefits from improved hot section life prediction technology for aircraft engine Combustor and turbine parts [ATAA PAPER 79-1154] A79-38963 General aviation turbine engine /GATE/ concepts [ATAA PAPER 79-1157] A79-38964 Aircraft engine design using experimental stress analysis techniques [ATAA PAPER 79-1193] A 29-38978 A European view on gas turbine engine monitoring of present and future civil aircraft [ATAA PAPER 79-1202] A79-38982 Fault-tolerant, high reliability electronic engine control system [ATAA PAPER 79-1203] A79-38984 Electric propulsion for high performance light aircraft [ATAA PAPER 79-1265] A79-38984 Electric propulsion for high performance light aircraft [ATAA PAPER 79-1265] A79-38984 Electric propulsion for high performance light aircraft [ATAA PAPER 79-1265] A79-38987 Payback period - An engineering cost/benefit method ~ for aircraft engines [ATAA PAPER 79-1265] A79-39817 Aircraft engine nozzle [MAA PAPER 79-1265] A79-39817 Aircraft engine nozzle [MAA PAPER 79-1265] A79-23971 Water absorption of fluids/oils contamination of aircraft engine oils and inhibitors [AD-A065915] Aircraft engine oils and inhibitors [AD-A065915] Aircraft engine oils and inhibitors [AD-A065915] Aircraft engine oils and inhibitors [AD-A065915] Aircraft engine oils and inhibitors

Analysis of the impact of a 270 VDC power source	
on the avionic power supplies in the S-3A aircraft	
[AD-A066526] N79-24989 Premixed Prevaporized Combustor Technology Forum	
[NASA-CP-2078] N79-24994	
Lean, premixed, prevaporized combustor conceptual	
design study	
879-25013	
Lean, premixed, prevaporized combustor conceptual design study	
N79-25014	
Non-destructive inspection methods for propulsion	
systems and components [AGARD-LS-103] #79-25412	
[AGARD-LS-103] N79-25412 State-of-the-art of nondestructive inspection of	
aircraft engines	
N79-25413	
High resolution radiography in the aero-engine industry	
N79-25414	
AIRCRAFT BQUIPEBNT	
A system for providing an integrated display of	
instantaneous information relative to aircraft attitude, heading, altitude, and horizontal	
situation	
[NASA-CASE-FRC-11005-1] N79-24988	
AAES/TA-7C control and display interface	
[AD-A067219] N79-24992 Dynamic evaluation of experimental integral	
fuel-tank sealants, part 2	
[AD-A066592] N79-25236	
AIRCRAFT FUEL SYSTEMS	
Formation of water-fuel emulsions in tanks of grounded aircraft	
A79-36587	
Crash-resistant fuel systems for general aviation	
alrcraft [SAE PAPER 790592] A79-36726	
Fuel on fire - Rapid response to a military problem	
A79-38090	
AIRCRAFT FUBLS	
Industry seeks lighter aircraft weight	
sirarsft docian porformando	
aırcraft design performance A79-36100	
A79-36100 Detonation characteristics of Soviet GOST 1012-72	
A79-36100 Detonation characteristics of Soviet GOST 1012-72 aviation gasoline	
A79-36100 Detonation characteristics of Soviet GOST 1012-72 aviation gasoline [SAE PAPER 790630] A79-36757	
A79-36100 Detonation characteristics of Soviet GOST 1012-72 aviation gasoline	
A79-36100 Detonation characteristics of Soviet GOST 1012-72 aviation gasoline [SAE PAPER 790630] A79-36757 Lean, premixed, prevaporized combustion for aircraft gas turbine engines [NSA-TH-79148] N79-23964	
A79-36100 Detonation characteristics of Soviet GOST 1012-72 aviation gasoline [SAE PAPER 790630] A79-36757 Lean, premixed, prevaporized combustion for aircraft gas turbine engines [NASA-TH-79148] N79-23964 Design and evaluation of aircraft heat source	
A79-36100 Detonation characteristics of Soviet GOST 1012-72 aviation gasoline [SAE PAPER 790630] A79-36757 Lean, premixed, prevaporized combustion for aircraft gas turbine engines [NASA-TH-79148] N79-23964	
A79-36100 Detonation characteristics of Soviet GOST 1012-72 aviation gasoline [SAE PAPER 790630] A79-36757 Lean, premixed, prevaporized combustion for aircraft gas turbine engines [NSA-TH-79148] N79-23964 Design and evaluation of aircraft heat source systems for use with high-freezing point fuels [NASA-CR-159568] N79-24172 Autoignition of fuels	
A79-36100 Detonation characteristics of Soviet GOST 1012-72 aviation gasoline [SAE PAPER 790630] A79-36757 Lean, premixed, prevaporized combustion for aircraft gas turbine engines [NASA-TH-79148] N79-23964 Design and evaluation of aircraft heat source systems for use with high-freezing point fuels [NASA-CR-159568] N79-24172 Autoignition of fuels N79-25001	
A79-36100 Detonation characteristics of Soviet GOST 1012-72 aviation gasoline [SAE PAPER 790630] A79-36757 Lean, premixed, prevaporized combustion for aircraft gas turbine engines [NASA-TM-79148] N79-23964 Design and evaluation of aircraft heat source systems for use with high-freezing point fuels [NASA-CR-159568] N79-24172 Autoignition of fuels N79-25001 The impact of alternate fuels on aircraft	
A79-36100 Detonation characteristics of Soviet GOST 1012-72 aviation gasoline [SAE PAPER 790630] A79-36757 Lean, premixed, prevaporized combustion for aircraft gas turbine engines [NASA-TH-79148] N79-23964 Design and evaluation of aircraft heat source systems for use with high-freezing point fuels [NASA-CR-159568] N79-24172 Autoignition of fuels N79-25001 The impact of alternate fuels on aircraft configuration characteristics military aircraft	
A79-36100 Detonation characteristics of Soviet GOST 1012-72 aviation gasoline [SAE PAPER 790630] A79-36757 Lean, premixed, prevaporized combustion for aircraft gas turbine engines [NASA-TM-79148] N79-23964 Design and evaluation of aircraft heat source systems for use with high-freezing point fuels [NASA-CR-159568] N79-24172 Autoignition of fuels N79-25001 The impact of alternate fuels on aircraft configuration characteristics military aircraft [AD-A066983] N79-25244	
A79-36100 Detonation characteristics of Soviet GOST 1012-72 aviation gasoline [SAE PAPER 790630] A79-36757 Lean, premixed, prevaporized combustion for aircraft gas turbine engines [NSA-TH-79148] N79-23964 Design and evaluation of aircraft heat source systems for use with high-freezing point fuels [NSA-CR-159568] N79-24172 Autoignition of fuels N79-25001 The impact of alternate fuels on aircraft configuration characteristics military aircraft [AD-A066983] N79-25244 AIRCRAFT GUIDANCE	
A79-36100 Detonation characteristics of Soviet GOST 1012-72 aviation gasoline [SAE PAPER 790630] A79-36757 Lean, premixed, prevaporized combustion for aircraft gas turbine engines [NASA-TM-79148] N79-23964 Design and evaluation of aircraft heat source systems for use with high-freezing point fuels [NASA-CR-159568] N79-24172 Autoignition of fuels N79-25001 The impact of alternate fuels on aircraft configuration characteristics military aircraft [AD-A066983] N79-25244 AIRCRAFT GUIDAMCB Evaluation of an PM/CW range measurement system for VTOL landing	
A79-36100 Detonation characteristics of Soviet GOST 1012-72 aviation gasoline [SAE PAPER 790630] A79-36757 Lean, premixed, prevaporized combustion for aircraft gas turbine engines [NASA-TM-79148] N79-23964 Design and evaluation of aircraft heat source systems for use with high-freezing point fuels [NASA-CR-159568] N79-24172 Autoignition of fuels N79-25001 The impact of alternate fuels on aircraft configuration characteristics military aircraft [AD-A066983] N79-25244 AIRCRAFT GUIDAMCE Evaluation of an PM/CW range measurement system for VTOL landing A79-36086	
A79-36100 Detonation characteristics of Soviet GOST 1012-72 aviation gasoline [SAE PAPER 790630] A79-36757 Lean, premixed, prevaporized combustion for afficraft gas turbine engines [NASA-TH-79148] N79-23964 Design and evaluation of aircraft heat source systems for use with high-freezing point fuels [NASA-CR-159568] N79-24172 Autoignition of fuels N79-25001 The impact of alternate fuels on aircraft configuration characteristics military aircraft [AD-A066983] N79-25244 AIRCRAFT GUIDAMCB Evaluation of an PM/CW range measurement system for VTOL landing A79-36086 Capturing and tracking performance of the	
A79-36100 Detonation characteristics of Soviet GOST 1012-72 aviation gasoline [SAE PAPER 790630] A79-36757 Lean, premixed, prevaporized combustion for aircraft gas turbine engines [NASA-TH-79148] N79-23964 Design and evaluation of aircraft heat source systems for use with high-freezing point fuels [NASA-CR-159568] N79-24172 Autoignition of fuels N79-25001 The impact of alternate fuels on aircraft configuration characteristics military aircraft [AD-A066983] N79-25244 AIRCRAFT GUIDAMCB Evaluation of an PM/CW range measurement system for VTOL landing A79-36086 Capturing and tracking performance of the horizontal guidance and control systems of the	
A79-36100 Detonation characteristics of Soviet GOST 1012-72 aviation gasoline [SAE PAPER 790630] A79-36757 Lean, premixed, prevaporized combustion for afficraft gas turbine engines [NASA-TH-79148] N79-23964 Design and evaluation of aircraft heat source systems for use with high-freezing point fuels [NASA-CR-159568] N79-24172 Autoignition of fuels N79-25001 The impact of alternate fuels on aircraft configuration characteristics military aircraft [AD-A066983] N79-25244 AIRCRAFT GUIDAWCB Evaluation of an PM/CW range measurement system for VTOL landing A79-36086 Capturing and tracking performance of the horizontal guidance and control systems of the terminal configured vehicle [NASA-TH-80068] N79-25034	
A79-36100 Detonation characteristics of Soviet GOST 1012-72 aviation gasoline [SAE PAPER 790630] A79-36757 Lean, premixed, prevaporized combustion for aircraft gas turbine engines [NASA-TH-79148] N79-23964 Design and evaluation of aircraft heat source systems for use with high-freezing point fuels [NASA-CR-159568] N79-24172 Autoignition of fuels N79-25001 The impact of alternate fuels on aircraft configuration characteristics military aircraft [AD-A066983] N79-25244 AIRCRAFT GUIDAMCB Evaluation of an PM/CW range measurement system for VTOL landing A79-36086 Capturing and tracking performance of the horizontal guidance and control systems of the terminal configured vehicle [NASA-TH-79068] N79-25034 AIRCRAFT GAUSA	
A79-36100 Detonation characteristics of Soviet GOST 1012-72 aviation gasoline [SAE PAPER 790630] A79-36757 Lean, premixed, prevaporized combustion for aircraft gas turbine engines [NASA-TM-79148] N79-23964 Design and evaluation of aircraft heat source systems for use with high-freezing point fuels [NASA-CR-159568] N79-24172 Autoignition of fuels N79-25001 The impact of alternate fuels on aircraft configuration characteristics military aircraft [AD-A0665983] N79-25244 AIRCRAFT GUIDANCE Evaluation of an PM/CW range measurement system for VTOL landing A79-36086 Capturing and tracking performance of the horizontal guidance and control systems of the terminal configured vehicle [NASA-TM-80068] N79-25034 AIRCRAFT GUDONEL Aircraft Company Lightning	
A79-36100 Detonation characteristics of Soviet GOST 1012-72 aviation gasoline [SAE PAPER 790630] A79-36757 Lean, premixed, prevaporized combustion for aircraft gas turbine engines [NASA-TH-79148] N79-23964 Design and evaluation of aircraft heat source systems for use with high-freezing point fuels [NASA-CR-159568] N79-24172 Autoignition of fuels N79-25001 The impact of alternate fuels on aircraft configuration characteristics military aircraft [AD-N066983] N79-25244 AIRCRAFT GUIDAMCE Evaluation of an PM/CW range measurement system for VTOL landing A79-36086 Capturing and tracking performance of the horizontal guidance and control systems of the terminal configured vehicle [NASA-TH-80068] N79-25034 AIRCRAFT HAZARDS The ScDonnell Aircraft Company Lightning Simulation Laboratory A79-37294	
A79-36100 Detonation characteristics of Soviet GOST 1012-72 aviation gasoline [SAE PAPER 790630] A79-36757 Lean, premixed, prevaporized combustion for aircraft gas turbine engines [NASA-TM-79148] N79-23964 Design and evaluation of aircraft heat source systems for use with high-freezing point fuels [NASA-CR-159568] N79-24172 Autoignition of fuels N79-25001 The impact of alternate fuels on aircraft configuration characteristics military aircraft [AD-A0665983] N79-25244 AIRCRAFT GUIDAWCB Evaluation of an PM/CW range measurement system for VTOL landing A79-36086 Capturing and tracking performance of the horizontal guidance and control systems of the terminal configured vehicle [NASA-TM-80068] N79-25034 AIRCRAFT HAZARDS The McDonnell Aircraft Company Lightning Simulation Laboratory A79-37294 Identification of voltage transients on aircraft	
A79-36100 Detonation characteristics of Soviet GOST 1012-72 aviation gasoline [SAE PAPER 790630] A79-36757 Lean, premixed, prevaporized combustion for afficraft gas turbine engines [NASA-TH-79148] N79-23964 Design and evaluation of aircraft heat source systems for use with high-freezing point fuels [NASA-CH-159568] N79-24172 Autoignition of fuels N79-25001 The impact of alternate fuels on aircraft configuration characteristics military aircraft [AD-A066983] N79-25244 AIRCRAFT GUIDAWCB Evaluation of an PM/CW range measurement system for VTOL landing A79-36086 Capturing and tracking performance of the horizontal guidance and control systems of the terminal configured vehicle [NASA-TH-80068] N79-25034 AIRCRAFT HAZARDS The McDonnell Aircraft Company Lightning Simulation Laboratory A79-37294 Identification of voltage transients on aircraft cabling under LTA excitation Lightning	
A79-36100 Detonation characteristics of Soviet GOST 1012-72 aviation gasoline [SAE PAPER 790630] A79-36757 Lean, premixed, prevaporized combustion for aircraft gas turbine engines [NASA-TM-79148] N79-23964 Design and evaluation of aircraft heat source systems for use with high-freezing point fuels [NASA-CR-159568] N79-24172 Autoignition of fuels N79-25001 The impact of alternate fuels on aircraft configuration characteristics military aircraft [AD-A0665983] N79-25244 AIRCRAFT GUIDAWCB Evaluation of an PM/CW range measurement system for VTOL landing A79-36086 Capturing and tracking performance of the horizontal guidance and control systems of the terminal configured vehicle [NASA-TM-80068] N79-25034 AIRCRAFT HAZARDS The McDonnell Aircraft Company Lightning Simulation Laboratory A79-37294 Identification of voltage transients on aircraft	
A79-36100 Detonation characteristics of Soviet GOST 1012-72 aviation gasoline [SAE PAPER 790630] A79-36757 Lean, premixed, prevaporized combustion for aircraft gas turbine engines [NASA-TH-79148] N79-23964 Design and evaluation of aircraft heat source systems for use with high-freezing point fuels [NASA-CR-159568] N79-24172 Autoignition of fuels N79-25001 The impact of alternate fuels on aircraft configuration characteristics military aircraft [AD-A066983] N79-25244 AIRCRAFT GUIDAWCB Evaluation of an PM/CW range measurement system for VTOL landing A79-36086 Capturing and tracking performance of the horizontal guidance and control systems of the terminal configured vehicle [NASA-TH-80068] N79-25034 AIRCRAFT HAZARDS The McDonnell Aircraft Company Lightning Simulation Laboratory A79-37294 Identification of voltage transients on aircraft cabling under LTA ercitation Lightning Transient Analysis A79-38531 Method of assessment of the antistatic protection	
A79-36100 Detonation characteristics of Soviet GOST 1012-72 aviation gasoline [SAE PAPER 790630] A79-36757 Lean, premixed, prevaporized combustion for aircraft gas turbine engines [NASA-TH-79148] N79-23964 Design and evaluation of aircraft heat source systems for use with high-freezing point fuels [NASA-CR-159568] N79-24172 Autoignition of fuels N79-25001 The impact of alternate fuels on aircraft configuration characteristics military aircraft [AD-A066983] N79-25244 AIRCRAFT GUIDAMCB Evaluation of an PM/CW range measurement system for VTOL landing A79-36086 Capturing and tracking performance of the horizontal guidance and control systems of the terminal configured vehicle [NASA-TH-80068] N79-25034 AIRCRAFT HAZARDS The ScDonnell Aircraft Company Lightning Simulation Laboratory A79-37294 Identification of voltage transients on aircraft cabling under LTA excitation Lightning Transient Analysis A79-36531 Method of assessment of the antistatic protection of aircraft	
A79-36100 Detonation characteristics of Soviet GOST 1012-72 aviation gasoline [SAE PAPER 790630] A79-36757 Lean, premixed, prevaporized combustion for aircraft gas turbine engines [NASA-TH-79148] N79-23964 Design and evaluation of aircraft heat source systems for use with high-freezing point fuels [NASA-CR-159568] N79-24172 Autoignition of fuels N79-25001 The impact of alternate fuels on aircraft configuration characteristics military aircraft [AD-A066983] N79-25244 AIRCRAFT GUIDAMCB Evaluation of an PM/CW range measurement system for VTOL landing A79-36086 Capturing and tracking performance of the horizontal guidance and control systems of the terminal configured vehicle [NASA-TH-80068] N79-25034 AIRCRAFT HAZARDS The ScDonnell Aircraft Company Lightning Simulation Laboratory A79-37294 Identification of voltage transients on aircraft cabling under LTA excitation Lightning Transient Analysis A79-36531 Method of assessment of the antistatic protection of aircraft	
A79-36100 Detonation characteristics of Soviet GOST 1012-72 aviation gasoline [SAE PAPER 790630] A79-36757 Lean, premixed, prevaporized combustion for aircraft gas turbine engines [NASA-TH-79148] N79-23964 Design and evaluation of aircraft heat source systems for use with high-freezing point fuels [NASA-CR-159568] N79-24172 Autoignition of fuels N79-25001 The impact of alternate fuels on aircraft configuration characteristics military aircraft [AD-N066983] N79-25244 AIRCRAFT GUIDANCE Evaluation of an PM/CW range measurement system for VTOL landing A79-36086 Capturing and tracking performance of the horizontal guidance and control systems of the terminal configured vehicle [NASA-TH-80068] N79-25034 AIRCRAFT HAZARDS The Sconnell Aircraft Company Lightning Simulation Laboratory A79-37294 Identification of voltage transients on aircraft cabling under LTA excitation Lightning Transient Analysis A79-38531 Method of assessment of the antistatic protection of aircraft [ONERA, TP NO. 1979-41] A79-39090 Aircraft icing [NASA-CR-2086] N79-23912	
A79-36100 Detonation characteristics of Soviet GOST 1012-72 aviation gasoline [SAE PAPER 790630] A79-36757 Lean, premired, prevaporized combustion for alicraft gas turbine engines [NASA-TH-79148] N79-23964 Design and evaluation of aircraft heat source systems for use with high-freezing point fuels [NASA-CR-159568] N79-24172 Autoignition of fuels N79-25001 The impact of alternate fuels on aircraft configuration characteristics military aircraft [AD-A066983] N79-25244 AIRCRAFT GUIDAWCB Evaluation of an PM/CW range measurement system for VTOL landing A79-36086 Capturing and tracking performance of the horizontal guidance and control systems of the terminal configured vehicle [NASA-TH-80068] N79-25034 AIRCRAFT HAZARDS The GDonnell Aircraft Company Lightning Simulation Laboratory A79-37294 Identification of voltage transients on aircraft cabling under LTA excitation Lightning Transient Analysis A79-38531 Method of assessment of the antistatic protection of aircraft [ONERA, TP NO. 1979-41] A79-39090 Aircraft icing Introduction	
A79-36100 Detonation characteristics of Soviet GOST 1012-72 aviation gasoline [SAE PAPER 790630] A79-36757 Lean, premixed, prevaporized combustion for afficraft gas turbine engines [NASA-TH-79148] N79-23964 Design and evaluation of aircraft heat source systems for use with high-freezing point fuels [NASA-CR-159568] N79-24172 Autoignition of fuels N79-25001 The impact of alternate fuels on aircraft configuration characteristics military aircraft [AD-A066983] N79-25244 AIRCRAFT GUIDAWCB Evaluation of an PM/CW range measurement system for VTOL landing A79-36086 Capturing and tracking performance of the horizontal guidance and control systems of the terminal configured vehicle [NASA-TH-80068] N79-25034 AIRCRAFT HAZARDS The McDonnell Aircraft Company Lightning Simulation Laboratory A79-37294 Identification of voltage transients on aircraft cabling under LTA excitation Lightning Transient Analysis A79-38531 Method of assessment of the antistatic protection of aircraft [ONERA, TP RO. 1979-41] A79-39090 Aircraft icing [NASA-CP-2086] N79-23913	
A79-36100 Detonation characteristics of Soviet GOST 1012-72 aviation gasoline [SAE PAPER 790630] A79-36757 Lean, premired, prevaporized combustion for alicraft gas turbine engines [NASA-TH-79148] N79-23964 Design and evaluation of aircraft heat source systems for use with high-freezing point fuels [NASA-CR-159568] N79-24172 Autoignition of fuels N79-25001 The impact of alternate fuels on aircraft configuration characteristics military aircraft [AD-A066983] N79-25244 AIRCRAFT GUIDAWCB Evaluation of an PM/CW range measurement system for VTOL landing A79-36086 Capturing and tracking performance of the horizontal guidance and control systems of the terminal configured vehicle [NASA-TH-80068] N79-25034 AIRCRAFT HAZARDS The GDonnell Aircraft Company Lightning Simulation Laboratory A79-37294 Identification of voltage transients on aircraft cabling under LTA excitation Lightning Transient Analysis A79-38531 Method of assessment of the antistatic protection of aircraft [ONERA, TP NO. 1979-41] A79-39090 Aircraft icing Introduction	
A79-36100 Detonation characteristics of Soviet GOST 1012-72 aviation gasoline [SME PAPER 790630] A79-36757 Lean, premixed, prevaporized combustion for aircraft gas turbine engines [NASA-TH-79148] N79-23964 Design and evaluation of aircraft heat source systems for use with high-freezing point fuels [NASA-CH-159568] N79-24172 Autoignition of fuels N79-25001 The impact of alternate fuels on aircraft configuration characteristics military aircraft [AD-A066983] N79-25244 AIRCRAFT GUIDAWCB Evaluation of an PM/CW range measurement system for VTOL landing A79-36086 Capturing and tracking performance of the horizontal guidance and control systems of the terminal configured vehicle [NASA-TH-80068] N79-25034 AIRCRAFT HAZARDS The McDonnell Aircraft Company Lightning Simulation Laboratory A79-37294 Identification of voltage transients on aircraft [ONERA, TP NO. 1979-41] A79-39090 Aircraft icing [NASA-CP-2086] N79-23913 Erecutive summary of Aircraft Icing Specialists Workshop N79-23914	
A79-36100 Detonation characteristics of Soviet GOST 1012-72 aviation gasoline [SAE PAPER 790630] A79-36757 Lean, premixed, prevaporized combustion for aircraft gas turbine engines [NASA-TH-79148] N79-23964 Design and evaluation of aircraft heat source systems for use with high-freezing point fuels [NASA-CR-159568] N79-24172 Autoignition of fuels N79-25001 The impact of alternate fuels on aircraft configuration characteristics military aircraft [AD-N066983] N79-25244 AIRCRAFT GUIDANCE Evaluation of an PM/CW range measurement system for VTOL landing A79-36086 Capturing and tracking performance of the horizontal guidance and control systems of the terminal configured vehicle [NASA-TH-80068] N79-25034 AIRCRAFT HAZARDS The Schonnell Aircraft Company Lightning Simulation Laboratory A79-37294 Identification of voltage transients on aircraft cabling under LTA excitation Lightning Transient Analysis A79-38531 Method of assessment of the antistatic protection of aircraft [ONERA, TP NO. 1979-41] A79-39090 Aircraft icing: Introduction N79-23912 Aircraft icing: Introduction N79-23913 Executive summary of Aircraft Icing Specialists Workshop N79-23914 Icing of aircraft Some remarks with an historical	
A79-36100 Detonation characteristics of Soviet GOST 1012-72 aviation gasoline [SME PAPER 790630] A79-36757 Lean, premixed, prevaporized combustion for aircraft gas turbine engines [NASA-TH-79148] N79-23964 Design and evaluation of aircraft heat source systems for use with high-freezing point fuels [NASA-CH-159568] N79-24172 Autoignition of fuels N79-25001 The impact of alternate fuels on aircraft configuration characteristics military aircraft [AD-A066983] N79-25244 AIRCRAFT GUIDAWCB Evaluation of an PM/CW range measurement system for VTOL landing A79-36086 Capturing and tracking performance of the horizontal guidance and control systems of the terminal configured vehicle [NASA-TH-80068] N79-25034 AIRCRAFT HAZARDS The McDonnell Aircraft Company Lightning Simulation Laboratory A79-37294 Identification of voltage transients on aircraft [ONERA, TP NO. 1979-41] A79-39090 Aircraft icing [NASA-CP-2086] N79-23913 Erecutive summary of Aircraft Icing Specialists Workshop N79-23914	

∆-5

AIRCRAFT INDUSTRY

Civil Helicopter icing problems	N79-23917
A review of the icing situation from the	873-23317
standpoint of general aviation	N79-23918
Overview of helicopter ice protection syst	
developments	N79-23919
Porcasting the guantitative characteristic aircraft icing	
aircraft icing [BLL-TRANS-1364-(9022.549)]	N79-24971
AIRCEAPT INDUSTRY	
Producing light aircraft - Three viability studies	case
	A79-36376
AIRCRAFT INSTRUMENTS F-18 - A special report	
The intercept of covert radar	A79-38131
-	A79-38132
Theoretical fundamentals of radio altimetr Russian book	y
	A79-38145
Tachystoscopic testing of onboard instrume	nts A79-38817
AIBCRAFT LANDING	
The effects of low-level wind shear on the approach and go-around performance of a	landing
jet aircraft	-
[SAE PAPER 790568] A wind shear/downdraft drift angle warning	A79-36708 system
TOTADA à digital computer anoman for air	A79-38477
VOLAR: A digital computer program for sim VSTOL aircraft launch and recovery from	
ships. Volume 1: Program description [AD-A066172]	N79-23954
VOLAR: A digital computer program for sim	ulating
VSTOL aircraft launch and recover from s ships. Volume 2: Appendices	mall
[AD-A066173]	N79-23955
AIRCRAFT MAINTENANCE Effects of extended oil changes on aircraf	t piston
engine wear and oil characteristics	
[SAE PAPER 790629] Impact of advanced technologies on aircraf	A79-36756 t design
	179-37045
High level maintenance below sea level	A79-38825
Effect of maintenince plan and engine dura on helicopter propulsion system ownershi	bility cost
[AIAA PAPER 79-1317]	A79-39033
The aircraft air conditioner data revisite for comparison of alternative system con-	d cepts
	A79-39895
Evaluation of new bonding systems for depo maintenance of aircraft honeycomb panels	t-Te∆eī
[AD-A066117]	N79-24161
AIRCRAFT MANBUVERS Energy maneuverability display validation -	F-16
aircraft [APFDL-TR-78-35-VOL-1]	N79-23947
Proceedings of AFFDL Flying Qualities Symp	osium
[AD-A066493] Technical evaluation report on the 25th Gu:	N79-24982 Ldance
and Control Panel Symposium on guidance a	and
Control Design Considerations for Low Altant and Terminal Area Flight	titude
[AGARD-AR-129]	N79-25037
MIRCRAFT MODBLS Model study of aircraft disk brakes	
AIRCRAFT NOISE	A79-38816
Propeller aircraft noise around general av	Lation
alrports	
1 3A5 PAPER / 903941	A79-36728
[SAE PAPER 790594] An experimental study of propeller-induced	A79-36728
	A79-36728
An experimental study of propeller-induced structural vibration and interior noise [SAE PAPER 790625] Engine induced structural-borne noise in a	A79-36753
An experimental study of propeller-induced structural vibration and interior noise [SAE PAPER 790625]	A79-36753
An experimental study of propeller-induced structural vibration and interior noise [SAE PAPER 790625] Engine induced structural-borne noise in a aviation aircraft [SAE PAPER 790626] Summary of noise reduction characteristics	A79-36753 general A79-36754
An experimental study of propeller-induced structural vibration and interior noise [SAE PAPER 790625] Engine induced structural-borne noise in a aviation aircraft [SAE PAPER 790626] Summary of noise reduction characteristics typical general aviation materials [SAE PAPER 790627]	A79-36753 general A79-36754 of A79-36755
An experimental study of propeller-induced structural vibration and interior noise [SAE PAPER 790625] Engine induced structural-borne noise in a aviation aircraft [SAE PAPER 790626] Summary of noise reduction characteristics typical general aviation materials	A79-36753 general A79-36754 of A79-36755 noise

SUBJECT INDEX

A study of the evolution of noise exposure different hypotheses of regulation	under
[ONERA, TP NO. 1979-44]	∆79-390 93
Assessment at full scale of nozzle/wing ge	
effects on OTW aeroacoustic characterist Over The Wing STOL engine configurations	
ere the stary ered engine contrigutations	179-39802
Statistical comparisons of aircraft flyove	
adjustment procedures for different weat conditions	her
[NASA-TP-1430]	N79-24773
Aircraft sonic boom: Studies on aircraft	flight,
allCraft design, and measurement. A	
bibliography with abstracts [NTIS/PS-79/0264/6]	N79-24780
Aircraft and airport noise reduction	
[GPO-29-661]	N79-25038
An experimental investigation of the effect rotor tip shape on helicopter blade-slap	
in the langley v/stol wind tunnel	
[NASA-TH-80066]	N79-25844
AIRCRAFT PARTS Development of an aircraft composite prope	ller
[SAE PAPER 790579]	A79-36714
Fundamentals of Gas Turbine Combustion	120 25016
[NASA-CP-2087] AIRCRAFT PERFORMANCE	N79-25016
The effects of low-level wind shear on the	
approach and go-around performance of a	landıng
jet aircraft [SAE PAPER 790568]	A79-36708
Design description of a four-place busines	s jet
using two WR-19 engines [SAB PAPER 790580]	N79-36715
Improving business jet performance - The M	
Sabreliner	
[SAB PAPER 790582] Selection of aircraft turbocharger systems	A79-36717
[SAE PAPER 790608]	A79-36739
New technologies for general aviation airc	
[SAE PAPER 790613] In Soviet service. V - Backfire	A79-36742
	179-36775
Dassault-Breguet - The Mirage 2000	A79-36974
Changing requirements in aircraft design	
Design, meet production aircraft cost	A79-37044 and
performance tradeoff considerations	
Electric propulsion for high performance 1	A79-37048
aircraft	rgat
[AIAA PAPER 79-1265]	A79-39011
An evaluation of turn anticipation techniq offset flying procedures using a single-	
RNAN system	
[AD-A066555] AIRCRAFT PILOTS	N79-24974
The dynamics of a general aviation pilot p	romotion
campaign	170 2000/
AIRCRAFT PRODUCTION	179-38886
Producing light aircraft - Three viability	case
studies	A79-36376
Some main points about general-aviation de	
practice	
AIRCRAFT RELIABILITY	179-37047
Crashworthiness analysis of field investig	ation of
business aircraft accidents [SAE PAPER 790587]	179-36721
The Fairchild can-opener - Shturmovik of t	
	he
eighties	
eighties Impact of advanced technologies on aircraf	179-36773
Impact of advanced technologies on aircraf	A79-36773 t design A79-37045
Impact of advanced technologies on aircraf Joint Airworthiness Requirements - Their h	A79-36773 t design A79-37045
Impact of advanced technologies on aircraf Joint Airworthiness Beguirements - Their h and progress	A79-36773 t design A79-37045 istory A79-37149
Impact of advanced technologies on aircraf Joint Airworthiness Bequirements - Their h and progress The test pilot in the airline industry or	A79-36773 t design A79-37045 istory A79-37149
Impact of advanced technologies on aircraf Joint Airworthiness Beguirements - Their h and progress	A79-36773 t design A79-37045 istory A79-37149
Impact of advanced technologies on aircraf Joint Airworthiness Bequirements - Their h and progress The test pilot in the airline industry or	A79-36773 t design A79-37045 istory A79-37149 'My bags A79-38478 ure rates
Impact of advanced technologies on aircraf Joint Airworthiness Requirements - Their h and progress The test pilot in the airline industry or are packed and I'm ready to go' Development of in-flight steady-state fail	A79-36773 t design A79-37045 istory A79-37149 My bags A79-38478
Impact of advanced technologies on aircraf Joint Airworthiness Requirements - Their h and progress The test pilot in the airline industry or are packed and I'm ready to go' Development of in-flight steady-state fail AIRCRAFT SAFETY Electronic system safety - Testing reality	A79-36773 t design A79-37045 istory A79-37149 *My bags A79-38478 ure rates A79-39912
Impact of advanced technologies on aircraf Joint Airworthiness Requirements - Their h and progress The test pilot in the airline industry or are packed and I'm ready to go' Development of in-flight steady-state fail AIRCRAFT SAFETY	A79-36773 t design A79-37045 istory A79-37149 *My bags A79-38478 ure rates A79-39912

Fuel on fire - Rapid response to a military problem A79-38090 Survivability in aircraft fires - New standards are needed A79-38091 RTCA standards - Improved specs. and regulations --- in avionics equipment 179-39919 AIRCRAFT SPECIFICATIONS The Lockheed C-5: Case study in aircraft design --- Book 179-36646 Westland unveils WG30 transport helicopter x79-38092 AIRCRAFT STABILITY A wind shear/downdraft drift angle warning system 179-38477 AIRCRAFT STRUCTURES Adhesive bonded structure of new pressurized piston twin aircraft [SAE PAPER 790563] A79-36704 Composite applications at Bell Helicopter [SAE PAPER 790578] A79-36713 Nonlinear structural crash dynamics analyses [SAE PAPER 790603] A79-36 Area Light twin using bonded metal construction [SAE PAPER 790603] A79-36 179-36722 A79-36732 A79-36735 Pretting fatigue, with reference to aircraft structures [SAE PAPER 790612] A79-36741 Development of the Beechcraft Hodel 77 [SAE PAPER 790617] A79-36745 Aircraft design and strength /2nd revised and enlarged edition/ --- Russian book A79-38140 Substructuring methods for design sensitivity analysis and structural optimization FAD-A0659351 N79-23949 NOVA-25, a stiffened panel extension of the NOVA-2 Computer program [AD-A066038] N79-23 Prediction of the angular response power spectral N79-23951 density of aircraft structures [AD-A066141] N79-23 Research and development activities in Italy in the field of aerospace structures and materials N79-23956 [AGARD-R-675] N79-24202 Advanced rotorcraft technology: Task force report [NaSA-TH-80541] N79-Composite forward fuselage systems integration, volume 2 --- effects of lightning N79-N79-24951 [AD-A066560] N79-24984 Non-destructive inspection methods for propulsion systems and components [AGARD-LS-103] ₦79-25412 Non-destructive methods for the early detection of fatigue damage in aircraft components N79-25417 Broad-band transducers for nondestructive inspection of aeronautical components 879-25419 AIRCEAPT SURVIVABILITY Infrared signature measurement techniques and simulation methods for aircraft survivability [AIAA PAPER 79-1186] A79-A79-38975 Method of assessment of the antistatic protection of aircraft [ONERA, TP NO. 1979-41] AIRCRAFT TIRES A79-39090 Proper aircraft tire size selection - Optimum performance with minimum maintenance [SAE PAPER 790598] A79-36 A tire runway interface friction prediction model 179-36730 concept A79-38137 Peasibility and cost effectiveness of airborne tire pressure indicating systems [AD-A065513] N79-24981 AIRCRAFT WAKES Turbulent wake measurements with a laser velocimeter [AIAA PAPER 79-1087] A79-38058 Vortex-induced oscillations - A selective review A79-39751 Aircraft wake vortices. A bibliography with abstracts [NTIS/PS-79/0166/3] N79-23939

AIRFOIL PROPILES The impact of noise regulations on propeller design [SAE PAPER 790593] 179-36727 Low-speed single-element airfoil synthesis 179-23890 A comparison of the aerodynamic characteristics of eight sailwing airfoil sections 179-23897 A finite element method for the computation of the transonic potential flow past airfoils [MBB-UFE-1352-0] 879-23935 Airfoil optimization for transonic flow using the methods of finite elements and characteristics [MBB-UPE-1362-0] 879-23937 Low-speed wind tunnel results for a modified 13-percent-thick airfoil [NASA-TH-X-74018] N79-24960 AIRFOILS Analysis of an unsteady aerodynamic force on a blade due to ununiform amplitude gusts A79-39059 Low-speed single-element airfoil synthesis ₩79-23890 An exploratory investigation of the effect of plastic coating on the profile drag of a practical-metal-construction sailplane airfoil N79-23891 Some new airfoils N79-23896 An annular wing [NASA-CASE-FRC-11007-2] N79-24959 Low-speed wind tunnel results for a modified 13-percent-thick airfoil [NASA-TH-X-74018] N N79-24960 Theoretical analysis of transonic flow past unstaggered oscillating cascades [AD-A063083] N79-24963 AIRFRANKS Differential method of designing rational aircraft frames made of composite materials 179-36592 Bonding and durability --- for airframe structures [SAE PAPER 790561] A79-367 Evaluation of methods for prediction of propulsion A79-36702 system drag [AIAA PAPER 79-1148] A79-38961 Interactional aerodynamics of the single rotor helicopter configuration. Volume 2B: Harmonic analyses of airframe surface pressure data, runs 7 - 14, midsection [AD-A061860] N79-23934 The production function and airframe cost estimation [AD-A065570] N79-23952 ANALYZE: Analysis of aerospace structures with membrane elements [AD-A065633] N79 Interactional aerodynamics of the single rotor N79-24379 helicopter configuration. Volume 28: Harmonic analysis of airframe surface pressure data, runs 7-14, mid section [AD-A061860] N79-24967 A cooling system for an aircraft having a cruise range from Mach 2 to Mach 8 [NASA-CASE-LAR-12406-1] N79-249 The influence of fleet variability on crack growth N79-24980 tracking procedures for transport/bomber aircraft [AD-A066596] N79-2543 N79-25433 AIRLINE OPERATIONS The airport performance model. Volume 1: Extensions, validations, and applications [AD-A062863] N79-25040 AIRPLANE PRODUCTION COSTS Design, meet production --- aircraft cost and performance tradeoff considerations 179-37008 AIRPORTS The airport performance model. Volume 1: Extensions, validations, and applications N79-25040 [AD-A062863] AIRSHÌPS Propelled lighter-than-air vehicles [GPO-43-457] 179-23925 ATRSPERD ffects of forward velocity on sound radiation from convecting monopole and dipole sources in jet flow --- subsonic aircraft model **X79-38393**

Wing shape optimization for maximum cross-country speed, with mathematical programming N79-23899 ALGORITHMS The role of three-dimensional flow analysis in the design of turbomachinery [AIAA PAPER 79-1231] A79-38995 ALTGNNRNT. Driveshaft alignment indicator [AD-A065988] N79-23973 ALL-WEATHER AIR NAVIGATION Night/Adverse Weather A-10 evaluator program A79-38479 ALTITUDE A system for providing an integrated display of instantaneous information relative to aircraft attitude, heading, altitude, and horizontal situation [NASA-CASE-FRC-11005-1] N79-24988 ALTITUDE TESTS Hultivariable control altitude demonstration on the F100 turbofan engine [AIAA PAPER 79-1204] A79-39814 ALUMINUM ALLOYS Definition and non-destructive detection of critical adhesive bond-line flaws [AD-A065584] N79-24163 ALUMINUM COATINGS Internally coated air-cooled gas turbine blading [NASA-CR-159574] N79-25018 AUPLIFIERS Model study of transient processes in a hydraulic power amplifier A79-38814 ANGLE OF ATTACK Control considerations for CCV fighters at high angles of attack A79-37295 Interference effects of aircraft components on the local blade angle of attack of a wing-mounted propeller [NASA-TH-78587] N79-25021 ANTENNA RADIATION PATTERNS High frequency near field scattering by an elliptic disk [AD-A065586] N79-24214 Fuselage-mounted antenna code: User's manual [AD-A065587] N79-24215 Wing-mounted antenna code: User's manual [AD-A065589] N79-24216 1 iterative approach for computing an antenna aperture distribution from given radiation Δn pattern data [AD-A065590] N79-24217 APPLICATIONS PROGRAMS (COMPUTERS) The application of microprocessor technology to in-flight computation N79-23902 APPROXTNATION. Second approximation in theory of a finite-span thin wing in a hypersonic gas flow A79-35927 Construction of an initial approximation for the solution of the integral equation of a lifting surface A79-35928 ASYMPTOTIC SERIES An asymptotic result for the scattering of a plane wave by a smooth convex cylinder [AD-A065588] N79-242 N79-24229 ATHOSPHERIC ATTENUATION Thermospheric propagation of sonic booms from the Concorde supersonic transport [AD-A067201] N79-25855 ATMOSPHERIC RADIATION Observation of atmospheric interactions at aeroplane altitude --- gamma ray emulsion experiments A79-37573 ATHOSPHERIC TURBULENCE Experimental data on the dynamic properties of several propeller vanes --- turbulence measurement in wind tunnel A79-38943 AUTOMATIC CONTROL Advanced braking controls for business aircraft [SAE PAPER 790599] A79-

SUBJECT INDEX

AUTOHATIC FLIGHT CONTROL

Drone formation control system /DFCS/ - A new generation test range system A79-36084 Westland unveils WG30 transport helicopter 179-38092 Digital flight control research using microprocessor technology A79-38533 Evaluation of a digital helicopter control system --- B0-105 helicopter [MBB-UFE-1349-0] N79-23980 AUTOMATIC PILOTS Capturing and tracking performance of the horizontal guidance and control systems of the terminal configured vehicle [NASA-TH-80068] N79-2: N79-25034 AUXILIARY POWER SOURCES Optimal selection of the geometrical characteristics of the reversing channel of a small-scale turbine with readmission of the gas --- for aircraft auxiliary power systems A79-36583 Effectiveness of readmission of the gas in high-pressure-ratio small-scale turbines --- for aircraft auxiliary power systems A79-36584 AVIONICS The results of synthesizing and evaluating potential solutions for Multi-Function Inertial Reference Assembly /MIRA/ candidate configurations - for transport and fighter aircraft A79-36082 Boeing 757/767 - On-the-spot report A79-36374 An optical-fiber multiterminal data system for aircraft A79-36484 A Demonstration Advanced Avionics System for general aviation [SAE PAPER 790569] [SAE PAPER 790569] A79-36709 Electronic system safety - Testing reality --- for avionics [SAE PAPER 790570] A79-36710 The Digibus multiplex at the heart of avionics A79-36975 F-18 - A special report A79-38131 Night/Adverse Weather A-10 evaluator program A79-38479 Exploring team avionics systems by simulation 179-38882 The F-16 RIW program --- Reliability Improvement Warranty A79-39889 CERT technology applied to an airborne radar --Combined Environment Reliability Testing A79-39893 Lower avionic temperature - Lower life cycle cost A79-39914 RTCA standards - Improved specs. and regulations -- in avionics equipment A79-39919 The effect of endless burn-in on reliability growth projections --- for solid state aviation electronics equipment 179-39920 Avionics standardization potential analysis [AD-A066138] . N79-23958 Aerospace computer systems. Part 1: Avionics applications, volume 2. A bibliography with abstracts [NTIS/PS-79/0312/3] N79-23959 Aerospace computer systems. Part 1: Avionics applications, volume 3. A bibliography with abstracts [NTIS/PS-79/0313/1] N79-23960 Analysis of the impact of a 270 VDC power source on the avionic power supplies in the S-3A aircraft [AD-A066526] N79-24989 Color display design guide [AD-A066630] N79-24991 AAES laboratory simulator requirements (A-7 aircfaft) [AD-A066393] N79-25041 Life cycle cost analysis concepts and procedures N79-25408

A79-36731

Recent experience in the development and application of LCC models Nvionics technology for tactical data handling N79-25979 The application of structured design and distributed techniques to avionics information processing architectures N79-25991 ATIAL PLOW TURBINES Radial equilibrium in axial turbomachines A79-37828

AXISYMMETRIC FLOW Estimation of compressible flows in turbomachines by an axisymmetric calculation method [OBERA, TP NO. 1979-60] A79-39096

B

B-1 AIRCRAPT	
Determination of subcritical frequency and	damping
from B-1 flight flutter test data	
[NASA-CR-3152]	N79-25426
BEECHCRAFT AIRCRAFT Development of the Beechcraft Hodel 77	
[SAE PAPER 790617]	A79-36745
BEBDING VIBRATION	A15 30145
Aeroelastic stability analysis of the AD-1	nanned
oblique-wing aircraft	
	A79-38136
BIBLIOGRAPHIES	
Alfcraft wake wortices. A bibliography with abstracts	c n
[NTIS/PS-79/0166/3]	N79-23939
Discrete address beacon system. A bibliogra	
with abstracts	
[NTIS/PS-79/0244/8]	N79-23945
Aerospace computer systems. Part 1: Avion	
applications, volume 2. A bibliography was abstracts	lith .
[NTIS/PS-79/0312/3]	N79-23959
Aerospace computer systems. Part 1: Avio	
applications, volume 3. A bibliography v	
abstracts	
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Aurcraft sonic boom: Effects on buildings.	. A
bibliography with abstracts [NTIS/PS-79/0265/3]	N79-24201
Aircraft sonic boom: Studies on aircraft	
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[NTIS/PS-79/0264/6]	₩79-24780
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bibliography	¥70-25002
bibliography [AD-A061687]	N79-25042
bibliography [AD-A061687] BIRD-AIRCRAFT COLLISIOES	N79-25042
bibliography [AD-A061687]	N79-25042 N79-38951
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Propulsion system sensitivities for a strate aircraft	egic
BOUNDARY LAYER FLOW	A79-38952
Second approximation in theory of a finite- thin wing in a hypersonic gas flow	-
BOUNDARY LAYER SEPARATION	A79-35927
Allowing for the wall boundary layer in an a compressor stage	axial
Self stabilizing sonic inlet	A79-36586
BREGUET AIRCRAFT	N79-24976
	A79-36974
BEITTLE HATEBIALS Brittle materials design, high temperature (
	y N79-25029
BROADBAND Broad-band ultrasonic transducers for	_
non-destructive inspection of aeronautical components	
BUCKLING	A79-39094
A variational theorem for laminated composi- plates of nonlinear materials and application	
	N79-24977
BUDGETING Is the AV-8B Advanced Harrier aircraft ready	y for
full-scale development [PB-290826/7] BUILDINGS	N79-24987
Aircraft sonic boom: Effects on buildings. bibliography with abstracts	A
	N79-24201
С	
C-5 AIRCRAFT	
The Lockheed C-5: Case study in aircraft de: Book	sign
CABIN ATMOSPHERES	A79-36646
CABIN ATMOSPHERES Survivability in aircraft fires - New stands are needed	ards
CABIN ATHOSPHERES Survivability in aircraft fires - New Stands are needed CALIBRATING	ards A79-38091
CABIN ATROSPHERES Survivability in aircraft fires - New stands are needed CALIBRATING Inertial Referenced Plight Inspection System	ards A79-38091
CABIN ATHOSPHERES Survivability in aircraft fires - New stands are needed CALIBRATING Inertial Referenced Flight Inspection System CAMBER Analysis of an unsteady aerodynamic force of	ards A79-38091 m A79-37150
CABIN ATROSPHERES Survivability in aircraft fires - New Stands are needed CALIBERATING Inertial Referenced Plight Inspection System CAMBER Analysis of an unsteady aerodynamic force of blade due to ununiform amplitude gusts	ards A79-38091 m A79-37150
CABIN ATROSPHERES Survivability in aircraft fires - New stands are needed CALIBRATING Inertial Referenced Plight Inspection System Analysis of an unsteady aerodynamic force of blade due to ununiform amplitude gusts CANADAIR AIRCRAFT Canadair Challenger flight test status	ards A79-38091 M A79-37150 n a A79-39059
CABIN ATROSPHERES Survivability in aircraft fires - New stands are needed CALIBRATING Inertial Referenced Plight Inspection System CAMBER Analysis of an unsteady aerodynamic force of blade due to ununiform amplitude gusts CANADAIR AIRCRAFT Canadair Challenger flight test status [SAE PAPER 790602] CARBON MONOTIDE	ards A79-38091 M A79-37150 D a A79-39059 A79-36734
CABIN ATROSPHERES Survivability in aircraft fires - New stands are needed CALIBRATING Inertial Referenced Plight Inspection System CAMBER Analysis of an unsteady aerodynamic force of blade due to ununiform amplitude gusts CANADAIR AIRCRAFT Canadair Challenger flight test status [SAE PAPER 790602] CARBON NOMOVIDE The effect of fuel sprays on emissions from turbine combustor	ards A79-38091 M A79-37150 n a A79-39059 A79-36734 a gas
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CABIN ATROSPHERES Survivability in aircraft fires - New stands are needed CALIBRATING Inertial Referenced Plight Inspection System CAMBER Analysis of an unsteady aerodynamic force of blade due to ununiform amplitude gusts CANADAIR AIRCRAFT Canadair Challenger flight test status [SAE PAPER 790602] CABBON MONOTIDE The effect of fuel sprays on emissions from turbine combustor [ATAA PAPER 79-1321] CASCADE FLOW Profile of a nozzle shaping the free-molecul intended to investigate air-intakes and ci	ards A79-38091 M A79-37150 n a A79-39059 A79-36734 a gas A79-39037 le flow ascades
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CABIN ATROSPHERES Survivability in aircraft fires - New stands are needed CALIBRATING Inertial Referenced Flight Inspection System Analysis of an unsteady aerodynamic force of blade due to ununiform amplitude gusts CAMBDER Analysis of an unsteady aerodynamic force of blade due to ununiform amplitude gusts CAMBDAIR AIRCRAFT Canadair Challenger flight test status [SAE PAPER 790602] CARBON MONOTIDE The effect of fuel sprays on emissions from turbine combustor [AIAA PAPER 79-1321] CASCADE PLOW Profile of a nozzle shaping the free-molecul intended to investigate air-intakes and ci Numerical calculation of inviscid transonic through rotors and fams Theoretical analysis of transonic flow past unstaggered oscillating cascades [AD-A063083] CASTING	ards A79-38091 m A79-37150 n a A79-39059 A79-36734 a gas A79-39037 leflow ascades A79-36122 flow N79-23906 N79-24963
CABIN ATROSPHERES Survivability in aircraft fires - New stands are needed CALIBRATING Inertial Referenced Plight Inspection System CAMBER Analysis of an unsteady aerodynamic force of blade due to ununiform amplitude gusts CANADAIR AIRCRAFT Canadair Challenger flight test status [SAE PAPER 790602] CAMBON MONOTIDE The effect of fuel sprays on emissions from turbine combustor [ATAA PAPEE 79-1321] CASCADE FLOW Profile of a nozzle shaping the free-molecul intended to investigate air-intakes and ci Numerical calculation of inviscid transonic through rotors and fams Theoretical analysis of transonic flow past unstaggered oscillating cascades [AD-A063083] CASTING Directionally solidified blades - Greater si	ards A79-38091 m A79-37150 n a A79-39059 A79-36734 a gas A79-39037 leflow ascades A79-36122 flow N79-23906 N79-24963
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CABIN ATROSPHERES Survivability in aircraft fires - New stands are needed CALIBRATING Inertial Referenced Flight Inspection System CAMBER Analysis of an unsteady aerodynamic force of blade due to ununiform amplitude gusts CANADAIR AIRCRAFT Canadair Challenger flight test status [SAE PAPER 790602] CABBON MONOTOR The effect of fuel sprays on emissions from turbine combustor [AIAA PAPER 79-1321] CASCADE PLOW Profile of a nozzle shaping the free-molecul intended to investigate air-intakes and ci Numerical calculation of inviscid transonic through rotors and fans Theoretical analysis of transonic flow past unstaggered oscillating cascades [AD-A063083] CASTING Directionally solidified blades - Greater si Advanced low emissions catalytic combustor p at General Electric	ards A79-38091 m A79-37150 n a A79-39059 A79-36734 a gas A79-36734 a gas A79-36037 leflow accades A79-23906 N79-24963 trength A79-36248 program N79-25011
CABIN ATROSPHERES Survivability in aircraft fires - New stands are needed CALIBRATING Inertial Referenced Flight Inspection System Analysis of an unsteady aerodynamic force of blade due to ununiform amplitude gusts CAMBDER Analysis of an unsteady aerodynamic force of blade due to ununiform amplitude gusts CAMBDAIR AIRCRAFT Canadair Challenger flight test status [SAE PAPER 790602] CABBON HOMOIDE The effect of fuel sprays on emissions from turbine combustor [ATAA PAPER 79-1321] CASCADE FLOW Profile of a nozzle shaping the free-molecul intended to investigate air-intakes and ca Numerical calculation of inviscid transonic through rotors and fams Theoretical analysis of transonic flow past unstaggered oscillating cascades [AD-A063003] CASTING Directionally solidified blades - Greater si Advanced low emissions catalytic combustor at General Electric Advanced low emissions catalytic combustor j at Pratt and Whitney	ards A79-38091 m A79-37150 n a A79-39059 A79-36734 a gas A79-36734 a gas A79-36037 leflow accades A79-23906 N79-24963 trength A79-36248 program N79-25011
CABIN ATROSPHERES Survivability in aircraft fires - New stands are needed CALIBRATING Inertial Referenced Plight Inspection System CAMBER Analysis of an unsteady aerodynamic force of blade due to ununiform amplitude gusts CANADAIR AIRCRAFT Canadair Challenger flight test status [SAE PAPER 790602] CABBON MONOTOR The effect of fuel sprays on emissions from turbine combustor [AIAA PAPER 79-1321] CASCADE PLOW Profile of a nozzle shaping the free-molecul intended to investigate air-intakes and ca Numerical calculation of inviscid transonic through rotors and fans Theoretical analysis of transonic flow past unstaggered oscillating cascades [AD-A063003] CASTING Directionally solidified blades - Greater si Advanced low emissions catalytic combustor [at General Electric Advanced low emissions catalytic combustor [at Pratt and Whitney CENTRIPUGAL COMPRESSORS A novel correlation of centrifugal compresson	ards A79-38091 M A79-37150 n a A79-39059 A79-36734 a gas A79-36734 a gas A79-36122 flow N79-23906 N79-24963 trength A79-36248 program N79-25011 program
CABIN ATROSPHERES SURVIVABILITY IN AIRCRAFT fires - New stands are needed CALIBRATING Inertial Referenced Flight Inspection System CAMBER Analysis of an unsteady aerodynamic force of blade due to ununiform amplitude gusts CANADAIR AIRCRAFT Canadair Challenger flight test status [SAE PAPER 790602] CARBON HOMOIDE The effect of fuel sprays on emissions from turbine combustor [ATAA PAPER 79-1321] CASCADE FLOW Profile of a nozzle shaping the free-molecul intended to investigate air-intakes and ci Numerical calculation of inviscid transonic through rotors and fans Theoretical analysis of transonic flow past unstaggered oscillating cascades [AD-A063083] CASTING Directionally solidified blades - Greater si Advanced low emissions catalytic combustor j at General Electric Advanced low emissions catalytic combustor j at Pratt and Whitney CENTHIFUGAL COMPRESSORS A novel correlation of centrifugal compresso performance for off-design prediction	ards A79-38091 M A79-37150 n a A79-39059 A79-36734 a gas A79-36734 a gas A79-36122 flow N79-23906 N79-24963 trength A79-36248 program N79-25011 program

CERAMICS

Estimation of compressible flows in turbomachines by an axisymmetric calculation method [ONERA, TP NO. 1979-60] A79-39096 CERANICS Industry tests of NASA ceramic thermal barrier coating --- for gas turbine engine applications [NASA-TP-1425] N79-25023 CERTIFICATION A new light twin using bonded metal construction [SAE PAPER 790603] A79-36735 CHANNEL FLOW Optimal selection of the geometrical characteristics of the reversing channel of a small-scale turbine with readmission of the gas --- for aircraft auxiliary power systems A79-36583 CHANNELS (DATA TRANSMISSION) The Digibus multiplex at the heart of avionics A79-36975 CHEMICAL ANALYSIS Detonation characteristics of Soviet GOST 1012-72 aviation gasoline [SAE PAPER 790630] A79-36757 CIRCUIT PROTECTION Method of assessment of the antistatic protection of aircraft [ONERA, TP NO. 1979-41] A79-39090 CIVIL AVIATION Civil Helicopter icing problems N79-23917 Air pollutant emission factors for military and civil aircraft [PB-292520/4] N79-25567 CLASSIFICATIONS Optimum frequencies for aircraft classification [AD-A065697] N79-24220 CLOUD GLACIATION Forcasting the guantitative characteristics of aircraft lcing [BLL-TRANS-1364- (9022.549)] N79-24971 COCKPIT SINULATORS Sidestick/Throttle Controller - An alternate approach A79-38476 COCKPITS An evaluation of turn anticipation techniques and offset flying procedures using a single-waypoint RNAN system N79-24974 FAD-A0665551 Peasibility and cost effectiveness of airborne tire pressure indicating systems [AD-A065513] N79-24981 COLOR Color display design guide [AD-A066630] ¥79-24991 [AD-A000050] COMBUSTIBLE PLOW Development of a gas turbine combustor dilution zone design analysis [AIAA PAPER 79-1194] COMBUSTION CHANBERS A79-38979 Development of a gas turbine combustor dilution zone design analysis [AIAA PAPER 79-1194] A79-A79-38979 Analysis of the impact of the use of broad specification fuels on combustors for commercial aircraft gas turbine engines [AIAA PAPER 79-1195] A79-38980 Lean stability augmentation for premixing, prevaporizing combustors [AINA PAPER 79-1319] A79-39 The effect of fuel sprays on emissions from a gas A79-39035 turbine combustor [AIAA PAPER 79-1321] A79-39037 fueled with a simulated partial-oxidation product gas AIAA PAPER 79-1322] A79-39038 Effect of degree of fuel vaporization upon emissions for a premixed prevaporized combustion system --- for gas turbine engines [NASA-TH-79154] N79-2390 N79-23965 Premixed Prevaporized Combustor Technology Forum [NASA-CP-2078] N79-249 Advanced low emissions catalytic combustor program N79-24994 at General Electric N79-25011 Advanced low emissions catalytic combustor program at Pratt and Whitney N79-25012

SUBJECT INDEX

Lean, premixed, prevaporized combustor conceptual design study N79-25013 Lean, premixed, prevaporized combustor conceptual design study N79-25014 Fundamentals of Gas Turbine combustion [NASA-CP-2087] N79-25016 Optical in situ versus probe measurements of nitric oxide concentration as a function of axial position in a combustor exhaust [AD-A067329] N79-25025 CONBUSTION CONTROL The effect of fuel sprays on emissions from a gas turbine combustor [AIAA PAPER 79-1321] 179-39037 CONBUSTION EPPICIENCY Fossil fuel heat pumps for domestic, commercial and industrial space heating 179-37852 Lean, premixed, prevaporized combustion for aircraft gas turbine engines [AIAA PAPER 79-1318] A79-39034 Lean stability augmentation for premixing, Lean stability augmentation for premixing, prevaporizing combustors [AIAA PAPER 79-1319] Lean, premixed, prevaporized combustion for aircraft gas turbine engines [NASA-TH-79148] Procedure concentration for a figure of the figu A79-39035 N79-23964 Two-stage supercharger sets: Efficiency and head distribution under full- and part-load conditions [RTS-11613] 879-24342 CONBUSTION PRODUCTS Lean stability augmentation for premixing, prevaporizing combustors [AIAA PAPER 79-1319] A79-39 The effect of fuel sprays on emissions from a gas A79-39035 turbine combustor [ATAM PAPER 79-1321] A79 Emission characteristics of a premix combustor A79-39037 fueled with a simulated partial-oxidation product gas [AIAA PAPER 79-1322] A79-39038 Effect of fuel/air nonuniformity on mitric oxide emissions N79-25004 CONBUSTION STABILITY Test verification of a turbofan partial swirl afterburner [AIAA PAPER 79-1199] A79-38981 Operating condition and geometry effects on low-frequency afterburner combustion instability in a turbofan at altitude [NASA-TP-1475] N79-25022 COMMBRCIAL AIRCRAFT Boeing 757/767 - On-the-spot report A79-36374 Electronic system safety - Testing reality --- for avionics [SAE PAPER 790570] A79-36 Airbus picks up speed - and the junior A310 takes 179-36710 off 179-36774 Design, meet production --- arcraft cost and performance tradeoff considerations A79-37048 Joint Airworthiness Requirements - Their history and progress A79-37149 The test pilot in the airline industry or 'Hy bags are packed and I'm ready to go' A79-38478 COMMUNICATION CABLES The estimation of induced-voltage peak magnitude and energy level under LTA/EMP ercitation of low-loss aircraft cabling --- Lightning Transit Analysis/Electro-Hagnetic Pulse A79-37238 COMMUNICATION DETROBKS A review of the 3M data base for fault-tolerant system incentives --- communication networks f AD-A0666971 N79-24990 COMMUNICATION SATELLITES Air Force Space Laser Communications A79-38706

CONTINUOUS WAVE RADAR

COMPONENT RELIABILITY The effect of endless burn-in on reliability growth projections --- for solid state aviation electronics equipment A79-39920 COMPOSITE MATERIALS Differential method of designing rational aircraft frames made of composite materials A79-36592 COMPOSITE STRUCTURES Composite applications at Bell Helicopter [SAE PAPER 790578] A79-36713 Development of an aircraft composite propeller [SAE PAPER 790579] A79-Composite forward fuselage systems integration, A79-36714 volume 2 --- effects of lightning [AD-A066560] N79-24984 COMPRESSIBLE FLOW Estimation of compressible flows in turbomachines Lows of compressible flows in tur by an axisymmetric calculation method [ONERA, TP NO. 1979-60] COMPRESSOR BLADES A79-39096 Allowing for the wall boundary layer in an axial compressor stage A79-36586 COMPRESSORS Turbulence characteristics of compressor discharge flows --- JT9D engine tests N79-24995 Turbulence measurements in the compressor exit flow of a General Electric CP6-50 engine N79-24996 COMPUTER GRAPHICS Computer graphics create the new wave of design -37046 A79 User's guide: Computer program with interactive graphics for analysis of plane frame structures (CFRAME) [AD-A067349] N79-25428 COMPUTER PROGRAMMING VOLAR: A digital computer program for simulating VSTOL aircraft launch and recovery from small ships. Volume 1: Program description ships, Volum [AD-A066172] N79-23954 VOLAR: A digital computer program for simulating VSTOL aircraft launch and recover from small ships. Volume 2: Appendices [AD-A066173] COMPUTER PROGRAMS N79-23955 Aeroelastic stability analysis of the AD-1 manned oblique-wing aircraft A79-38136 The dynamics of a general aviation pilot promotion campaign A79-38886 Dynamic structural analysis with substructures [AD-A065937] COMPUTER SYSTEMS DESIGN N79-24378 The Digibus multiplex at the heart of avionics A79-36975 Turbine design system [AD-A066092] N79-23974 COMPUTER SYSTEMS PROGRAMS A streamlined control system development process --- to optimize aircraft propulsion system performance [AIAA PAPER 79-1344] COMPUTERIZED DESIGN A79-39048 General aviation aircraft design for performance using small computers [SAE PAPER 790614] x79-36743 Computer graphics create the new wave of design A79-37046 Exploring team avionics systems by simulation A79-38882 Wing-mounted antenna code: User's manual [AD-A065589] ANALYZE: Analysis of aerospace structures N79-24216 with membrane elements [AD-A065633] COMPUTERIZED SIMULATION N79-24379 Nonlinear structural crash dynamics analyses [SAE PAPER 790588] A79 Experimental verification of program KRASH - A A79-36722 mathematical model for general aviation structural crash dynamics [SAE PAPER 790589] 179-36723

1

Seat/Occupant crash dynamic analysis verification test program [SAE PAPER 790590] 179-36724 Exploring team avionics systems by simulation A79-38882 An aircraft simulation using a product of exponentials as matrizant A79-38885 The role of three-dimensional flow analysis in the design of turbomachinery [AIAA PAPEE 79-1231] The application of the Prop-Pan concept in **179-38995** Infinite and the first first state of the second state of the seco 179-39047 RELSIM-A systems reliability simulation code A79-39900 VOLLR: A digital computer program for simulating VSTOL aircraft launch and recovery from small ships. Volume 1: Program description [AD-A066172] N79-23954 Aerospace computer systems. Part 1: Avionics applications, volume 2. A bibliography with abstracts [NTIS/PS-79/0312/3] Combined pressure and temperature distortion N79-23959 effects on internal flow of a turbofan engine [NASA-TH-79136] N79-23963 Regression Simulation of turbine engine performance: Accuracy improvement (task 4) N79-25027 AD-A0663981 The airport performance model. Volume 1: Extensions, validations, and applications ₩79-25040 [AD-A0628631 COMPUTERS Some new airfoils N79-23896 CONCORDE AIRCRAFT Thermospheric propagation of sonic booms from the Concorde supersonic transport [AD-A067201] N79-25855 CONFERENCES The science and technology of low speed and motorless flight, part 1
[NASA-CP-2085] N79-23889 Aircraft icing [NASA-CP-2086] N79-23912 Technical evaluation report on the 27th Guidance and Control Panel Symposium on the V/STOL Aircraft at Night and in Poor Visibility [AGARD-AR-142] N79-23946 Research and development activities in Italy in the field of aerospace structures and materials [AGARD-R-675] N79-24202 Status of knowledge of sonic booms [NASA-TM-80113] ₩79-24955 Premixed Prevaporized Combustor Technology Forum [NASA-CP-2078] N79-24994 CONGRESSIONAL REPORTS Propelled lighter-than-air vehicles [GPO-43-457] N79-23925 Aircraft and airport noise reduction [GPO-29-661] CONSTRUCTION INDUSTRY Propelled lighter-than-air vehicles [GPO-43-457] N79-25038 N79-23925 CONSTRUCTION MATÉRIALS The selection of materials technologies for full-scale development --- aircraft engine applications [AIA PAPER 79-1152] A79-38 Research and development activities in Italy in the field of aerospace structures and materials A79-38962 [AGARD-R-675] N79-24202 CONTANINATION Water absorption of fluids/oils --- contamination of aircraft engine oils and inhibitors [AD-A065915] N79-24158 CONTINUITY (MATHEMATICS) A vector-continuous loading concept for aerodynamic panel methods [NASA-TH-80104] N79-24956 CONTINUOUS WAVE RADAR Evaluation of an FM/CW range measurement system for VTOL landing A79-36086

CONTROL CONFIGURED VEHICLES Control considerations for CCV fighters at high angles of attack 179-37295 CONTROL EQUIPMENT AMES/TA-7C control and display interface [AD-A067219] N79-24992 CONTROL SINULATION Sidestick/Throttle Controller - An alternate approach A79-38476 An aircraft simulation using a product of exponentials as matrizant A79-38885 CONTROL STABILITY ßffects of a spin chute installation on spin characteristics --- of light general aviation aircraft [SAE PAPER 790564] A79-36705 CONTROL STICKS Sidestick/Throttle Controller - An alternate approach A79-38476 CONTROL SURPACES Some theoretical considerations of a stall proof airplane [SAE PAPER 790604] A79-36736 Pactors influencing the accuracy of aerodynamic hirge-moment prediction [AD-A066606] N79-24965 CONTROL TREORY Active control for the Total-In-Flight simulator (ACTIPS) [NASA-CR-3118] N79-23978 Inalysis of digital flight control systems with flying qualities applications. Volume 1: Executive summary [AD-A066809] N79-25035 CONTROLLABILITY Frecision controllability of the F-15 airplane [NASA-TH-72861] N79-23979 proceedings of APFDL Flying Qualities Symposium [AD-A066493] CONVECTIVE HEAT TRANSFER N79-24982 Transient ablation of Teflon in intense radiative and convective environments A79-38123 COOLING SYSTEMS Lower avionic temperature - Lower life cycle cost A79-39914 A cooling system for an aircraft having a cruise range from Mach 2 to Mach 8 [NASA-CASE-LAR-12406-1] N79-2 179-24980 CORNER FLOW Influence of the flow angle on the characteristics of an elbow-shaped air intake --- of gas turbine engines 179-36585 CORROSION PREVENTION Internally coated air-cooled gas turbine blading [NASA-CR-159574] N79-2 N79-25018 filterability study of corrosion inhibited JP-4 179-25247 TAD-A0668871 COSHIC BAY SHOWERS Observation of atmospheric interactions at aeroplane altitude --- gamma ray emulsion experiments 179-37573 COSMIC RAYS Vertical cutoff rigidity and the intensity distribution of cosmic rays near Cape Town A79-37468 COST ANALYSIS The results of synthesizing and evaluating potential solutions for Multi-Punction Inertial Reference Assembly /MIRA/ candidate configurations -- for transport and fighter aircraft A79-36082 Air Force Space Laser Communications A79-38706 Diagnostics of wear in aeronautical systems A79-39805 Avionics standardization potential analysis [AD-A066138] N79-23958 COST BFFECTIVEBESS The selection of materials technologies for full-scale development --- aircraft engine applications [AIAA PAPER 79-1152] N79-38962

SUBJECT INDEX

Payback period - An engineering cost/benefit method -- for aircraft engines [AIAA PAPER 79-1235] A79-Peasibility and cost effectiveness of airborne tire pressure indicating systems [AD-A065513] N79-179-39817 N79-24981 COST ESTIMATES Effect of maintenince plan and engine durability on helicopter propulsion system ownership cost [AIAA PAPER 79-1317] A79-3 A79-39033 The production function and airframe cost estimation [AD-A065570] N79-23952 COST REDUCTION Computer graphics create the new wave of design 179-37046 Cost benefits from improved hot section life prediction technology --- for aircraft engine combustor and turbine parts [AIAA PAPER 79-1154] A79-38963 Damage tolerant design - An approach to reducing the life cycle cost of gas turbine engine disks [AIAA PAPER 79-1189] A79-38 The monorotor gas turbine [AIAA PAPER 79-1230] A79-38 CRACK INITIATION A79-38976 A79-38994 Pretting fatigue, with reference to aircraft structures [SAE PAPER 790612] CRACK PROPAGATION A79-36741 Pretting fatigue, with reference to aircraft structures [SAE PAPER 790612] A79-36741 The influence of fleet variability on crack growth tracking procedures for transport/bomber aircraft [AD-A066596] N79-2543 N79-25433 CRASHES Nonlinear structural crash dynamics analyses [SAE PAPER 790588] A79 Experimental verification of program KRASH - A A79-36722 mathematical model for general aviation structural crash dynamics [SAE PAPER 790589] A79-36723 Seat/Occupant crash dynamic analysis verification test program [SAE PAPER 790590] A79-36 Crash-resistant fuel systems for general aviation A79-36724 aircraft [SAE PAPER 790592] CREEP PROPERTIES A79-36726 The strainrange partitioning behavior of an advanced gas turbine disk alloy, AF2-1DA [AIAA PAPER 79-1192] CRUCIFORM WINGS x79-38977 Supersonic flow in the area of antisymmetric thin cruciform wings with supersonic leading edges in a horizontal plane, with consideration of flow separation on the edges [AD-A065993] N79-23929 CROISING FLIGHT Recent results obtained with a new method for measuring aircraft power and drag in flight [SAE PAPER 790616] A79-36744 [SAL PAPER 750010] CRIGEBUIC WIND TUBBELS Aeroelastic models for cryogenic wind tunnels [ONERA, TP NO. 1979-39] Balance and sting design for cryogenic wind tunnels [ONERA, TP NO. 1979-40] A79-39089 CYCLIC LOADS A79-39088 A79-39089 Pretting fatigue, with reference to aircraft structures [SAE PAPER 790612] A79-36741

D

DASSAULT AIRCRAFT Dassault-Breguet - The Mirage 2000 A79-36974 DATA BASES A review of the 3H data base for fault-tolerant system incentives --- communication networks [AD-A066697] N79-24990 DATA LINKS Air Force Space Laser Communications A79-38706 DATA PROCESSING Application of parameter identification techniques to analysis of flight data A79-37735

Processing of airborne reconnaissance data for in-flight display and near real-time transmission [AGARD-AR-135] 179-24993 The application of structured design and distributed techniques to avionics information processing architectures 879-25991 DATA REDUCTION Application of advanced data reduction methods to gas turbine dynamic analysis A79-36024 Propeller aircraft noise around general aviation airports [SAE PAPER 790594] DATA SHOOTHING A79-36728 A computer program for double sweep optimal smoothing [AD-A0665121 N79-25278 DATA SYSTERS An optical-fiber multiterminal data system for aircraft A79-36484 Avionics technology for tactical data handling N79-25979 DATA TRANSMISSION An optical-fiber multiterminal data system for aircraft A79-36484 DEAD RECKONING Stability analysis of relative navigation systems --- TDMA system for multi-member aircraft communities A79-36090 DEFECTS Definition and non-destructive detection of critical adhesive bond-line flaws [AD-A065584] N79-24163 DEFENSE PROGRAM Development of an airborne military system (MRCA system) T MBB-UPE-1322-01 N79-23904 DEFLECTORS Static test of a large scale swivel nozzle thrust deflector **FAIAA PAPER 79-12851** 179-39020 DEICERS Formulation of empirical formulas for calculating the hydraulic resistance of networks -aircraft deicing and air-conditioning systems A79-36593 Aircon electrically heated acrylic --- for ice formation prevention on alloraft transparencies [SAE PAPER 790600] A79-36 A79-36732 DESIGN ANALYSIS Design of quiet efficient propellers [SAE PAPER 790584] 179-36719 Lean, premixed, prevaporized combustor conceptual design study N79-25013 Lean, premixed, prevaporized combustor conceptual design study N79-25014 DTAGNOSTS Diagnostics of wear in aeronautical systems [NASA-TH-79185] N79-24350 DIFFRACTION High frequency near field scattering by an elliptic disk [AD-A065586] N79-24214 DIFFUSION Model diffuser investigation for propulsion wind tunnel 16T [AD-A065822] 179-23984 DIGITÀL COMMAND SYSTEMS Informativeness and effectiveness of digital command-generating devices --- flight vehicle onboard computers A79-36588 Evaluation of a digital helicopter control system --- B0-105 helicopter [HBB-0PE-1349-0] R79-23980 DIGITAL COMPUTERS A general aviation flight test application of the on-board computer [SAE PAPER 790583] 179-36718 Aultifunction keyboard implementation study [AD-A066140] N79-25046

DIGITAL NAVIGATION Hyperbolic positioning per se is passe --navigation computations from range measurements using microprocessor A79-36070 Recent results in navigation systems utilizing signal aiding from Navstar satellites 179-36096 Capturing and tracking performance of the horizontal guidance and control systems of the terminal configured vehicle [NASA-TH-80068] N79-2 N79-25034 DIGITÀL SYSTEMS Application of digital controls on the quiet clean short haul experimental engines [AIAA PAPER 79-1203] A79-389 A79-38984 RELSIN-A systems reliability simulation code A79-39900 LAR: A digital computer program for simulating VSTOL aircraft launch and recovery from small VOLAR: ships. Volume 1: Program description [AD-A066172] N79-23954 Analysis of digital flight control systems with flying qualities applications. Volume 1: Executive summary [AD-A066809] N79-25035 Analysis of digital flight control systems with flying qualities applications. Volume 2: Technical report [AD-A067177] DIRECT POWER GENERATORS N79-25036 Analytical modeling of the dynamics of brushless dc motors for aerospace applications: conceptual framework [NASA-TH-80445] N79~25310 DIRECTIONAL SOLIDIFICATION (CRYSTALS) Directionally solidified blades - Greater strength 179~36248 DISPLAY DEVICES A system for providing an integrated display of instantaneous information relative to aircraft attitude, heading, altitude, and horizontal situation NASA-CASE-FRC-11005-1] N79~24988 Color display design guide [AD-A066630] N79-24991 AAES/TA-7C control and display interface [AD-A067219] 879-24992 Processing of airborne reconnaissance data for in-flight display and near real-time transmission [AGARD~AR- 135] N79~24993 Design of an off-axis wide field-of-view visual display system for flight simulators AD-A066530] 879-25044 Multifunction keyboard implementation study N79-25046 [AD-A066140] DISTORTION Combined pressure and temperature distortion effects on internal flow of a turbofan engine [NASA-TM-79136] N79-N79-23963 Effect of steady-state pressure distortion on flow characteristics entering a turbofan engine N79-23969 [NASA-TH-79134] Blast induced distortion experiments on an engine inlet [AD-A066811] ₩79-25026 DRAG Numerical optimization techniques for bound circulation distribution for minimum induced drag of nonplanar wings: Basic formulations [NASA-CR-3154] N79-23924 DRAG MEASUBBNEBT Recent results obtained with a new method for measuring aircraft power and drag in flight [SAE PAPER 790616] A7 Measurement of the drag of slender cones in 179-36744 hypersonic flow at low Reynolds numbers using a magnetic suspension and balance [OUEL-1235/78] DROME AIRCRAFT N79-23938 Drone formation control system /DPCS/ - A new generation test range system 179-36084 DROP TESTS Nonlinear structural crash dynamics analyses [SAE PAPER 790588] 179-36722 DRY PRICTION Dry friction in the aerospace industry A79-39873

DUCTED PANS

DUCTED FANS Numerical calculation of inviscid transonic flow through rotors and fans N79-23906 Theoretical fan velocity distortions due to inlets and nozzles --- in V/STOL aircraft [NASA-TM-79150] N79-23911 DURABILITY Bonding and durability --- for airframe structures [SAE PAPER 790561] A79-36702 DYNAMIC CHARACTERISTICS Experimental data on the dynamic properties of several propeller vanes --- turbulence measurement in wind tunnel A79-38943 DYNABIC HODELS Model verification of force determination for measuring vibratory loads --- of rotors on helicopters 179-36379 The dynamics of a general aviation pilot promotion campaign 179-38886 DYNAMIC RESPONSE The analysis of propellers including interaction effects --- for general aviation aircraft [SAE PAPER 790576] A79-3 Nonlinear structural crash dynamics analyses A79-36712 [SAE PAPER 790588] 179-36722 DYNAMIC STABILITY Technical evaluation report on the Fluid Dynamics Panel Symposium on Dynamic Stability parameters [AGARD-AR-137] N79-23981 DYNAHIC STRUCTURAL ANALYSIS Nonlinear structural crash dynamics analyses [S&E PAPER 790588] Aircraft sonic boom: Effects on buildings. bibliography with abstracts [NTIS/PS-79/0265/3] DYNAUC TESTS A79-36722 Effects on buildings. A N79-24201 Application of advanced data reduction methods to gas turbine dynamic analysis A79-36024 Dynamic evaluation of experimental integral fuel-tank sealants, part 2 F AD-A0665921 N79-25236

E

ECONOMIC ANALYSIS	
Payback period - An engineering cost/benef	it method
for aircraft engines	
[AIAA PAPER 79-1235]	A79-39817
BCONONIC PACTORS	
New opportunities for future small civil t	urbine
engines - Overviewing the GATE studies	
[SAE PAPER 790619]	A79-36747
EDDY VISCOSITY	
A method for the calculation of 3D boundar	y layers
on practical wing configurations	
	A79-38906
EJECTORS	
Evaluation of an ejector-powered engine si	mulator
at transonic Mach numbers	
[AIAA PAPER 79-1165]	A79-38967
BLASTONERS	
Dynamic evaluation of experimental integra	1
fuel-tank sealants, part 2	
[AD-A066592]	N79-2523.6
ELECTRIC IGNITION	
Dual breakerless aircraft magneto	
[SAE PAPER 790606]	A79-36738
ELECTRIC HOTORS	
Electromechanical actuation for business a	
[SAE PAPER 790622]	A79-36750
ELECTRIC POTENTIAL	
Identification of voltage transients on ai	rcraft
cabling under LTA excitation Lightni	ng
Transient Analysis	
	A79-38531
ELECTRIC PROPULSION	
Electric propulsion for high performance 1	ight
aircraft	
[AIAA PAPER 79-1265]	A79-39011
BLECTROMAGNETIC COMPATIBILITY	
Composite forward fuselage systems integra	tion,
volume 2 effects of lightning	
[AD-A066560]	N79-24984

A79-37238 BLECTROMAGNETIC SCATTERING High frequency near field scattering by an ellıptic disk [AD-A055586] N79-242 An asymptotic result for the scattering of a plane N79-24214 wave by a smooth convex cylinder [AD-A065588] BLECTROMECHANICAL DEVICES \$79-24229 Electromechanical actuation for business aircraft [SAE PAPER 790622] A79-36 A79-36750 A comparison of hydraulic, pneumatic, and electro-mechanical actuators for general aviation flight controls [SAE PAPER 790623] 179-36751 The operational impact of Navy's first TAAP program --- P-3C Test, Analyze and Fix 179-39890 Analytical modeling of the dynamics of brushless dc motors for aerospace applications: A conceptual framework [NASA-TH-80445] N79-25310 ELECTRON BRAN WELDING Application of electron-beam welding to aviation production --- tests of turbine engine parts welded by electron beam N79-24940 ELECTRONIC CONTROL Fault-tolerant, high reliability electronic engine Control system [AIAA PAPER 79-1202] 179-38983 An electric control for an electrohydraulic active control aircraft landing gear [NASA-CR-3113] N79-23948 BLECTRONIC COUNTERNEASURES The intercept of covert radar A79-38132 ELECTRONIC EQUIPMENT F-18 - A special report A79-38131 ELECTRONIC BOUIPHENT TESTS Electronic system safety - Testing reality --- for avionics [SAE PAPER 790570] A79-36710 BLECTRONIC FILTERS A navigation filter for an integrated GPS/JTIDS/INS system for a tactical aircraft ---Joint Tactical Information Distribution System A79-36087 REFECTROSTATIC CHARGE Method of assessment of the antistatic protection of aircraft [ONERA, TP NO. 1979-41] ELECTROSTATICS A79-39090 Factors affecting electrostatic hazards [AD-A066927] ₩79-25245 BHULSIONS Formation of water-fuel emulsions in tanks of grounded aircraft A79-36587 ENGINE CONTROL Selection of aircraft turbocharger systems [SAE PAPER 790608] A79-36739 Fault-tolerant, high reliability electronic engine control system [AIAA PAPEB 79-1202] A79-389 Application of digital controls on the quiet clean A79-38983 ATAN PAPER 79-1203] A streamlined control system development process A79-38984 --- to optimize aircraft propulsion system performance [AIAA PAPER 79-1344] A79-39048 ENGINE DESIGN Industry seeks lighter aircraft weight --aircraft design performance A79-36100 Manufacturers developing fuel-efficient engines A79-36380 Allowing for the wall boundary layer in an axial compressor stage

A79-36586

SUBJECT INDEX

The estimation of induced-voltage peak magnitude and energy level under LTA/KHP excitation of low-loss aircraft cabling --- Lightning Transit Analysis/Electro-Magnetic Pulse

ELECTROMAGNETIC PULSES

SUBJECT INDEX

BEVIRONEENTAL TESTS

Preliminary QCGAT program test results Quiet,	
Clean General Aviation Turbofan	_
[SAE PAPER 790596] A79-3672	3
New technologies for general aviation aircraft	_
[SAE PAPER 790613] A79-36742	2
Rolls-Royce RB.401-07 turbofan engine for business	
aircraft in the 1980's	
[SAE PAPER 790620] A79-36741	5
Wind tunnel performance of four energy efficient	
propellers designed for Mach 0.8 cruise	
[SAE PAPER 790573] A79-36759	,
The evaluation of the weight of engine	
installations on transport aircraft A79-3782	
	'
Damage-tolerant fan blade design	•
[AIAA PAPER 79-1119] A79-3895	
Propulsion system sensitivities for a strategic aircraft	
[AIAA PAPER 79-1121] A79-38952	2
The multiple application core engine - Sizing and	
usage criteria high-pressure rotors in jet	
engines [AIAA PAPER 79-1123]	
[AIAA PAPER 79-1123] A79-3895: The selection of materials technologies for	,
full-scale development aircraft engine applications	
[AIAA PAPER 79-1152] A79-38962	,
	•
General aviation turbine engine /GATE/ concepts [AIAA PAPER 79-1157] A79-38964	
	,
A novel correlation of centrifugal compressor performance for off-design prediction	
	-
[AIAA PAPER 79-1159] A79-38965	,
Turbo-fan design for general aviation - The	
evolution of the RB.401	
[AIAA PAPER 79-1160] A79-38960	2
Aircraft engine design using experimental stress	
analysis techniques	
[AIAA PAPER 79-1193] A79-38978	>
What small turbine engine does the small believed on the second of the second second to bell is named	
helicopter need, or The road to hell is paved with good intentions fuel consumption,	
performance, environmental and engine	
reliability and acceptability considerations	
subordinating advanced turbine engine	
development for small helicopters	
[AIAA PAPER 79-1314] A79-39032	2
Lean, premixed, prevaporized combustion for	•
Lean, premixed, prevaporized combustion for aircraft gas turbine engines	
[AIAA PAPER 79-1318] A79-39034	ŧ
The application of the Prop-Pan concept in	
preliminary design of a very advanced technology	
light twin /VATLIT '85/	
[AIAA PAPER 79-1343] A79-3904	,
A streamlined control system development process	
to optimize aircraft propulsion system	
performance	
[AIAA PAPER 79-1344] A79-39048	3
Contribution to the development of motor emission	
regulations	
[ONERA, TP NO. 1979-43] A79-39092	2
[ONERA, TP NO. 1979-43] A79-39092 Materials and structural aspects of advanced	
gas-turbine helicopter engines	
A79-39804	ł
Payback period - An engineering cost/benefit method	
for aircraft engines	_
[AIAA PAPER 79-1235] A79-3981	,
Advanced low emissions catalytic combustor program at General Electric	
N79-2501	
Advanced low emissions catalytic combustor program	
at Pratt and Whitney	
N79-25012	2
Lean, premixed, prevaporized combustor conceptual	
design study	_
N79-2501	5
Lean, premixed, prevaporized combustor conceptual	
design study	_
N79-25014	ł
Design study and performance analysis of a	
high-speed multistage variable-geometry fan for	
a variable cycle engine	
[NASA-CR-159545] N79-25020	,
BNGINE PAILURE	
Effects of steady-state pressure distortion on the stall margin of a 185-21 turboist engine	
stall margın of a J85-21 turbojet engine [NASA-TM-79123] N79-23968	
	,

ENGINE INLETS	
Aerodynamıc problems ın engine aırframe	
integration on fighter airplanes	# 70 33036
[MBB-UPE-1359-0] Self stabilizing sonic inlet	N79-23936
[NASA-CASE-LEW-11890-1]	N79-24976
Blast induced distortion experiments on an	engine
inlet [AD-A066811]	₩79-25026
ENGINE MONITORING INSTRUMENTS	119 25020
A European view on gas turbine engine moni	toring
of present and future civil aircraft	170-20002
[AIAA PAPER 79-1200] Diagnostics of wear in aeronautical system	A79-38982
-	A79-39805
ENGINE NOISE	
Propeller aircraft noise around general av airports	141101
[SAE PAPER 790594]	A79-36728
ENGINE PARTS	£-
Cost benefits from improved hot section li prediction technology for aircraft e	re naine
combustor and turbine parts	
[AIAA PAPER 79-1154]	A79-38963
Small hole drilling and inspection with pu laser systems in air-cooled aircraft	
structures	engane
[AIAA PAPER 79-1268]	A79-39012
ENGINE STARTERS A starter for gas turbine engines	
A Statter for gas turbine engines	A79-36797
ENGINE TESTS	
Application of advanced data reduction met	hods to
gas turbine dynamıc analysıs	A79-36024
A review of Curtiss-Wright rotary engine	
developments with respect to general avi	ation
potential [SAE PAPER 790621]	A79-36749
Engine induced structural-borne noise in a	
aviation aircraft	170 26750
[SAE PAPER 790626] Detonation characteristics of Soviet GOST	A79-36754 1012-72
aviation gasoline	
[SAE PAPER 790630]	∆79-36757
High level maintenance below sea level	∆79-38825
Test verification of a turbofan partial sw	
	111
afterburner	
[AIAA PAPER 79-1199]	A79-38981
	A79-38981 rocess
[AIAA PAPER 79-1199] A streamlined control system development p to optimize arrcraft propulsion syst performance	A79-38981 rocess em
[AIAA PAPER 79-1199] A streamlined control system development p to optimize arccaft propulsion syst performance [AIAA PAPER 79-1344]	A79-38981 rocess em A79-39048
[AIAA PAPER 79-1199] A streamlined control system development p to optimize arccraft propulsion syst performance [AIAA PAPER 79-1344] Bultivariable control altitude demonstrati the F100 turbofan engine	A79-38981 rocess em A79-39048 on on
[AIAA PAPER 79-1199] A streamlined control system development p to optimize arcraft propulsion syst performance [AIAA PAPER 79-1344] Multivariable control altitude demonstrati the F100 turbofan engine [AIAA PAPER 79-1204]	A79-38981 rocess em A79-39048 on on A79-39814
[AIAA PAPER 79-1199] A streamlined control system development p to optimize aırcraft propulsıon syst performance [AIAA PAPER 79-1344] Multvariable control altitude demonstratı the F100 turbofan engine [AIAA PAPER 79-1204] Turbulence characteristics of compressor d	A79-38981 rocess em A79-39048 on on A79-39814
[AIAA PAPER 79-1199] A streamlined control system development p to optimize arccraft propulsion syst performance [AIAA PAPER 79-1344] Multivariable control altitude demonstrati the F100 turbofan engine [AIAA PAPER 79-1204] Turbulence characteristics of compressor d flows JT9D engine tests	A79-38981 rocess em A79-39048 on on A79-39814 ischarge N79-24995
[AIAA PAPER 79-1199] A streamlined control system development p to optimize aırcraft propulsıon syst performance [AIAA PAPER 79-1344] Kultvarıable control altitude demonstratı the F100 turbofan engine [AIAA PAPER 79-1204] Turbulence characteristics of compressor d flows JT9D engine tests Turbulence measurements in the compressor	A79-38981 rocess em A79-39048 on on A79-39814 ischarge N79-24995 exit
[AIAA PAPER 79-1199] A streamlined control system development p to optimize arccraft propulsion syst performance [AIAA PAPER 79-1344] Multivariable control altitude demonstrati the F100 turbofan engine [AIAA PAPER 79-1204] Turbulence characteristics of compressor d flows JT9D engine tests	A79-38981 rocess em A79-39048 on on A79-39814 ischarge N79-24995 exit
<pre>[AIAA PAPER 79-1199] A streamlined control system development p to optimize aırcraft propulsıon syst performance [AIAA PAPER 79-1344] Multvarıable control altitude demonstratı the F100 turbofan engine [AIAA PAPER 79-1204] Turbulence characteristics of compressor d flows JT9D engine tests Turbulence measurements in the compressor flow of a General Electric CF6-50 engine ENGIMEERING MANAGEMENT</pre>	A79-38981 rocess em A79-39048 on on A79-39814 ischarge N79-24995 exit N79-24996
[AIAA PAPER 79-1199] A streamlined control system development p to optimize arccraft propulsion syst performance [AIAA PAPER 79-1344] Multivariable control altitude demonstrati the P100 turbofan engine [AIAA PAPER 79-1204] Turbulence characteristics of compressor d flows JT9D engine tests Turbulence measurements in the compressor flow of a General Electric CF6-50 engine EMGINEERING MANAGEMENT The test pilot in the airline industry or	A79-38981 rocess em A79-39048 on on A79-39814 ischarge N79-24995 exit N79-24996
<pre>[AIAA PAPER 79-1199] A streamlined control system development p to optimize aırcraft propulsıon syst performance [AIAA PAPER 79-1344] Multvarıable control altitude demonstratı the F100 turbofan engine [AIAA PAPER 79-1204] Turbulence characteristics of compressor d flows JT9D engine tests Turbulence measurements in the compressor flow of a General Electric CF6-50 engine ENGIMEERING MANAGEMENT</pre>	A79-38981 rocess em A79-39048 on on A79-39814 ischarge N79-24995 exit N79-24996 'Hy bags
[AIAA PAPER 79-1199] A streamlined control system development p to optimize arccraft propulsion syst performance [AIAA PAPER 79-1344] Multivariable control altitude demonstrati the P100 turbofan engine [AIAA PAPER 79-1204] Turbulence characteristics of compressor d flows JT9D engine tests Turbulence measurements in the compressor flow of a General Electric CF6-50 engine EMGINEERING MANAGEMENT The test pilot in the airline industry or	A79-38981 rocess em A79-39048 on on A79-39814 ischarge N79-24995 exit N79-24996
<pre>[AIAA PAPER 79-1199] A streamlined control system development p to optimize arccraft propulsion syst performance [AIAA PAPER 79-1344] Sultivariable control altitude demonstrati the P100 turbofan engine [AIAA PAPER 79-1204] Turbulence characteristics of compressor d flows JT9D engine tests Turbulence measurements in the compressor flow of a General Electric CF6-50 engine ENGINEERING MANAGEMENT The test pilot in the airline industry or are packed and I'm ready to go' ENGINES Advanced General Aviation Turbine Engine (</pre>	A79-38981 rocess em A79-39048 on on A79-39814 ischarge N79-24995 exit N79-24996 'My bags A79-38478
[AIAA PAPER 79-1199] A streamlined control system development p to optimize aırcraft propulsion syst performance [AIAA PAPER 79-1344] Multvariable control altitude demonstrati the F100 turbofan engine [AIAA PAPER 79-1204] Turbulence characteristics of compressor d flows JT9D engine tests Turbulence measurements in the compressor flow of a General Electric CP6-50 engine ENGINEERING MANAGEMENT The test pilot in the airline industry or are packed and I'm ready to go' ENGINES Advanced General Aviation Turbine Engine (concepts	A79-38981 rocess en A79-39048 on on A79-39814 ischarge N79-24995 exit N79-24996 'Hy bags A79-38478 GATE)
<pre>[AIAA PAPER 79-1199] A streamlined control system development p to optimize arccraft propulsion syst performance [AIAA PAPER 79-1344] Sultivariable control altitude demonstrati the P100 turbofan engine [AIAA PAPER 79-1204] Turbulence characteristics of compressor d flows JT9D engine tests Turbulence measurements in the compressor flow of a General Electric CF6-50 engine ENGINEERING MANAGEMENT The test pilot in the airline industry or are packed and I'm ready to go' ENGINES Advanced General Aviation Turbine Engine (</pre>	A79-38981 rocess em A79-39048 on on A79-39814 ischarge N79-24995 exit N79-24996 'My bags A79-38478
<pre>[AIAA PAPER 79-1199] A streamlined control system development p to optimize aırcraft propulsion syst performance [AIAA PAPER 79-1344] Bultvariable control altitude demonstrati the F100 turbofan engine [AIAA PAPER 79-1204] Turbulence characteristics of compressor d flows JT9D engine tests Turbulence measurements in the compressor flow of a General Electric CP6-50 engine ENGINEERING MANAGEMENT The test pilot in the airline industry or are packed and I'm ready to go' ENGINES Advanced General Aviation Turbine Engine (concepts [NASA-CE-159603] ENVIRONMENT SIMULATION The McDonnell Aircraft Company Lightning</pre>	A79-38981 rocess en A79-39048 on on A79-39814 ischarge N79-24995 exit N79-24996 'Hy bags A79-38478 GATE)
<pre>[AIAA PAPER 79-1199] A streamlined control system development p to optimize arccraft propulsion syst performance [AIAA PAPER 79-1344] Multivariable control altitude demonstrati the P100 turbofan engine [AIAA PAPER 79-1204] Turbulence characteristics of compressor d flows JT9D engine tests Turbulence measurements in the compressor flow of a General Electric CF6-50 engine ENGINEERING MANAGEMENT The test pilot in the airline industry or are packed and I'm ready to go' ENGINES Advanced General Aviation Turbine Engine (concepts [NASA-CR-159603] ENVIRONMENT SINULATION</pre>	A79-38981 rocess em A79-39048 on on A79-39814 ischarge N79-24995 exit N79-24996 'Hy bags A79-38478 GATE) N79-25017
<pre>[AIAA PAPER 79-1199] A streamlined control system development p to optimize aırcraft propulsion syst performance [AIAA PAPER 79-1344] Bultvariable control altitude demonstrati the F100 turbofan engine [AIAA PAPER 79-1204] Turbulence characteristics of compressor d flows JT9D engine tests Turbulence measurements in the compressor flow of a General Electric CP6-50 engine ENGINEERING MANAGEMENT The test pilot in the airline industry or are packed and I'm ready to go' ENGINES Advanced General Aviation Turbine Engine (concepts [NASA-CE-159603] ENVIRONMENT SIMULATION The McDonnell Aircraft Company Lightning</pre>	A79-38981 rocess en A79-39048 on on A79-39814 ischarge N79-24995 exit N79-24996 'Hy bags A79-38478 GATE)
<pre>[AIAA PAPER 79-1199] A streamlined control system development p to optimize arccraft propulsion syst performance [AIAA PAPER 79-1344] Multivariable control altitude demonstrati the P100 turbofan engine [AIAA PAPER 79-1204] Turbulence characteristics of compressor d flows JT9D engine tests Turbulence measurements in the compressor flow of a General Electric CF6-50 engine ENGINEERING MANAGEMENT The test pilot in the airline industry or are packed and I'm ready to go' ENGINES Advanced General Aviation Turbine Engine (concepts [NASA-CR-159603] ENVIRONMENT SINULATION The McDonnell Aircraft Company Lightning Simulation Laboratory</pre>	A79-38981 rocess em A79-39048 on on A79-39814 ischarge N79-24995 exit N79-24996 'Hy bags A79-38478 GATE) N79-25017 A79-37294 le cost
<pre>[AIAA PAPER 79-1199] A streamlined control system development p to optimize arccraft propulsion syst performance [AIAA PAPER 79-1344] Multivariable control altitude demonstrati the P100 turbofan engine [AIAA PAPER 79-1204] Turbulence characteristics of compressor d flows JT9D engine tests Turbulence measurements in the compressor flow of a General Electric CF6-50 engine ENGINEERING MANAGEMENT The test pilot in the airline industry or are packed and I'm ready to go' ENGINES Advanced General Aviation Turbine Engine (concepts [NASA-CR-159603] ENVIRONMENT SINULATION The McDonnell Aircraft Company Lightning Simulation Laboratory ENVIRONMENTAL CONTROL Lower avionic temperature - Lower life cyce</pre>	A79-38981 rocess em A79-39048 on on A79-39814 ischarge N79-24995 exit N79-24996 'My bags A79-38478 GATE) N79-25017 A79-37294
<pre>[AIAA PAPER 79-1199] A streamlined control system development p to optimize aircraft propulsion syst performance [AIAA PAPER 79-1344] Bultvariable control altitude demonstrati the F100 turbofan engine [AIAA PAPER 79-1204] Turbulence characteristics of compressor d flows JT9D engine tests Turbulence measurements in the compressor flow of a General Electric CP6-50 engine ENGINEERING MANAGEMENT The test pilot in the airline industry or are packed and I'm ready to go' ENGINES Advanced General Aviation Turbine Engine (concepts [NASA-CE-159603] ENVIRONMENT SIMULATION The McDonnell Aircraft Company Lightning Simulation Laboratory ENVIRONMENTAL CONTROL</pre>	A79-38981 rocess em A79-39048 on on A79-39814 ischarge N79-24995 exit N79-24996 'Hy bags A79-38478 GATE) N79-25017 A79-37294 le cost
<pre>[AIAA PAPER 79-1199] A streamlined control system development p to optimize aircraft propulsion syst performance [AIAA PAPER 79-1344] Bultvariable control altitude demonstrati the F100 turbofan engine [AIAA PAPER 79-1204] Turbulence characteristics of compressor d flows JT9D engine tests Turbulence measurements in the compressor flow of a General Electric CP6-50 engine ENGINEERING MANAGEMENT The test pilot in the airline industry or are packed and I'm ready to go' ENGINES Advanced General Aviation Turbine Engine (concepts [NASA-CE-159603] ENVIRONMENT SIMULATION The McDonnell Aircraft Company Lightning Simulation Laboratory ENVIRONMENTAL CONTROL Lower avionic temperature - Lower life cyce ENVIRONMENTAL SURVEYS</pre>	A79-38981 rocess em A79-39048 on on A79-39814 ischarge N79-24995 exit N79-24995 exit N79-24996 'Hy bags A79-38478 GATE) N79-25017 A79-37294 le cost A79-39914
<pre>[AIAA PAPER 79-1199] A streamlined control system development p to optimize aircraft propulsion syst performance [AIAA PAPER 79-1344] Multivariable control altitude demonstrati the F100 turbofan engine [AIAA PAPER 79-1204] Turbulence characteristics of compressor d flows JT9D engine tests Turbulence measurements in the compressor flow of a General Electric CP6-50 engine ENGIMEERING MANAGEMENT The test pilot in the airline industry or are packed and I'm ready to go' ENGIMES Advanced General Aviation Turbine Engine (concepts [NASA-CE-159603] ENVIRONMENT SINULATION The McDonnell Aircraft Company Lightning Simulation Laboratory ENVIRONMENTAL CONTROL Lower avionic temperature - Lower life cyce ENVIRONMENTAL SURVEYS Photovoltaics and environmental impact considerations</pre>	A79-38981 rocess em A79-39048 on on A79-39814 ischarge N79-24995 exit N79-24996 'Hy bags A79-38478 GATE) N79-25017 A79-37294 le cost
<pre>[AIAA PAPER 79-1199] A streamlined control system development p to optimize aircraft propulsion syst performance [AIAA PAPER 79-1344] Multivariable control altitude demonstrati the P100 turbofan engine [AIAA PAPER 79-1204] Turbulence characteristics of compressor d flows JT9D engine tests Turbulence measurements in the compressor flow of a General Electric CP6-50 engine ENGIMEERING MANAGEMENT The test pilot in the airline industry or are packed and I'm ready to go' ENGIMES Advanced General Aviation Turbine Engine (concepts [NASA-CR-159603] ENVIRONMENT SINULATION The McDonnell Aircraft Company Lightning Simulation Laboratory ENVIRONMENTAL CONTROL Lover avionic temperature - Lover life cyc ENVIRONMENTAL SUBVEYS Photovoltaics and environmental impact considerations ENVIRONMENTAL TESTS</pre>	A79-38981 rocess em A79-39048 on on A79-39814 ischarge N79-24995 exit N79-24996 'Hy bags A79-38478 GATE) N79-25017 A79-37294 le cost A79-379914 N79-25496
<pre>[AIAA PAPER 79-1199] A streamlined control system development p to optimize aircraft propulsion syst performance [AIAA PAPER 79-1344] Multivariable control altitude demonstrati the F100 turbofan engine [AIAA PAPER 79-1204] Turbulence characteristics of compressor d flows JT9D engine tests Turbulence measurements in the compressor flow of a General Electric CP6-50 engine ENGIMEERING MANAGEMENT The test pilot in the airline industry or are packed and I'm ready to go' ENGIMES Advanced General Aviation Turbine Engine (concepts [NASA-CE-159603] ENVIRONMENT SINULATION The McDonnell Aircraft Company Lightning Simulation Laboratory ENVIRONMENTAL CONTROL Lower avionic temperature - Lower life cyce ENVIRONMENTAL SURVEYS Photovoltaics and environmental impact considerations</pre>	A79-38981 rocess em A79-39048 on on A79-39814 ischarge N79-24995 exit N79-24995 exit N79-24996 'Hy bags A79-38478 GATE) N79-25017 A79-37294 'le cost A79-39914 N79-25496 ar

EQUATIONS OF NOTION

EQUATIONS OF HOTION An introduction to dynamic derivatives. 2: The equations of motion for wind tunnel pitch-yaw oscillation rigs [ARL-ABBO-NOTE-377] N79-23982 EQUIPMENT SPECIFICATIONS RTCA standards - Improved specs. and regulations --- in avionics equipment A79-39919 RUBOPR Joint Airworthiness Requirements - Their history and progress A79-37149 EUROPEAN AIRBUS Airbus picks up speed - and the junior A310 takes off A79-36774 A European view on gas turbine engine monitoring of present and future civil aircraft [AIAA PAPER 79-1200] EXHAUST PLOW SIMULATION A79-38982 V/STOL aircraft configuration effects on exhaust gas ingestion [AIAA PAPER 79-1284] A79-39019 EXHAUST GASES Concepts for reducing exhaust emissions and fuel consumption of the aircraft piston engine [SAB PAPER 790605] A79-36 Contribution to the development of motor emission A79-36737 regulations [ONERA, TP NO. 1979-43] Effect of degree of fuel vaporization upon A79-39092 emissions for a premixed prevaporized combustion system --- for gas turbine engines [NASA-TM-79154] N79-23965 Two-stage supercharger sets: Efficiency and head distribution under full- and part-load conditions [RTS-11613] N79-24342 Effect of fuel/air nonuniformity on nitric oxide emissions N79-25004 Optical in situ versus probe measurements of nitric oxide concentration as a function of axial position in a combustor exhaust [AD-A067329] N79-25025 Exhaust emissions characteristics for a general aviation light-aircraft Avco Lycoming 10-360-A186D piston engine FAD-A066556] ₹79-25544 Exhaust emissions characteristics for a general aviation light-aircraft Avco-Lycoming 10-360-BiBD piston engine [AD-A066589] N79-25545 Aircraft air pollution emission estimation techniques, ACEE [AD-A067262] N79-25550 Air pollutant emission factors for military and civil aircraft
[PB-292520/4] N79-25567 EXHAUST NOZZLES Effect of shocks on film cooling of a full scale turbojet exhaust nozzle having an external expansion surface [AIAA PAPER 79-1170] A79-38969 EXPANDABLE STRUCTURES Effect of shocks on film cooling of a full scale turbojet exhaust nozzle having an external expansion surface [NASA-TM-79157] EIPONENTIAL FUNCTIONS An aircraft simulation using a product of N79-23966 exponentials as matrizant A79-38885

F

F-5 AIRCRAFT Some observations on the mechanism of aircraft wing rock
A79-38135
P-15 ATRCRAFT
Precision controllability of the F-15 airplane
[NASA-TM-72861] N79-23979
F-16 AIRCRAFT
The F-16 RIW program Reliability Improvement
Warranty
A79-39889

SUBJECT INDEX

Energy maneuverability display validation --- F-16 aircraft [AFFDL-TR-78-35-VOL-1] N79-23947 F-18 AIRCRAFT F-18 - A special report A79-38131 P-111 AIRCRAFT Identification of voltage transients on aircraft cabling under LTA excitation --- Lightning Transient Analysis A79-38531 PATL-SAPR SYSTEMS Reliability, performance, and fault isolation considerations in the design of interconnected navigation systems 179-36077 Fail-safe optimal design of structures with substructuring [AD-A065936] FAILURE ANALYSIS N79-23950 Bonding and durability --- for airframe structures [SAE PAPER 790561] A79-The aircraft air conditioner data revisited ---A79-36702 for comparison of alternative system concepts A79-39895 Development of in-flight steady-state failure rates 179-39912 The effect of endless burn-in on reliability growth projections --- for solid state aviation electronics equipment 179-39920 PAIRCHILD-HILLER AIRCRAFT The Fairchild can-opener - Shturmovik of the eighties A79-36773 FATIGUE (MATERIALS) Pretting fatigue, with reference to aircraft structures [SAE PAPER 790612] 179-36741 Designing with damping materials to reduce noise and structural fatigue --- of aircraft components [SAE PAPER 790631] 179-36758 Definition and non-destructive detection of critical adhesive bond-line flaws [AD-A065584] N79-24163 Non-destructive methods for the early detection of fatigue damage in aircraft components N79-25417 FATIGUE LIFE The strainrange partitioning behavior of an advanced gas turbine disk alloy, AP2-1DA [AIAA PAPER 79-1192] A79-38977 PATIGUE TESTING MACHINES Installation for studying fatigue strength of materials in acoustic loading --- for aircraft skins A79-39070 PEEDBACK CONTROL Multivariable control altitude demonstration on the F100 turbofan engine [NASA-TN-79183] N79-25015 FIBER OPTICS An optical-fiber multiterminal data system for aircraft A79-36484 FIGHTER AIRCRAFT The results of synthesizing and evaluating potential solutions for Hulti-Function Inertial Reference Assembly /HIRA/ candidate configurations --- for transport and fighter aircraft A79-36082 The British Merospace Harrier: Case study in aircraft design --- Book A79-36644 Control considerations for CCV fighters at high angles of attack A79-37295 Reliability and maintainability contribution to Hornet mission success A79-39915 Development of an airborne military system (MRCA system) [MBB-UFE-1322-0] N79-23904 Aerodynamic problems in engine airframe integration on fighter airplanes N79-23936

FILE COOLING Effect of shocks on film cooling of a full scale turbojet exhaust nozzle having an external erpansion surface [AIAA PAPER 79-1170] A79-36 Effect of shocks on film cooling of a full scale 179-38969 turbojet exhaust nozzle having an external expansion surface [NASA-TH-79157] N79-23966 FILTRATION A filterability study of corrosion inhibited JP-4 [AD-A066887 N79-25247 PINITE BLEMENT METHOD Nonlinear structural crash dynamics analyses [SAE PAPER 790588] A79-36722 A/9-367 A finite element method for the computation of the transonic potential flow past airfoils [MBB-UPE-1352-0] N79-239 N79-23935 Airfoil optimization for transonic flow using the methods of finite elements and characteristics [MBB-UFE-1362-0] N79-2 N79-23937 Dynamic structural analysis with substructures [AD-A065937] 179-24378 ANALYZE: Analysis of aerospace structures with membrane elements [AD-A065633] N79-24379 The computation of transonic flow in wind tunnels at inlets and cascades using the finite element method [MBB-UFE-1421-0] N79-24970 PINS Evaluation of ground-launch firings for the improved 2.75-inch rocket [AIAA PAPER 79-1297] A79-39027 Low-speed wind-tunnel investigation of wing fins as trailing-vortex-alleviation devices on a transport airplane model [NASA-TP-1453] N79-24961 PIRE EXTINGUISHERS Puel on fire - Rapid response to a military problem A79-38090 FIRE PREVENTION Crash-resistant fuel systems for general aviation aircraft [SAE PAPER 790592] 179-36726 Survivability in aircraft fires - New standards are needed A79-38091 FLAME HOLDERS Lean stability augmentation for premixing, prevaporizing combustors [AINA PAPER 79-1319] A79-39035 PLANE PROPAGATION Survivability in aircraft fires - New standards are needed A79-38091 The effect of hydrogen addition on ignition delays and flame propagation in spark ignition engines A79-38387 PLAPPING Rotor blade stability in turbulent flows. I A79-38118 PLEXIBLE BINGS Handling qualities of large flexible control-configured aircraft [NASA-CR-158694] N79-25033 PLIGHT CHARACTERISTICS The Learjet 'Longhorn' series - The first jets with winglets [SAE PAPER 790581] A79-367 Application of parameter identification techniques to analysis of flight data A79-36716 A79-37735 Proceedings of AFFDL Flying Qualities Symposium Analysis of digital flight control systems with flying qualities applications flying qualities applications. Volume 1: Executive summary [AD-A066809] N79-Analysis of digital flight control systems with flying qualities applications. Volume 2: N79-25035 Technical report [AD-A067177] N79-25036 PLIGHT CONDITIONS An improved method for predicting the effects of flight on jet mixing noise A79-39803

FLIGHT CONTROL The results of synthesizing and evaluating potential solutions for Multi-Punction Inertial Reference Assembly /MIRA/ candidate configurations --- for transport and fighter aircraft A79-36082 Effects of a spin chute installation on spin characteristics --- of light general aviation alfcraft [SAE PAPER 790564] 179-36705 Electromechanical actuation for business aircraft [SAE PAPER 790622] A79-36750 A comparison of hydraulic, pneumatic, and electro-mechanical actuators for general aviation flight controls [SAE PAPER 790623] A79-30 Technical evaluation report on the 27th Guidance and Control Panel Symposium on the V/STOL Aircraft at Night and in Poor Visibility 179-36751 [AGARD-AR-142] N79-23946 Handling qualities of large flexible control-configured arcraft [NASA-CR-158694] N79-25033 Indysis of digital flight control systems with flying gualities applications. Volume 1: Executive summary [AD-A066809] N79-25035 Analysis of digital flight control systems with flying qualities applications. Volume 2: Technical report [AD-A067177] N79-25036 Technical evaluation report on the 25th Guidance and Control Panel Symposium on guidance and Control Design Considerations for Low Altitude and Terminal Area Flight [AGARD-AR-129] N79-25037 FLIGHT HAZARDS Safety hazard of aircraft 1cing N79-23916 PLIGHT INSTRUMENTS. The application of microprocessor technology to in-flight computation N79-23902 Energy maneuverability display validation --- P-16 aircraft [AFFDL-TR-78-35-VOL-1] N79-23947 Processing of airborne reconnaissance data for in-flight display and near real-time transmission [AGARD-AR-135] N79-24993 N79-24993 PLIGHT SIMULATION Control considerations for CCV fighters at high angles of attack A79-37295 A wind shear/downdraft drift angle warning system A79-38477 An aircraft simulation using a product of exponentials as matrizant A79-38885 Effects of steady-state pressure distortion on the stall margin of a J85-21 turbojet engine [NASA-TH-79123] N79-23968 A simplified rotor system mathematical model for piloted flight dynamics simulation [NASA-TH-78575] N79-23977 Motion in flight simulation: An annotated bibliography [AD-A061687] Multifunction keyboard implementation study N79-25042 [AD-A066140] N79-25046 FLIGHT STRULATORS Sidestick/Throttle Controller - An alternate approach A79-38476 Active control for the Total-In-Plight simulator (ACTTES) [NSSA-CR-3118] N79-23 An evaluation of turn anticipation techniques and N79-23978 offset flying procedures using a single-waypoint RNAN System [AD-1066555] N79-24974 AAES laboratory simulator requirements (A~7 alrcraft) [AD-A066393] N79~25041 Optimal placement of regional flight simulators Les louvesoj N79-; Design of an off-aris wide field-of-view visual display system for flight simulators [AD-A066530] N79-3 [AD-A060450] N79-25043 N79-25044

FLIGHT TEST INSTRUMENTS A general aviation flight test application of the on-board computer [SAE PAPER 790583] A79-36718 PLIGHT TESTS Spin flight research summary [SAE PAPEE 790565] Canadair Challenger flight test status A79-36706 [SAE PAPER 790602] A79-36734 A new light twin using bonded metal construction [SAE PAPER 790603] A79-30 A79-36735 A unique facility for V/STOL aircraft hover testing A79-37296 The test pilot in the airline industry or 'Ny bags are packed and I'm ready to go' A79-38478 Project Sunrise --- solar-powered aircraft flight demonstration [AIAA PAPER 79-1264] A79-39010 Polar lift and drag determination during flight tests [MBB-UFE-1410-0] N79-24986 Determination of subcritical frequency and damping from B-1 flight flutter test data [NASA-CP-3152] N79-25426 FLIGHT VEHICLES Informativeness and effectiveness of digital command-generating devices --- flight vehicle onboard computers A79-36588 FLORTON Ground winds for Kennedy Space Center, Florida, 1979 revision [NASA-TH-78229] FLOW CHARACTERISTICS ¥79-25662 () CHARACTERISTICS Determination of cooling air mass flow for a horizontally-opposed aircraft engine installation [SAE PAPER 790609] Effect of steady-state pressure distortion on flow characteristics entering a turbofan engine (The state of steady-state) a state of a state of steady-state characteristics entering a state of a state of a state of steady-state (The state of steady-state pressure distortion on flow characteristics entering a state of a state of a state of a state (The state of steady-state of a state of a 179-36740 N79-23969 [NASA-TM-79134] Turbulence characteristics of compressor discharge flows --- JT9D engine tests N79-24995 Turbulence measurements in the compressor exit flow of a General Electric CF6-50 engine N79-24996 FLOW DISTORTION Combined pressure and temperature distortion effects on internal flow of a turbofan engine [ATAN PAPER 79-1309] A79-33 Method of determining non-steady-state force characteristics and flywheel effect of turbine blades from the streamflow pattern Å79-39031 A79-39071 Effects of steady-state pressure distortion on the stall margin of a J85-21 turbojet engine [NSA-TH-79123] N79-239 N79-23968 FLOW DISTRIBUTION Investigation of a laser Doppler velocimeter system to measure the flow field of a large scale V/STOL aircraft in ground effect [AIAA PAPER 79-1184] A75 A79-38974 [ATAA PAPER 79-104] The role of three-dimensional flow analysis in the design of turbomachinery [ATAA PAPER 79-1231] Analysis of an unsteady aerodynamic force on a 179-38995 blade due to ununiform amplitude gusts 179-39059 FLOW GBOMETRY Optimal selection of the geometrical characteristics of the reversing channel of a small-scale turbine with readmission of the gas --- for aircraft auxiliary power systems 179-36583 Influence of the flow angle on the characteristics of an elbow-shaped air intake --- of gas turbine engines A79-36585 The 'cloud-in-cell' technique applied to the roll up of vortex sheets N79-37725 Profiling of two-dimensional and three-dimensional nozzles and calculation of their flows A79-38168 FLOW MEASUREMENT Experimental analysis methods for unsteady flows in turbomachines

[ONERA, TP NO. 1979-59]

SUBJECT INDEX

FLOW RESTSTANCE Formulation of empirical formulas for calculating the hydraulic resistance of networks ---aircraft deicing and air-conditioning systems A79-36593 FLOW THEORY Lectures on hydroaeromechanics --- Russian book 179-36347 PLOW VRLOCITY Velocity slip and temperature difference of gas mixtures in quasi-one-dimensional nozzle flows A79-36423 Turbulent wake measurements with a laser velocimeter [AIAA PAPER 79-1087] A79-38058 PLOW VISUALIZATION Making fluid flows visible A79-36373 PLUID DYNAMICS. Radial equilibrium in axial turbomachines A79-37828 Aerodynamics [NASA-TT-F-765] PLUID PLOW N79-23908 Lectures on hydroaeromechanics --- Russian book A79-36347 PLUID BECHANICS Aerodynamics [NASA-TT-F-765] N79-23908 PLUTTER ANALYSIS Aeroelastic stability analysis of the AD-1 manned oblique-wing aircraft A79-38136 Determination of subcritical frequency and damping from B-1 flight flutter test data [NASA-CR-3152] N79-25426 FLY BY WIRE CONTROL Fault-tolerant, high reliability electronic engine control system [AIAA PAPER 79-1202] A79-38983 FORGING Advanced forging process for gas turbine engine fan blades [AIAA PAPER 79-1269] 179-39013 FOSSIL FUELS Fossil fuel heat pumps for domestic, commercial and industrial space heating A79-37852 FRACTURE STRENGTH Damage tolerant design - An approach to reducing the life cycle cost of gas turbine engine disks [AIAA PAPER 79-1189] A79-38 179-38976 FRANES User's guide: Computer program with interactive graphics for analysis of plane frame structures (CFRAME) [AD-A067349] N79-25428 FREE FLIGHT The science and technology of low speed and motorless flight, part 1 [NASA-CP-2085] N79-23889 FREE JETS Velocity slip and temperature difference of gas mixtures in quasi-one-dimensional nozzle flows A79-36423 Application of Laser Doppler Anemometry to aeroacoustic research A79-39500 FREE MOLECULAR PLOW Profile of a nozzle shaping the free-molecule flow intended to investigate air-intakes and cascades A79-36122 FREEZING Design and evaluation of aircraft heat source systems for use with high-freezing point fuels [NASA-CR-159568] N79-2 879-24172 PREQUENCIES Optimum frequencies for aircraft classification [AD-A065697] N79-24220 PRETTING Fretting fatigue, with reference to aircraft structures [SAE PAPER 790612] 179-36741 PRICTION FACTOR A tire runway interface friction prediction model concept A79-38137

179-39095

GAS TURBINE ENGINES

PUEL COMBUSTION Detonation characteristics of Soviet GOST 1012-72 aviation gasoline 179-36757 [SAE PAPER 790630] Possil fuel heat pumps for domestic, commercial and industrial space heating A79-37852 The effect of hydrogen addition on ignition delays and flame propagation in spark ignition engines 179-38387 Ignition of liquid fuel jets in a supersonic air stream [AIAA PAPER 79-1238] A79-38997 [NASA-CP-2078] R79-2 879-24994 Autoignition of fuels N79-25001 Effect of fuel/air nonuniformity on mitric oxide emissions 179-25004 FUEL CONSUMPTION Manufacturers developing fuel-efficient engines 179-36380 Concepts for reducing exhaust emissions and fuel consumption of the aircraft piston engine [SAE PAPER 790605] 179-36737 Changing requirements in aircraft design A79-37044 Turbo-fan design for general aviation - The evolution of the RB.401 [AIAA PAPER 79-1160] 179-38966 FUEL CONTAMINATION Pormation of water-fuel emulsions in tanks of grounded aircraft A79-36587 FUEL FLOW REGULATORS Lean stability augmentation for premixing, prevaporizing combustors [AIAA PAPER 79-1319] A79-39035 FUEL INJECTION The effect of hydrogen addition on ignition delays and flame propagation in spark ignition engines A79~38387 Ignition of liquid fuel jets in a supersonic air stream [AIAA PAPER 79-1238] A79-38997 Autoignition of hydrogen injected transverse to a supersonic airstream [AIAA PAPER 79-1239] A79-39818 FURL PUEPS A canister fuel pump for general aviation aircraft [SAE PAPER 790624] A79-367 FUEL SPRAYS A79~36752 The effect of fuel sprays on emissions from a gas turbine combustor [AIAA PAPER 79-1321] A79-39037 FUEL TANKS Formation of water-fuel emulsions in tanks of grounded aircraft 179-36587 Crash-resistant fuel systems for general aviation aircraft AIFCTAIL [SAE PAPER 790592] A79~36/20 Fuel on fire - Rapid response to a military problem A79~38090 Inflight fuel tank temperature survey data [NASA-CR-159569] 879-23940 Dynamic evaluation of experimental integral fuel-tank sealants, part 2 [AD~A066592] N79-25236 PURL TRSTS Detonation characteristics of Soviet GOST 1012-72 aviation gasoline [SAE PAPER 790630] 179-36757 PUBL-AIR RATIO Lean, premixed, prevaporized combustion for aircraft gas turbine engines [NAS1-TH-79148] 879-23964 Effect of degree of fuel vaporization upon emissions for a premixed prevaporized combustion system --- for gas turbine engines NA SA-TH-79154] N79-23965 Effect of fuel/air nonuniformity on nitric oxide emissions N79-25004

FULL SCALE TESTS Experimental verification of program KRASH ~ A mathematical model for general aviation structural crash dynamics [SAE PAPER 790589] 179-36723 Full-scale wind-tunnel investigation of an Ayres S2R-800 Thrush Agricultural Airplane [SAE PAPER 790618] 179-36746 [SAE PAPER /9Ubl8] Assessment at full scale of nozzle/wing geometry effects on OTW aeroacoustic characteristics --Over The Wing STOL engine configurations A79-39802 PUSELAGES Differential method of designing rational aircraft frames made of composite materials 179-36592 Identification of voltage transients on aircraft cabling under LTA excitation --- Lightning Transient Analysis A79-38531 Fuselage-mounted antenna code: User's manual [AD-A065587] 179-24215 Composite forward fuselage systems integration, volume 2 --- effects of lightning [AD-A066560] N79-24984 G GABBA RATS

Observation of atmospheric interactions at aeroplane altitude gamma ray emulsio erperiments	6
GAS DYNAMICS	A79- 37573
Optimal selection of the geometrical	
characteristics of the reversing channel	ofa
small-scale turbine with readmission of	the das
for aircraft auxiliary power systems	ene gub
Aerodynamics	A79-36583
[NASA-TT-P-765]	N79-23908
GAS FLOW	115 23500
Second approximation in theory of a finite	-snan
thin wing in a hypersonic gas flow	Span
cara wing in a liferboard gab fire	A79-35927
Allowing for the wall boundary layer in an	
compressor stage	ualus
compressor stude	A79-36586
GAS INJECTION	A75 50500
Effects of air injection on a turbocharged	
Teledyne Continental Motors TSIO-360-C es	
[SAE PAPER 790607]	A79-36760
A starter for gas turbine engines	A73-30700
A Statter fot gas carbine engines	179-36797
GAS MINTURES	A13-30737
Velocity slip and temperature difference of	fase
mixtures in quasi-one-dimensional nozzle	
mixedies in danse one armensional norrie	A79-36423
Lean, premixed, prevaporized combustion for	
aircraft gas turbine engines	•
[NASA-TN-79148]	N79-23964
Effect of degree of fuel vaporization upon	117 20004
emissions for a premixed prevaporized co	abustion
system for gas turbine engines	
[NASA-TH-79154]	N79-23965
Effect of fuel/air nonuniformity on mitric	
emissions	URLUU
011002040	N79-25004
GAS TEMPERATURE	
Velocity slip and temperature difference of	foras
Velocity slip and temperature difference of mixtures in guasi-one-dimensional nozzle	
Velocity slip and temperature difference o mixtures in quasi-one-dimensional nozzle	flows
mixtures in quasi-one-dimensional nozzle GAS TUBBINE BUGINES	flows A79-36423
mixtures in quasi-one-dimensional nozzle	flows A79-36423
mixtures in quasi-one-dimensional nozzle GAS TUBBINE ENGINES Directionally solidified blades - Greater :	flows A79-36423 strength A79-36248
mixtures in quasi-one-dimensional nozzle GAS TUBBINE BUGINES	flows A79-36423 strength A79-36248 eristics
mixtures in quasi-one-dimensional nozzle GAS TURBING ENGINES Directionally solidified blades - Greater : Influence of the flow angle on the characte	flows A79-36423 strength A79-36248 eristics
mixtures in quasi-one-dimensional nozzle GAS TUBBING BNGINES Directionally solidified blades - Greater : Influence of the flow angle on the charact of an elbow-shaped air intake of gas	flows A79-36423 strength A79-36248 eristics
mixtures in quasi-one-dimensional nozzle GAS TURBING ENGINES Directionally solidified blades - Greater s Influence of the flow angle on the charact of an elbow-shaped air intake of gas engines	flows A79-36423 strength A79-36248 eristics turbine
mixtures in quasi-one-dimensional nozzle GAS TUBBING BNGINES Directionally solidified blades - Greater : Influence of the flow angle on the charact of an elbow-shaped air intake of gas	flows A79-36423 strength A79-36248 eristics turbine A79-36585
mixtures in quasi-one-dimensional nozzle GAS TUBBING BNGINES Directionally solidified blades - Greater is Influence of the flow angle on the charact of an elbow-shaped air intake of gas engines Effects of air injection on a turbocharged	flows A79-36423 strength A79-36248 eristics turbine A79-36585
 mixtures in quasi-one-dimensional nozzle GAS TUBBINE ENGINES Directionally solidified blades - Greater is Influence of the flow angle on the character of an elbow-shaped air intake of gas engines Effects of air injection on a turbocharged Teledyne Continental Motors TSIO-360-C ex [SAE PAPER 790607] 	flows A79-36423 strength A79-36248 eristics turbine A79-36585 agine
 mixtures in quasi-one-dimensional nozzle GAS TUBBINE BNGINES Directionally solidified blades - Greater is Influence of the flow angle on the character of an elbow-shaped air intake of gas engines Effects of air injection on a turbocharged Teledyne Continental Hotors TSIO-360-C enders 	flows A79-36423 strength A79-36248 eristics turbine A79-36585 agine
 mixtures in quasi-one-dimensional nozzle GAS TUBBINE ENGINES Directionally solidified blades - Greater is Influence of the flow angle on the character of an elbow-shaped air intake of gas engines Effects of air injection on a turbocharged Teledyne Continental Motors TSIO-360-C ex [SAE PAPER 790607] 	flows A79-36423 strength A79-36248 eristics turbine A79-36585 ngine A79-36760 A79-36797
 mixtures in quasi-one-dimensional nozzle GAS TUBBING BNGINES Directionally solidified blades - Greater is Influence of the flow angle on the character of an elbow-shaped air intake of gas engines Effects of air injection on a turbocharged Teledyne Continental Motors TSIO-360-C ex [SAE PAPER 790607] A starter for gas turbine engines 	flows A79-36423 strength A79-36248 eristics turbine A79-36585 agine A79-36760 A79-36797 n delays
 mixtures in quasi-one-dimensional nozzle GAS TUBBINE ENGINES Directionally solidified blades - Greater is Influence of the flow angle on the character of an elbow-shaped air intake of gas engines Effects of air injection on a turbocharged Teledyne Continental Motors TSIO-360-C ex [SAE PAPER 790607] A starter for gas turbine engines The effect of hydrogen addition on ignition 	flows A79-36423 strength A79-36248 eristics turbine A79-36585 agine A79-36760 A79-36797 n delays

GAS TURBINES

A method of reducing aircraft turbine blade vibrations A79-38819 Infrared signature measurement techniques and Infared signature measurement techniques and simulation methods for aircraft survivability [ATAA PAPER 79-1186] A79-38 Damage tolerant design - An approach to reducing the life cycle cost of gas turbine engine disks [AIAA PAPER 79-1189] A79-38 Development of a gas turbine combustor dilution zone design analysis [ATAA PAPER 79-1194] A79-38 Manalysis of the impact of the new of bread 179-38975 A79-38976 A79-38979 Analysis of the impact of the use of broad specification fuels on combustors for commercial aircraft gas turbine engines [AIAA PAPER 79-1195]. A79-389 A79-38980 The monorotor gas turbine [AIAA PAPER 79-1230] A79-38994 Lean, premixed, prevaporized combustion for aircraft gas turbine engines [AIAA PAPER 79-1318] A79-39034 Lean stability augmentation for premixing, Lean stability augmentation for prevaporizing combustors [AINA PAPER 79-1319] A79-39 The effect of fuel sprays on emissions from a gas A79-39035 turbine combustor [AIAA PAPER 79-1321] A79-39037 fueled with a simulated partial-oxidation product gas [AIAA PAPER 79-1322] A79-39038 Materials and structural aspects of advanced gas-turbine helicopter engines A79-39804 Lean, premixed, prevaporized combustion for aircraft gas turbine engines [NASA-TN-79148] [NASA-TH-79148] N79-239 Effect of degree of fuel vaporization upon emissions for a premixed prevaporized combustion system --- for gas turbine engines [NASA-TH-79154] N79-239 December 2017 N79-23964 N79-23965 Premixed Prevaporized Combustor Technology Forum [NASA-CP-2078] N79-24994 Turbulence characteristics of compressor discharge flows --- JT9D engine tests N79-24995 Turbulence measurements in the compressor exit flow of a General Electric CF6-50 engine N79-24996 Advanced low emissions catalytic combustor program at General Electric N79-25011 Internally coated air-cooled gas turbine blading [NASA-CR-159574] N79-25 Industry tests of NASA ceramic thermal barrier coating --- for gas turbine engine applications N79-25018 [NASA-TP-1425] N79-25023 Brittle materials design, high temperature gas turbine: Ceramic turbine rotor technology [AD-A067176] 179-25029 GAS TURBINES Application of advanced data reduction methods to gas turbine dynamic analysis 179-36024 Optimal selection of the geometrical characteristics of the reversing channel of a small-scale turbine with readmission of the gas
--- for aircraft auxiliary power systems A79-36583 Effectiveness of readmission of the gas in high-pressure-ratio small-scale turbines --- for aircraft auxiliary power systems A79-36584 Turbine design system [AD-A066092] Fundamentals of Gas Turbine combustion N79-23974 [NASA-CP-2087] N79-25016 GASEOUS FUELS Possil fuel heat pumps for domestic, commercial and industrial space heating A79-37852 Emission characteristics of a premix combustor fueled with a simulated partial-oxidation product gas [AINA PAPER 79-1322] A79-39038 GASOLINE Detonation characteristics of Soviet GOST 1012-72 aviation gasoline SAE PAPER 790630]

SUBJECT INDEX

Stability characteristics of hydrocarbon fuels from alternative sources [BETC/RI-78/23] GENERAL AVIATION AIRCRAFT N79-24178 Evaluation of GPS performance for low-cost general aviation 179-36065 Effects of a spin chute installation on spin characteristics --- of light general aviation aircraft (SAE PAPER 790564) 179-36705 Spin flight research summary [SAE PAPER 790565] A79-36706 A Demonstration Advanced Avionics System for general aviation [SAE PAPER 790569] A79-36709 The design and selection of optimum propellers for general aviation aircraft [SAE PAPER 790575] 179-36711 The analysis of propellers including interaction The analysis of properters including interaction effects --- for general aviation aircraft [SAE PAPER 790576] A79-: Design description of a four-place business jet using two WR-19 engines [SAE PAPER 790580] A79-: The Learjet 'Longhorn' series - The first jets A79-36712 A79-36715 with winglets [SAE PAPER 790581] A79-36716 Improving business jet performance - The Mark Five Sabreliner [SAE PAPER 790582] A79-36 general aviation flight test application of the 179-36717 on-board computer [SAE PAPER 790583] A79-36718 [SAE PAPER 790505] Design of quiet efficient propellers [SAE PAPER 790584] A79-36719 Crashworthiness analysis of field investigation of business aircraft accidents [SAE PAPER 790587] A79-36721 NASA general aviation crashworthiness seat development (SAE PAPER 790591] A79-36725 Propeller aircraft noise around general aviation airports [SAE PAPER 790594] 179-36728 Preliminary QCGAT program test results --- Quiet, Clean General Aviation Turbofan [SAE PAPER 790596] A79-36729 Advanced braking controls for business aircraft [SAE PAPER 790599] A79-: Canadair Challenger flight test status A79-36731 [SAE PAPER 790602] 179-36734 Concepts for reducing exhaust emissions and fuel consumption of the aircraft piston engine [SAE PAPER 790605] 179-36737 [SAE PAPER 790613] [SAE PAPER 790613] [General aviation aircraft design for performance A79-36742 using small computers [SAE PAPER 790614] A79-36743 Development of the Beechcraft Hodel 77 [SAE PAPER 790617] A79-30 New opportunities for future small civil turbine **▲79-36745** engines - Overviewing the GATE studies [SAE PAPER 790619] A79-3674 Rolls-Royce RB.401-07 turbofan engine for business 179-36747 alrcraft in the 1980's [SAE PAPER 790620] 179-36748 review of Curtiss-Wright rotary engine developments with respect to general aviation potential SAE PAPER 790621] A79-36749 Flectromechanical actuation for busiress aircraft [SAE PAPER 790622] A79-36 179-36750 comparison of hydraulic, pneumatic, and A electro-mechanical actuators for general aviation flight controls [SAE PAPER 790623] 179-36751 canister fuel pump for general aviation aircraft [SAE PAPER 790624] A79-36752 Engine induced structural-borne noise in a general aviation aircraft [SAE PAPER 790626] A79-36754 Summary of noise reduction characteristics of typical general aviation materials [SAE PAPER 790627] A79-36755 Some main points about general-aviation design practice A79-37047

A79-36757

.

HELICOPTER ENGINES

The dynamics of a general aviation pilot promotion
campaign A79-38886
General aviation turbine engine /GATE/ concepts [AIAA PAPER 79-1157] A79-38964
Turbo-fan design for general aviation - The evolution of the RB.401
[AIAA PAPER 79-1160] A79-38966 The application of the Prop-Pan concept in
preliminary design of a very advanced technology light twin /VATLIT '85/ [AIAA PAPER 79-1343] A79-39047
A review of the Icing situation from the standpoint of general aviation
N79-23918 Low-speed wind tunnel results for a modified 13-percent-thick airfoil
[NAŠA-TM-X-74018] N79-24960 Advanced General Aviation Turbine Engine (GATE)
concepts [NASA-CR-159603] N79-25017
GEOMETRY Introduction to the arcopter arc wing and the Bertelsen effect for positive pitch stability
and control N79-23895
GLIDERS A case study in design - The Gossamer Condor
A79-37050 An exploratory investigation of the effect of
plastic coating on the profile drag of a practical-metal-construction sailplane airfoil N79-23891
Optimum tail plane design for sailplanes N79-23892
The application of microprocessor technology to in-flight computation
N79-23902 Design of propellers for motorsoarers
GLIDING N79-23903
The science and technology of low speed and motorless flight, part 1
[NASA-CP-2085] N79-23889 GLOBAL POSITIONING SYSTEM
Evaluation of GPS performance for low-cost general aviation A79-36065
Loran C - Its future in the shadow of Nawstar GPS A79-36071
A navigation filter for an integrated GPS/JTIDS/INS system for a tactical aircraft
Joint Tactical Information Distribution System A79-36087 Recent results in navigation systems utilizing
signal aiding from Navstar satellites A79-36096
GRAPHS (CHARTS) The Rockwell International Sabreliner-65: Case
study in aircraft design Book A79-36645
Seat/Occupant crash dynamic analysis verification test program
[SAE PAPER 790590] A79-36724 A study of the evolution of noise exposure under
different hypotheses of regulation [ONERA, TP NO. 1979-44] A79-39093 GEOUND EFFECT
Hethodology for prediction of V/STOL propulsion induced forces in ground effect
[AIAA PAPER 79-1281] A79-39017 GROUND BFFECT (AERODINANICS)
Investigation of a laser Doppler velocimeter system to measure the flow field of a large
scale V/STOL alreraft in ground effect [AIAA PAPER 79-1184] A79-38974
GROUND SUPPORT BQUIPHRNT High level maintenance below sea level
GROUND TESTS
Method of assessment of the antistatic protection of aircraft
[ONERA, TP NO. 1979-41] A79-39090 GROUND WIND Fround Winds for Kennedr Space Conter Blarida
Ground Winds for Kennedy Space Center, Plorida, 1979 revision [WASA-TH-78229] N79-25662
(alloa III (0220) (0.09-20002

GUIDANCE (MOTION) A system for providing an integrated display of instantaneous information relative to aircraft attitude, heading, altitude, and horizontal situation [NASA-CASE-PRC-11005-1] N79-24 GUNS (ORDNANCE) Precision controllability of the P-15 airplane [NASA-TH-72861] N79-23 GUST LOADS Analysis of an unsteady aerodynamic force on a blade due to ununiform amplitude gusts A79-39 N79-24988 N79-23979 A79-39059 Η HARRTER ATECRAPT

The British Aerospace Barrier: Case study in
aırcraft design Book
A79-36644 Is the AV-8B Advanced Harrier aircraft ready for
full-scale development [PB-290826/7] N79-24987
HAZARDS Factors affecting electrostatic hazards
[AD-A066927] N79-25245
HEAD-UP DISPLAYS Energy maneuverability display validation F-16
aircraft [APPDL-TR-78-35-VOL-1] N79-23947
HEAT PUMPS Possil fuel heat pumps for domestic, commercial
and industrial space heating
A79-37852 A cooling system for an aircraft having a cruise
range from Mach 2 to Mach 8
[NAŠA-CASE-LAR-12406-1] N79-24980 HEAT RESISTAFT ALLOYS
Directionally solidified blades - Greater strength A79-36248
The application of rapid solidification rate superalloys to radial wafer turbine blades
[AIAA PAPER 79-1226] A79-38991
BBAT SHI BLDING Transient ablation of Teflon in intense radiative
and convective environments A79-38123
HEAT SOURCES Design and evaluation of aircraft heat source
systems for use with high-freezing point fuels
[NASA-CR+159568] N79-24172 HEIGET
Theoretical fundamentals of radio altimetry
Russian book A79-38145
A79-38145 HELICOPTER CONTROL Model study of transient processes in a hydraulic
A79-38145 HELICOPTER CONTROL Model study of transient processes in a hydraulic power amplifier A79-38814
A79-38145 HELICOPTER CONTROL Model study of transient processes in a hydraulic power amplifier
A79-38145 HELICOPTER CONTROL Model study of transient processes in a hydraulic power amplifier A79-38814 Evaluation of a digital helicopter control system 80-105 helicopter [MBB-UFE-1349-0] N79-23980
A79-38145 HELICOPTER CONTROL Model study of transient processes in a hydraulic power amplifier A79-38814 Evaluation of a digital helicopter control system B0-105 helicopter [MBD-UFE-1349-0] HELICOPTER DESIGN
HELICOPTER CONTROL Model study of transient processes in a hydraulic power amplifier A79-38814 Evaluation of a digital helicopter control system B0-105 helicopter [MBB-0PE-1349-0] HELICOPTER DESIGN Composite applications at Bell Helicopter [SAE PAPER 790578]
A79-38145 HELICOPTEB CONTROL Model study of transient processes in a hydraulic power amplifier A79-38814 Evaluation of a digital helicopter control system B0-105 helicopter [MBB-UFE-1349-0] N79-23980 HELICOPTER DESIGN Composite applications at Bell Helicopter [SAE PAPER 790578] Interactional aerodynamics of the single rotor
A79-38145 HELICOPTER CONTROL Model study of transient processes in a hydraulic power amplifier A79-38814 Evaluation of a digital helicopter control system B0-105 helicopter [MBB-UPE-1349-0] HELICOPTER DESIGN Composite applications at Bell Helicopter [SAE PAPER 790578] Interactional aerodynamics of the single rotor helicopter configuration. Volume 2B: Harmonic analyses of airframe surface pressure data, runs
A79-38145 HELICOPTEB CONTROL Model study of transient processes in a hydraulic power amplifier A79-38814 Evaluation of a digital helicopter control system B0-105 helicopter [MBB-UPE-1349-0] N79-23980 HELICOPTER DESIGN Composite applications at Bell Helicopter [SAE PAPER 790578] Interactional aerodynamics of the single rotor helicopter configuration. Volume 2B: Harmonic analyses of airframe surface pressure data, runs 7 - 14, midsection
A79-38145 HELICOPTER CONTROL Model study of transient processes in a hydraulic power amplifier A79-38814 Evaluation of a digital helicopter control system B0-105 helicopter [MBB-UPE-1349-0] N79-23980 HELICOPTER DESIGN Composite applications at Bell Helicopter [SAB PAPER 790578] A79-36713 Interactional aerodynamics of the single rotor helicopter configuration. Volume 2B: Harmonic analyses of airframe surface pressure data, runs 7 - 14, midsection [AD-A061860] N79-23934 Pail-safe optimal design of structures with
A79-38145 HELICOPTEB CONTROL Model study of transient processes in a hydraulic power amplifier A79-38814 Evaluation of a digital helicopter control system B0-105 helicopter [MBB-UFE-1349-0] N79-23980 HELICOPTER DESIGN Composite applications at Bell Helicopter [SAE PAPER 790578] Interactional aerodynamics of the single rotor helicopter configuration. Volume 2B: Harmonic analyses of airframe surface pressure data, runs 7 - 14, midsection [AD-A061860] Pail-safe optimal design of structures with substructuring
A79-38145 HELICOPTEB CONTROL Model study of transient processes in a hydraulic power amplifier A79-38814 Evaluation of a digital helicopter control system B0-105 helicopter [MBB-UPE-1349-0] N79-23980 HELICOPTEB DESIGN Composite applications at Bell Helicopter [SAB PAPER 790578] A79-36713 Interactional aerodynamics of the single rotor helicopter configuration. Volume 2B: Harmonic analyses of airframe surface pressure data, runs 7 - 14, midsection [AD-A061860] N79-23934 Pail-safe optimal design of structures with substructuring [AD-A065936] N79-23950 Advanced rotorcraft technology: Task force report
A79-38145 HELICOPTBE CONTROL Model study of transient processes in a hydraulic power amplifier A79-38814 Evaluation of a digital helicopter control system B0-105 helicopter [MBB-UPE-1349-0] N79-23980 HELICOPTER DESIGN Composite applications at Bell Elelicopter [SAE PAPER 790578] Composite applications of the single rotor helicopter configuration. Volume 2B: Harmonic analyses of airframe surface pressure data, runs 7 - 14, midsection N79-23934 Pail-safe optimal design of structures with substructuring [AD-A065936] N79-23950 Advanced rotorcraft technology: Task force report [NASA-TH-80541] HELICOPTER BENERS
A79-38145 HELICOPTEB CONTROL Model study of transient processes in a hydraulic power amplifier A79-38814 Evaluation of a digital helicopter control system B0-105 helicopter [MBB-UPE-1349-0] HELICOPTER DESIGN Composite applications at Bell Belicopter [SAB PAPER 790578] A79-36713 Interactional aerodynamics of the single rotor helicopter configuration. Volume 2B: Harmonic analyses of airframe surface pressure data, runs 7 - 14, midsection [AD-A061860] N79-23934 Fail-safe optimal design of structures with substructuring [AD-A065936] N79-23950 Advanced rotorcraft technology: Task force report [NASA-TB-80541] N79-24951 HELICOPTER ENGINES What small turbine engine does the small
A79-38145HELICOPTBE CONTROLModel study of transient processes in a hydraulic power amplifierA79-38814Evaluation of a digital helicopter control system B0-105 helicopter [MBB-UPE-1349-0]M79-23980HELICOPTER DESIGNComposite applications at Bell Elelicopter [SAE PAPER 790578]A79-36713Interactional aerodynamics of the single rotor helicopter configuration. Volume 28: Harmonic analyses of airframe surface pressure data, runs 7 - 14, midsection [AD-A061860]Fail-safe optimal design of structures with substructuring [AD-A065936]M79-23950Advanced rotorcraft technology: Task force report [NASA-TH-80541]HELICOPTER BEGINESWhat small turbine engine does the small helicopter need, or The road to hell is paved with good intentions fuel consumption,
A79-38145 HELICOPTER CONTROL Model study of transient processes in a hydraulic power amplifier A79-38814 Evaluation of a digital helicopter control system B0-105 helicopter [MBB-0FE-1349-0] N79-23980 HELICOPTER DESIGN Composite applications at Bell Helicopter [SAB PAPER 790578] Interactional aerodynamics of the single rotor helicopter configuration. Volume 2B: Harmonic analyses of airframe surface pressure data, runs 7 - 14, midsection [AD-A061860] Fail-safe optimal design of structures with substructuring [AD-A065936] Advanced rotorcraft technology: Task force report [NASA-TH-80541] HELICOPTER ENGINES What small turbine engine does the small helicopter need, or The road to hell is paved with good intentions fuel consumption, performance, environmental and engine
A79-38145 HELICOPTBE CONTROL Model study of transient processes in a hydraulic power amplifier A79-38814 Paraletic and the state of the state o
A79-38145 HELICOPTBE CONTROL Model study of transient processes in a hydraulic power amplifier A79-38814 Paraletic and the state of the state o
A79-38145 HELICOPTBE CONTROL Model study of transient processes in a hydraulic power amplifier A79-38814 Paraletic amplifier A79-38814 Evaluation of a digital helicopter control system B0-105 helicopter [MBB-UPE-1349-0] N79-23980 HELICOPTED DESIGN Composite applications at Bell Elelicopter [SAE PAPER 790578] A79-36713 Interactional aerodynamics of the single rotor helicopter configuration. Volume 28: Harmonic analyses of airframe surface pressure data, runs 7 - 14, midsection [AD-A061860] N79-23934 Fail-safe optimal design of structures with substructuring N79-23950 Advanced rotorcraft technology: Task force report [NASA-TB-80541] HAI small turbine engine does the small helicopter need, or The road to hell is paved with good intentions fuel consumption, performance, environmental and engine reliability and acceptability considerations subordinating advanced turbine engine A79-39032 [ATA PAPER 79-1314] A79-39032
A79-38145 HELICOPTEB CONTROL Model study of transient processes in a hydraulic power amplifier A79-38814 Paraluation of a digital helicopter control system

.

Materials and structural aspects of advanced gas-turbine helicopter engines A79-39804 Diagnostics of wear in aeronautical systems A79-39805 Driveshaft alignment indicator [AD-A065988] N79-23973 Helicopter transmission vibration and noise reduction program. Volume 3: Evaluation of fiber PP metal-matrix housing specimens [AD-A066794] N79-N79-24983 HELICOPTER WARES Interactional aerodynamics of the single rotor helicopter configuration. Volume 6B: One-third octave hand spectrograms of wake single film data, basic configuration wake explorations [AD-A061861] N79 Interactional aerodynamics of the single rotor N79-23931 helicopter configuration. Volume 3A: Plow angle and velocity wake profiles in low frequency band, basic investigations and hub variations [AD-A061766] N79-23932 Interactional aerodynamics of the single rotor helicopter configuration. Volume 3B: Plow angle and velocity wake profiles in low frequency band, air ejector systems and other devices [AD-A061767] ₩79-23933 **HELICOPTERS** Model verification of force determination for measuring vibratory loads --- of rotors on helicopters A79-36379 Westland unveils WG30 transport helicopter A79-38092 Civil Helicopter icing problems N79-23917 Overview of helicopter ice protection system developments N79-23919 Technical evaluation report on the 27th Guidance and Control Panel Symposium on the V/STOL Aircraft at Night and in Poor Visibility [AGARD-AR-142] N79-23946 Helicopter rotor airfoil [NASA-CASE-LAR-12396-1] N79-24958 Interactional aerodynamics of the single rotor helicopter configuration. Volume 3B: Flow angle and velocity wake profiles in low frequency band, air ejector systems and other devices [AD-A061767] N79-24966 Interactional aerodynamics of the single rotor helicopter configuration. Volume 28: Harmonic analysis of airframe surface pressure data, runs 7-14, mid section [AD-A061860] N79 An experimental investigation of the effect of N79-24967 rotor tip shape on helicopter blade-slap noise --- in the langley v/stol wind tunnel [NASA-TH-80066] N79-2 N79-25844 BELIUS-BEON LASERS Small hole drilling and inspection with pulsed laser systems --- in air-cooled aircraft engine structures [AIAA PAPER 79-1268] A79-39012 HIGH RESOLUTION High resolution radiography in the aero-engine industry N79-25414 HIGH TEMPERATURE TESTS Transient ablation of Teflon in intense radiative and convective environments A79-38123 HISTORIES Executive summary of Aircraft Icing Specialists Workshop N79-23914 HONEYCONB STRUCTURES Adhesive bonded structure of new pressurized piston twin aircraft [SAE PAPER 790563] A79-36704 Summary of noise reduction characteristics of typical general aviation materials [SAE PAPER 790627] A79 A79-36755 Evaluation of new bonding systems for depot-level maintenance of aircraft honeycomb panels

FAD-A0661171

SUBJECT INDER

BORIZONTAL PLIGHT A system for providing an integrated display of instantaneous information relative to aircraft attitude, heading, altitude, and horizontal situation [NASA-CASE-PRC-11005-1] N79-24988 HORIZONTAL TAIL SURPACES Optimum tail plane design for sailplanes N79-23892 BOVERING STABILITY A unique facility for V/STOL aircraft hover testing 179-37296 HUMAN FACTORS ENGINEERING Seat/Occupant crash dynamic analysis verification test program [SAE PAPER 790590] NASA general aviation crashworthiness seat development A79-36724 [SAE PAPER 790591] A79-36725 Tachystoscopic testing of onboard instruments A79-38817 The time budget as a criterion for the workload of air traffic controllers [MBB-UFF-1353-0] N79-239 Energy maneuverability display validation --- P-16 N79-23943 aircraft [AFFDL-TR-78-35-VOL-1] N79-239 HYBRID WAVIGATION SYSTEMS The MX 1105, an integrated Transit/Omega navigator N79-23947 A79-36072 A navigation filter for an integrated GPS/JTIDS/INS system for a tactical aircraft ---Joint Tactical Information Distribution System 179-36087 HYDRAULIC ANALOGIES Making fluid flows visible 179-36373 HYDRAULIC CONTROL An electric control for an electrohydraulic active control aircraft landing gear [NASA-CR-3113] N79-23948 HYDRAULIC EQUIPHENT Pormulation of empirical formulas for calculating the hydraulic resistance of networks --aircraft deicing and air-conditioning systems 179-36593 Hodel study of transient processes in a hydraulic power amplifier A79-38814 HYDRAULIC PLUIDS Water absorption of fluids/oils --- contamination of aircraft engine oils and inhibitors [AD-A065915] N79-24158 HIDRAULIC TEST TUNNELS Method of determining non-steady-state force characteristics and flywheel effect of turbine blades from the streamflow pattern 179-39071 Investigation of aerodynamic characteristics of subsonic wings [NASA-CR-158661] N79-HYDROCARBON FUELS Stability characteristics of hydrocarbon fuels from alternative sources N79-23921 [BETC/RI-78/23] Autoignition of fuels N79-24178 N79-25001 HYDROCARBONS The effect of fuel sprays on emissions from a gas turbine combustor [AIAA PAPER 79-1321] 179-39037 HYDRODYNAMIC BOUATIONS Lectures on hydroaeromechanics --- Russian book A79-36347 HYDROGEN FUELS The effect of hydrogen addition on ignition delays and flame propagation in spark ignition engines 179-38387 Autoignition of hydrogen injected transverse to a supersonic airstream [AIAA PAPER 79-1239] A79-39818 HYDRONECHANICS Lectures on hydroaeromechanics --- Russian book 179-36347 HYPERBOLIC NAVIGATION Hyperbolic positioning per se is passe --navigation computations from range measurements using microprocessor 179-36070

≜-22

N79-24161

BYPERSOUIC AIRCHAFT A cooling system for an aircraft having a	6 777 60
range from Mach 2 to Mach 8	cratse
	#TO 30000
[NASA-CASE-LAR-12406-1]	N79-24980
HYPERSONIC FLIGHT	
Autoignition of hydrogen injected transve	rse to a
supersonic airstream	
[AIAA PAPER 79-1239]	A79-39818
HYPERSONIC FLOW	
Second approximation in theory of a finit	e-span
thin wing in a hypersonic gas flow	
	1 79-35927
Measurement of the drag of slender cones	
hypersonic flow at low Reynolds numbers magnetic suspension and balance	using a
[OUEL-1235/78]	₩79-23938

ł

ICE FORMATION	
Aircon electrically heated acrylic for	lce
formation prevention on aircraft transpa	rencies
[SAE PAPER 790600]	179-36732
Aircraft lcing	
[NASA-CP-2086]	N79-23912
	N/3-23912
Aircraft icing: Introduction	
	₩79-23913
Executive summary of Aircraft Icing Specia	lists
Workshop	
NOT RENO P	N79-23914
Icing of aircraft Some remarks with an his	torical
slant from a cloud physicist	
	N79-23915
Safety hazard of aircraft icing	
Surecy mazard of directure termy	W70 33046
	N79-23916
Civil Helicopter icing problems	
	N79-23917
A review of the icing situation from the	
standpoint of general aviation	
	N79-23918
Overview of helicopter ice protection syst	en
developments	
	N79-23919
T	N/9-23515
IDENTIFYING	
Some possible applications of identificati	on
theory techniques in telemetry for a	ircraft
COmmunication	
COMMUTICALION	170 36500
	A79-36589
IGNITION	
Autoignition of fuels	
	N79-25001
IGNITION LINITS	
14811104 210112	
And a second and the second and a second sec	
Autoignition of hydrogen injected transver	se to a
supersonic alfstream	se to a
supersonic alfstream	se to a A79-39818
supersonic allstream [AIAA PAPER 79-1239]	
supersonic alistream (AIAA PAPER 79-1239] IGHITION SYSTEMS	
supersonic alistream (AIAA PAPER 79-1239] IGNITION SYSTEMS Dual breakerless aircraft magneto	A79-39818
supersonic alfstream [AIAA PAPER 79-1239] IGWITION SYSTEMS Dual breakerless aircraft magneto [SAE PAPER 790606]	
supersonic alfstream [AIAA PAPER 79-1239] IGWITION SYSTEMS Dual breakerless aircraft magneto [SAE PAPER 790606]	A79-39818
supersonic alistream [AIAA PAPER 79-1239] IGWITION SYSTEMS Dual breakerless aircraft magneto [SAE PAPER 790606] IMPACT DAWAGE	A79-39818
supersonic alfstream (ATAA PAPER 79-1239] IGNITION SYSTEPS Dual breakerless aircraft magneto (SAE PAPER 790606] IRPACT DANAGE Damage-tolerant fan blade design	A79-39818 A79-36738
Supersonic alfstream (AIAA PAPER 79-1239] IGNITION SYSTEMS Dual breakerless aircraft magneto [SAE PAPER 790606] INPACT DANAGE Damage-tolerant fan blade design (AIAA PAPER 79-1119]	A79-39818
supersonic alfstream [AIAA PAPER 79-1239] IGNITION SISTEMS Dual breakerless aircraft magneto [SAF PAPER 790606] IMPACT DANAGE Damage-tolerant fan blade design [AIAA PAPER 79-1119] IMPACT TESTS	A79-39818 A79-36738 A79-38951
supersonic alistream (ATAA PAPER 79-1239] IGNITION SYSTRUS Dual breakerless aircraft magneto (SAE PAPER 790606] IMPACT DANAGE Damage-tolerant fan blade design (ATAA PAPER 79-1119] IMPACT TESTS Experimental verification of program KRASH	A79-39818 A79-36738 A79-38951
supersonic alistream (ATAA PAPER 79-1239] IGNITION SYSTRUS Dual breakerless aircraft magneto (SAE PAPER 790606] IMPACT DANAGE Damage-tolerant fan blade design (ATAA PAPER 79-1119] IMPACT TESTS Experimental verification of program KRASH	A79-39818 A79-36738 A79-38951
Supersonic allstream (AIAA PAPER 79-1239] IGNITION SYSTEMS Dual breakerless aircraft magneto [SAE PAPEE 790606] IMPACT DAMAGE Damage-tolerant fan blade design [AIAA PAPER 79-1119] IMPACT TESTS Experimental verification of program KRASH mathematical model for general aviation	A79-39818 A79-36738 A79-38951
supersonic alistream [ATAA PAPER 79-1239] IGHITIOR SISTERS Dual breakerless aircraft magneto [SAE PAPER 790606] IMPACT DANAGE Damage-tolerant fan blade design [ATAA PAPER 79-1119] IMPACT TESTS Experimental verification of program KRASH mathematical model for general aviation structural crash dynamics	A79-39818 A79-36738 A79-38951 - A
supersonic alfstream [ATAA PAPER 79-1239] IGHITION SYSTRBS Dual breakerless aircraft magneto [SAE PAPER 790606] IRPACT DANAGE Damage-tolerant fan blade design [ATAA PAPER 79-1119] IRPACT TESTS Experimental verification of program KRASH mathematical model for general aviation structural Crash dynamics [SAE PAPER 790589]	A79-39818 A79-36738 A79-38951 - A A79-36723
supersonic allstream (ATAA PAPER 79-1239] ISHITON SYSTEMS Dual breakerless aircraft magneto (SAE PAPER 790606] IMPACT DAMAGE Damage-tolerant fan blade design [ATAA PAPER 79-1119] IMPACT TESTS Experimental verification of program KRASH mathematical model for general aviation structural crash dynamics [SAE PAPER 790589] Seat/Occupant crash dynamic analysis verif	A79-39818 A79-36738 A79-38951 - A A79-36723
supersonic alfstream [ATAA PAPER 79-1239] IGHITION SYSTRBS Dual breakerless aircraft magneto [SAE PAPER 790606] IRPACT DANAGE Damage-tolerant fan blade design [ATAA PAPER 79-1119] IRPACT TESTS Experimental verification of program KRASH mathematical model for general aviation structural Crash dynamics [SAE PAPER 790589]	A79-39818 A79-36738 A79-38951 - A A79-36723
supersonic alistream [ATAA PAPER 79-1239] IGNITION SISTEMS Dual breakerless aircraft magneto [SAE PAPEE 790606] IMPACT DAMAGE Damage-tolerant fan blade design [ATAA PAPER 79-1119] IMPACT TESTS Experimental verification of program KRASH mathematical model for general aviation structural crash dynamics [SAE PAPEE 790589] Seat/Occupant crash dynamic analysis verif test program	A79-39818 A79-36738 A79-38951 - A A79-36723 ication
supersonic allstream [ATAA PAPER 79-1239] IGHITION SYSTRBS Dual breakerless aircraft magneto [SAE PAPER 790606] IRPACT DAMAGE Damage-tolerant fan blade design [ATAA PAPER 79-1119] IRPACT TBSTS Experimental verification of program KRASH mathematical model for general aviation structural crash dynamics [SAE PAPEE 790589] Seat/Occupant crash dynamic analysis verif test program [SAE PAPEE 790590]	A79-39818 A79-36738 A79-38951 - A A79-36723
supersonic alistream [ATAA PAPER 79-1239] IGNITION SYSTEPS Dual breakerless aircraft magneto [SAE PAPER 790606] IMPACT DANAGE Damage-tolerant fan blade design [ATAA PAPER 79-1119] IMPACT TESTS Experimental verification of program KRASH mathematical model for general aviation structural crash dynamics [SAE PAPEE 790509] Seat/Occupant crash dynamic analysis verif test program [SAE PAPER 790590] NASA general aviation crashworthiness seat	A79-39818 A79-36738 A79-38951 - A A79-36723 ication
supersonic alistream [ATAA PAPER 79-1239] IGHITION SISTEMS Dual breakerless aircraft magneto [SAE PAPER 790606] IMPACT DANAGE Damage-tolerant fan blade design [ATAA PAPER 79-1119] IMPACT TESTS Experimental verification of program KRASH mathematical model for general aviation structural crash dynamics [SAE PAPER 790589] Seat/Occupant crash dynamic analysis verif test program [SAE PAPER 790590] NASA general aviation crashworthiness seat development	A79-39818 A79-36738 A79-38951 - A A79-36723 ication A79-36724
supersonic allstream [ATAA PAPER 79-1239] IGHITION SYSTRBS Dual breakerless aircraft magneto [SAE PAPER 790606] IRPACT DAMAGE Damage-tolerant fan blade design [ATAA PAPER 79-1119] IRPACT TBSTS Experimental verification of program KRASH mathematical model for general aviation structural crash dynamics [SAE PAPER 790589] Seat/Occupant crash dynamic analysis verif test program [SAE PAPER 790590] NASA general aviation crashworthiness seat development [SAE PAPER 790591]	A79-39818 A79-36738 A79-38951 - A A79-36723 ication A79-36724 A79-36725
supersonic allstream [ATAA PAPER 79-1239] IGHITION SYSTRBS Dual breakerless aircraft magneto [SAE PAPER 790606] IRPACT DAMAGE Damage-tolerant fan blade design [ATAA PAPER 79-1119] IRPACT TBSTS Experimental verification of program KRASH mathematical model for general aviation structural crash dynamics [SAE PAPER 790589] Seat/Occupant crash dynamic analysis verif test program [SAE PAPER 790590] NASA general aviation crashworthiness seat development [SAE PAPER 790591]	A79-39818 A79-36738 A79-38951 - A A79-36723 ication A79-36724 A79-36725
supersonic alistream [ATAA PAPER 79-1239] IGHITION SYSTRBS Dual breakerless aircraft magneto [SAE PAPER 790606] IMPACT DAMAGE Damage-tolerant fan blade design [ATAA PAPER 79-1119] IMPACT TESTS Experimental verification of program KRASH mathematical model for general aviation structural crash dynamics [SAE PAPER 790589] Seat/Occupant crash dynamic analysis verif test program [SAE PAPER 790590] NASA general aviation crashworthiness seat development [SAE PAPER 790591] Crash-resistant fuel systems for general a	A79-39818 A79-36738 A79-38951 - A A79-36723 ication A79-36724 A79-36725
supersonic alistream [ATAA PAPER 79-1239] IGNITION SISTEMS Dual breakerless aircraft magneto [SAE PAPER 790606] IMPACT DAMAGE Damage-tolerant fan blade design [ATAA PAPER 79-1119] IMPACT TESTS Experimental verification of program KRASH mathematical model for general aviation structural crash dynamics [SAE PAPER 790589] Seat/Occupant crash dynamic analysis verif test program [SAE PAPER 790590] NASA general aviation crashworthiness seat development [SAE PAPER 790591] Crash-resistant fuel systems for general a aircraft	A79-39818 A79-36738 A79-38951 - A A79-36723 ication A79-36724 A79-36725 viation
supersonic alistream [ATAA PAPER 79-1239] IGHITION SYSTEPS Dual breakerless aircraft magneto [SAE PAPER 790606] IMPACT DAMAGE Damage-tolerant fan blade design [ATAA PAPER 79-1119] IMPACT TESTS Experimental verification of program KRASH mathematical model for general aviation structural crash dynamics [SAE PAPER 790589] Seat/Occupant crash dynamic analysis verif test program [SAE PAPER 790590] NASA general aviation crashworthiness seat development [SAE PAPER 790591] Crash-resistant fuel systems for general a aircraft [SAE PAPER 790592]	A79-39818 A79-36738 A79-38951 - A A79-36723 ication A79-36724 A79-36725
supersonic allstream [ATAA PAPER 79-1239] IGHITION SYSTRMS Dual breakerless aircraft magneto [SAE PAPER 790606] IMPACT DAMAGE Damage-tolerant fan blade design [ATAA PAPER 79-1119] IMPACT TESTS Experimental verification of program KRASH mathematical model for general aviation structural crash dynamics [SAE PAPER 790509] Seat/Occupant crash dynamic analysis verif test program [SAE PAPER 790590] NASA general aviation crashworthiness seat development [SAE PAPER 790591] Crash-resistant fuel systems for general a aircraft [SAE PAPER 790592] IMPACT TOLERAMCES	A79-39818 A79-36738 A79-38951 - A A79-36723 ication A79-36724 A79-36725 viation
supersonic allstream [ATAA PAPER 79-1239] IGHITION SYSTRMS Dual breakerless aircraft magneto [SAE PAPER 790606] IMPACT DAMAGE Damage-tolerant fan blade design [ATAA PAPER 79-1119] IMPACT TESTS Experimental verification of program KRASH mathematical model for general aviation structural crash dynamics [SAE PAPER 790509] Seat/Occupant crash dynamic analysis verif test program [SAE PAPER 790590] NASA general aviation crashworthiness seat development [SAE PAPER 790591] Crash-resistant fuel systems for general a aircraft [SAE PAPER 790592] IMPACT TOLERAMCES	A79-39818 A79-36738 A79-38951 - A A79-36723 ication A79-36724 A79-36725 viation
supersonic allstream [ATAA PAPER 79-1239] IGHITIOR SISTEMS Dual breakerless aircraft magneto [SAE PAPER 790606] IMPACT DAMAGE Damage-tolerant fan blade design [ATAA PAPER 79-1119] IMPACT TESTS Experimental verification of program KRASH mathematical model for general aviation structural crash dynamics [SAE PAPER 790589] Seat/Occupant crash dynamic analysis verif test program [SAE PAPER 790590] NASA general aviation crashworthiness seat development [SAE PAPER 790591] Crash-resistant fuel systems for general a aircraft [SAE PAPER 790592] IMPACT TOLERANCES Damage-tolerant fan blade design	A79-39818 A79-36738 A79-38951 - A A79-36723 ication A79-36724 A79-36725 viation A79-36726
supersonic allstream [ATAA PAPER 79-1239] IGHITION SYSTEMS Dual breakerless aircraft magneto [SAE PAPEN 790606] IMPACT DAMAGE Damage-tolerant fan blade design [ATAA PAPER 79-1119] INPACT TOLERANCES Experimental verification of program KRASH mathematical model for general aviation structural crash dynamics [SAE PAPEE 790589] Seat/Occupant crash dynamic analysis verif test program [SAE PAPEE 790590] NASA general aviation crashworthiness seat development [SAE PAPEE 790591] Crash-resistant fuel systems for general a aircraft [SAE PAPEE 790592] INPACT TOLERANCES Damage-tolerant fan blade design [ATAA PAPER 79-1119]	A79-39818 A79-36738 A79-38951 - A A79-36723 ication A79-36724 A79-36725 viation
supersonic allstream [ATAA PAPER 79-1239] IGHITION SYSTRDS Dual breakerless aircraft magneto [SAE PAPEN 790606] IRPACT DANAGE Damage-tolerant fan blade design [ATAA PAPER 79-1119] IRPACT TBSTS Experimental verification of program KRASH mathematical model for general aviation structural crash dynamics [SAE PAPEE 790509] Seat/Occupant crash dynamic analysis verif test program [SAE PAPEE 790590] NASA general aviation crashworthiness seat development [SAE PAPEE 790591] Crash-resistant fuel systems for general a aircraft [SAE PAPEE 790592] IMPACT TOLERANCES Damage-tolerant fan blade design [ATAA PAPER 79-1119] IN-FLIGHT HOBITORING	A79-39818 A79-36738 A79-38951 - A A79-36723 ication A79-36724 A79-36725 viation A79-36726 A79-36726
supersonic alistream [ATAA PAPER 79-1239] IGNITION SISTEMS Dual breakerless aircraft magneto [SAE PAPEE 790606] IMPACT DAMAGE Damage-tolerant fan blade design [ATAA PAPER 79-1119] IMPACT TESTS Experimental verification of program KRASH mathematical model for general aviation structural crash dynamics [SAE PAPEE 790589] Seat/Occupant crash dynamic analysis verif test program [SAE PAPEE 790590] NASA general aviation crashworthiness seat development [SAE PAPEE 790591] Crash-resistant fuel systems for general a aircraft [SAE PAPEE 790592] IMPACT TOLERANCES Damage-tolerant fan blade design [ATAA PAPEE 79-1119] IN-FLIGHT MONTORING Inflight fuel tank temperature survey data	A79-39818 A79-36738 A79-38951 - A A79-36723 ication A79-36724 A79-36725 viation A79-36726 A79-38951
supersonic allstream [ATAA PAPER 79-1239] IGHITION SYSTRDS Dual breakerless aircraft magneto [SAE PAPEN 790606] IRPACT DANAGE Damage-tolerant fan blade design [ATAA PAPER 79-1119] IRPACT TBSTS Experimental verification of program KRASH mathematical model for general aviation structural crash dynamics [SAE PAPEE 790509] Seat/Occupant crash dynamic analysis verif test program [SAE PAPEE 790590] NASA general aviation crashworthiness seat development [SAE PAPEE 790591] Crash-resistant fuel systems for general a aircraft [SAE PAPEE 790592] IMPACT TOLERANCES Damage-tolerant fan blade design [ATAA PAPER 79-1119] IN-FLIGHT HOBITORING	A79-39818 A79-36738 A79-38951 - A A79-36723 ication A79-36724 A79-36725 viation A79-36726 A79-36726
<pre>supersonic allstream [ATAA PAPER 79-1239] IGHITION SYSTEMS Dual breakerless aircraft magneto [SAE PAPER 790606] IMPACT DAMAGE Damage-tolerant fan blade design [ATAA PAPER 79-1119] INPACT TESTS Experimental verification of program KRASH mathematical model for general aviation structural crash dynamics [SAE PAPEE 790589] Seat/Occupant crash dynamic analysis verif test program [SAE PAPEE 790590] NASA general aviation crashworthiness seat development [SAE PAPEE 790591] Crash-resistant fuel systems for general a aircraft [SAE PAPEE 790592] INPACT TOLERANCES Damage-tolerant fan blade design [ATAA PAPER 79-1119] IN-FLIGHT BOHITORING Inflight fuel tank temperature survey data [NASA-CR-159569]</pre>	A79-39818 A79-36738 A79-38951 - A A79-36723 ication A79-36724 A79-36725 viation A79-36726 A79-38951
supersonic allstream [ATAA PAPER 79-1239] IGHITION SYSTRMS Dual breakerless aircraft magneto [SAE PAPER 790606] IRPACT DAMAGE Damage-tolerant fan blade design [ATAA PAPER 79-1119] IRPACT TESTS Experimental verification of program KRASH mathematical model for general aviation structural crash dynamics [SAE PAPEE 790509] Seat/Occupant crash dynamic analysis verif test program [SAE PAPEE 790590] NASA general aviation crashworthiness seat development [SAE PAPEE 790591] Crash-resistant fuel systems for general a aircraft [SAE PAPER 790592] INPACT TOLERANCES Damage-tolerant fan blade design [ATAA PAPER 79-1119] IN-PLICHT MONITORING Inflight fuel tank temperature survey data [NASA-CR-159569] INERTIAL HAVIGATION	A79-39818 A79-36738 A79-38951 - A A79-36723 ication A79-36724 A79-36725 viation A79-36726 A79-38951 X79-23940
supersonic alistream [ATAA PAPER 79-1239] IGNITION SISTEMS Dual breakerless aircraft magneto [SAE PAPEE 790606] IMPACT DAMAGE Damage-tolerant fan blade design [ATAA PAPER 79-1119] IMPACT TESTS Experimental verification of program KRASH mathematical model for general aviation structural crash dynamics [SAE PAPEE 790589] Seat/Occupant crash dynamic analysis verif test program [SAE PAPEE 790590] NASA general aviation crashworthiness seat development [SAE PAPEE 790591] Crash-resistant fuel systems for general a aircraft [SAE PAPEE 790592] IMPACT TOLERANCES Damage-tolerant fan blade design [ATAA PAPEE 79-1119] IN-FLIGHT HOWITORING Inflight fuel tank temperature survey data [MASA-CR-159569] INERTIAL MAVIGATION Reliability, performance, and fault isolat	A79-39818 A79-36738 A79-38951 - A A79-36723 ication A79-36724 A79-36725 viation A79-36726 A79-38951 N79-23940 ion
<pre>supersonic allstream [ATAA PAPER 79-1239] IGHITION SYSTEMS Dual breakerless aircraft magneto [SAE PAPEN 790606] IMPACT DAMAGE Damage-tolerant fan blade design [ATAA PAPER 79-1119] INPACT TESTS Experimental verification of program KRASH mathematical model for general aviation structural crash dynamics [SAE PAPEE 790589] Seat/Occupant crash dynamic analysis verif test program [SAE PAPEE 790590] NASA general aviation crashworthiness seat development [SAE PAPEE 790591] Crash-resistant fuel systems for general a aircraft [SAE PAPEE 790592] IMPACT TOLERANCES Damage-tolerant fan blade design [ATAA PAPER 79-1119] IN-FLIGHT BOHITORING Inflight fuel tank temperature survey data [NASA-CR-159569] IMENTIAL MAYIGATION Reliability, performance, and fault isolat considerations in the design of intercon</pre>	A79-39818 A79-36738 A79-38951 - A A79-36723 ication A79-36724 A79-36725 viation A79-36726 A79-38951 N79-23940 ion
supersonic alistream [ATAA PAPER 79-1239] IGNITION SISTEMS Dual breakerless aircraft magneto [SAE PAPEE 790606] IMPACT DAMAGE Damage-tolerant fan blade design [ATAA PAPER 79-1119] IMPACT TESTS Experimental verification of program KRASH mathematical model for general aviation structural crash dynamics [SAE PAPEE 790589] Seat/Occupant crash dynamic analysis verif test program [SAE PAPEE 790590] NASA general aviation crashworthiness seat development [SAE PAPEE 790591] Crash-resistant fuel systems for general a aircraft [SAE PAPEE 790592] IMPACT TOLERANCES Damage-tolerant fan blade design [ATAA PAPEE 79-1119] IN-FLIGHT HOWITORING Inflight fuel tank temperature survey data [MASA-CR-159569] INERTIAL MAVIGATION Reliability, performance, and fault isolat	A79-39818 A79-36738 A79-38951 - A A79-36723 ication A79-36724 A79-36725 viation A79-36726 A79-38951 N79-23940 ion

A navigation filter for an integrated GPS/JTIDS/INS system for a tactical aircraft ---Joint Tactical Information Distribution System 179-36087 INERTIAL REFERENCE SYSTEMS Inertial Referenced Flight Inspection System A79-37150 THPORMATION THROPY Some possible applications of identification theory techniques in telemetry --- for aircraft communication A79-36589 THPRARED RADIATION Infrared signature measurement techniques and simulation methods for arcraft survivability [AIAA PAPER 79-1186] A79-IFFRARED SPECTROMETERS 179-38975 Infrared signature measurement techniques and simulation methods for aircraft survivability [AIAA PAPER 79-1186] INGESTION (ENGINES) Danage-tolerant fan blade design 179-38975 [AIAA PAPER 79-1119] A79-38951 V/STOL aircraft configuration effects on exhaust gas ingestion [AIAA PAPER 79-1284] A79-39019 INBIBITORS Water absorption of fluids/oils --- contamination of aircraft engine oils and inhibitors [AD-A065915] N79-24158 INLET PLON Combined pressure and temperature distortion effects on internal flow of a turbofan engine [AIAA PAPER 79-1309] Effect of steady-state pressure distortion on flow characteristics entering a turbofan engine
[NASA-TM-79134]
Self stabilizing sonic inlet
[NASA-CASE-LEW-11890-1]
Note: Self Stabilizing Sonic Stabilizin N79-23969 N79-24976 INLET NOZZLES Theoretical fan velocity distortions due to inlets and nozzles --- in V/STOL aircraft [HASA-TH-79150] N79-23911 THLET PRESSURE Predicted P100 engine response to circumferential pressure and temperature distortion [AINA PAPER 79-1310] A79-39 179-39819 INSPECTION High level maintenance below sea level A79-38825 Small hole drilling and inspection with pulsed laser systems --- in air-cooled aircraft engine structures [AIAA PAPER 79-1268] A79-39012 Non-destructive inspection methods for propulsion systems and components [AGARD-LS-103] N79-25412 State-of-the-art of nondestructive inspection of aircraft engines N79-25413 High resolution radiography in the aero-engine industry N79-25414 Non-destructive methods for the early detection of fatique damage in aircraft components 879-25417 Broad-band transducers for nondestructive inspection of aeronautical components N79-25419 INSTRUMENT LANDING SYSTEMS Inertial Referenced Flight Inspection System 179-37150 INTAKE SYSTEMS Theoretical fan velocity distortions due to inlets and nozzles --- in V/STOL aircraft [NASA-TH-79150] N79-23911 INTEGRAL BOUATIONS Construction of an initial approximation for the solution of the integral equation of a lifting surface A79-35928 INTERCEPTION The intercept of covert radar A79-38132 INTERPERENCE DRAG A parametric study of support system interference effects on nozzle/afterbody throttle dependent

drag in wind tunnel testing [AIAA PAPER 79-1168]

179-38968

INTERNAL PRESSURE Combined pressure and temperature distortion effects on internal flow of a turbofan engine [AIAA PAPER 79-1309] A79-¥79-39031 INTERNATIONAL COOPERATION Internationalization of OMEGA x79-36069 Development of an airborne military system (MRCA system) FABB-UFE-1322-01 179-23904 INTERNATIONAL TRADE Joint Airworthiness Requirements - Their history and progress A79-37149 INTERPOLATION Time optimal control of a jet engine using a quasi-Hermite interpolation model NASA-CR-158711] N79-25019 INVISCID FLOW Second approximation in theory of a finite-span thin wing in a hypersonic gas flow A79-35927 Numerical calculation of inviscid transonic flow through rotors and fans N79-23906 ISOTHERBAL PROCESSES Advanced forging process for gas turbine engine fan blades [AIAA PAPER 79-1269] 179-39013 TTALY Research and development activities in Italy in the field of aerospace structures and materials [AGARD-R-675] N79-24202 TTERATION Construction of an initial approximation for the solution of the integral equation of a lifting surface A79-35928

J

J-85 ENGINE Effects of steady-state pressure distortion on the stall margin of a J85-21 turbojet engine ₩79-23968 [NASA-TH-79123] JET AIRCRAFT The effects of low-level wind shear on the approach and go-around performance of a landing jet aircraft [SAE PAPER 790568] Canadair Challenger flight test status 179-36708 [SAE PAPER 790602] 179-36734 JET AIRCRAFT NOISE Effects of forward velocity on sound radiation from convecting monopole and dipole sources in ret flow --- subsonic aircraft model A79-38393 Application of Laser Doppler Anemometry to neroacoustic research A79-39500 An improved method for predicting the effects of flight on jet mixing noise 179-39803 Detection of low flying aircraft by acoustical means (REPT-8-78) N79-24 Assessment at full scale of nozzle/wing geometry N79-24779 effects on OTW aero-acoustic characteristics short takeoff aircraft noise [NASA-TM-79168] N79-N79-25841 Validation of aircraft noise prediction program [NASA-CR-159047] N79-N79-25843 JET ENGINE PUELS Analysis of the impact of the use of broad specification fuels on combustors for commercial aircraft gas turbine engines [AINA PAPER 79-1195] A79 Stability characteristics of hydrocarbon fuels from alternative sources A79-38980 [BETC/RI-78/23] The impact of alternate fuels on aircraft N79-24178 configuration characteristics --- military aircraft [AD-A066983] N79-25244 A filterability study of corrosion inhibited JP-4 N79-25247 [AD-A066887] JET BNGINES guasi-Hermite interpolation model [NASA-CR-158711] N79-25019

SUBJECT INDEX

Design study and performance analysis of a high-speed multistage variable-geometry fan for a variable cycle engine [NASA-CR-159545] N79-25020 JET EXHAUST Aircraft air pollution emission estimation techniques, 1 [AD-A067262] ACEE N79-25550 JET PLOW Effects of forward velocity on sound radiation from convecting monopole and dipole sources in jet flow --- subsonic aircraft model A79-38393 JET MIXING PLOW Development of a gas turbine combustor dilution zone design analysis [AINA PAPER 79-1194] A79-2 A79-38979 Ignition of liquid fuel jets in a supersonic air stream [AIAA PAPER 79-1238] x79-38997 improved method for predicting the effects of An flight on jet mixing noise A79-39803 JET VANES Aircraft engine nozzle [NASA-CASE-ARC-10977-1] N79-23971 ĸ KELVIN-HELMHOLTZ INSTABILITY The 'cloud-in-cell' technique applied to the roll up of vortex sheets A79-37725 KEVLAR (TRADEMARK) Development of an aircraft composite propeller [SAE PAPER 790579] 179-36714 Ŀ LAMINAR BOUNDARY LAYER A method for the calculation of 3D boundary layers on practical wing configurations A79-38906 LAMINAR FLOW Calculation of a laminar wall jet in a wake A79-36582 LABINAR WAKES Calculation of a laminar wall jet in a wake 179-36582 LABIBATES Bonding and durability --- for airframe structures [SAE PAPER 790561] A79-36702 Engine demonstration test of a cooled laminated axial turbine [AIAA PAPER 79-1229] A79-30 variational theorem for laminated composite plates of nonlinear materials and applications A79-38993 to postbuckling N79-24977 LANDING GRAR An electric control for an electrohydraulic active control aircraft landing gear [NASA-CR-3113] N79-23948 LANDING LOADS Proper aircraft tire size selection - Optimum performance with minimum maintenance [SAE PAPER 790598] A79-36730 LASER ANEMOMETERS Turbulent wake measurements with a laser velocimeter [AIAA PAPER 79-1087] A79-38058 LASER APPLICATIONS

Air Force Space Laser Communications A79-38706 Small hole drilling and inspection with pulsed laser systems --- in air-cooled aircraft engine

laser systems --- in air-cooled aircraft engine structures [AIAA PAPER 79-1268] A79-39012 LASER DOPPLER VELOCIMETERS INVERTIGATION OF A LASOR DOPPLOR RELOCIMETERS

Investigation of a laser Doppler velocimeter system to measure the flow field of a large scale V/STOL aircraft in ground effect [AIAA PAPER 79-1184] Application of Laser Doppler Anemometry to aeroacoustic research

A79-39500

LASER DRILLING Small hole drilling and inspection with pu	lseđ
laser systems in air-cooled aircraft	engine
structures [AIAA PAPER 79-1268] LATERAL STABLLITY	A79~39012
An annular wing [WASA-CASE-PEC-11007-2] LEADIWG EDGES	N79-24959
Supersonic flow in the area of antisymmetr cruciform wings with supersonic leading	ic thin
cruciform wings with supersonic leading a a horizontal plane, with consideration o separation on the edges	edges 11 f flow
[AD-A065993] LBAR JET AIRCRAFT	N79-23929
The Learjet 'Longhorn' series - The first with winglets	jets
[SAE PAPER 790581]	179-36716
LECTURES Non-destructive inspection methods for prop	pulsion
systems and components [AGARD-LS-103]	N79-25412
LIPE (DURABILITY)	
Composite applications at Bell Helicopter [SAE PAPER 790578]	A79-36713
Cost benefits from improved hot section li prediction technology for aircraft e	
combustor and turbine parts	-
[AIAA PAPER 79-1154] LIPB CYCLE COSTS	A79-38963
Changing requirements in aircraft design	A79-37044
Damage tolerant design - An approach to re	ducing
the life cycle cost of gas turbine engine [AIAA PAPER 79-1189]	e disks 179-38976
The monorotor gas turbine	
[AIAA PAPER 79-1230] Development of in-flight steady-state fails	A79-38994 1re rates
	A79-39912
Lower avionıc temperature - Lower life cyc.	A79-39914
Reliability and maintainability contribution Rornet mission success	on to
	179-39915
Advanced General Aviation Turbine Engine (concepts	SATE)
[NNSA-CR-159603] Life cycle cost analysis concepts and proc	N79-25017
	N79-25408
Recent experience in the development and application of LCC models	
	N79-25410
LIPT Conversion of wing surface pressures into	
normalized lift coefficient [SAE PAPER 790567]	179-36707
Analysis of an unsteady aerodynamic force (
blade due to ununiform amplitude gusts	179-39059
Generation and breakdown of aerodynamic li	
Physical mechanism	N79-23894
Polar lift and drag determination during f. tests	Light
[MBB-UFE-1410-0]	N79-24986
LIFT DRAG RATIO An annular wing	
[NASA-CASE-PRC~11007-2] LIPTING BODIES	N79-24959
Construction of an initial approximation for	
solution of the integral equation of a li surface	ifting
Protong influencing the accuracy of several	A79-35928
Pactors influencing the accuracy of aerody hinge-moment prediction	
[AD-A066606] LIGHT AIRCBAPT	N79-24965
Industry seeks lighter aircraft weight	
aırcraft design performance	A79-36100
Producing light aircraft - Three viability studies	case
Effects of a spin chute installation on spi	A79-36376 in
characteristics of light general avia aircraft	
[SAE PAPER 790564]	A79-36705

Conversion of wing surface pressures into normalized lift coefficient [SAE PAPER 790567] AT Nonlinear structural crash dynamics analyses 179-36707 A79-36722 [SAE PAPER 790588] Experimental verification of program KRASH - A mathematical model for general aviation structural crash dynamics [SAE PAPER 790589] A79-36 Seat/Occupant crash dynamic analysis verification A79-36723 test program [SAE PAPER 790590] A79-36 Crash~resistant fuel systems for general aviation A79-36724 aircraft [SAR PAPER 790592] A79-3 A new light twin using bonded metal construction 179-36726 [SAE PAPER 790603] A79-36735 An experimental study of propeller-induced structural vibration and interior noise [SAE PAPER 790625] A79-36753 Summary of noise reduction characteristics of typical general aviation materials [SAE PAPER 790627] A case study in design - The Gossamer Condor A79-36755 A79-37050 Digital flight control research using microprocessor technology A79-38533 Electric propulsion for high performance light aircraft [AIAA PAPER 79-1265] A79-39011 Exhaust emissions characteristics for a general aviation light-aircraft Avco Lycoming 10-360-A1B6D piston engine [AD-A066556] N79-25544 Exhaust emissions characteristics for a general aviation light-aircraft Avco-Lycoming 10-360-BiBD piston engine [AD-A066589] ₩79-25545 LIGHTNING The estimation of induced-voltage peak magnitude and energy level under LTA/EMP ercitation of low-loss aircraft cabling --- Lightning Transit Analysis/Electro-Magnetic Pulse 179-37238 The McDonnell Aircraft Company Lightning Simulation Laboratory 179-37294 Composite forward fuselage systems integration, volume 2 --- effects of lightning [AD-A066560] 179-24984 LIGHTNING SUPPRESSION Identification of voltage transients on aircraft cabling under LTA excitation --- Lightning Transient Analysis A79-38531 LIQUID INJECTION Ignition of liquid fuel jets in a supersonic air stream [AIAA PAPER 79-1238] A79-38997 LOAD DISTRIBUTION (PORCES) Minimization theory of induced drag subject to constraint conditions [NASA-CR-3140] 879-23923 LOGIC CIRCUITS The operational impact of Navy's first TAAF program P-3C Test, Analyze and Pix A79-39890 LOGIC DESIGN Sultivariable control altitude demonstration on the F100 turbofan engine [AIAA PAPER 79-1204] 179-39814 LOGISTICS Cargo Logistics Airlift Systems Study (CLASS). Volume 2: Case study approach and results [NASA-CR-158913] 179-24978 LONG TERM SPPECTS The effect of endless burn-in on reliability growth projections --- for solid state aviation electronics equipment 179-39920 LONGITUDINAL STABILITY An annular wing [NASA-CASE-PRC-11007-2] 879-24959 LORANC Loran C - Its future in the shadow of Navstar GPS A79-36071

LOW ALTITUDE

SUBJECT INDEX

Detection of low flying aircraft by acoustical means [REPT-8-78] N79-2 Technical evaluation report on the 25th Guidance N79-20779 and Control Panel Symposium on guidance and Control Design Considerations for Low Altitude and Terminal Area Flight [AGARD-AR-129] N79-25037 LON COST Evaluation of GPS performance for low-cost general aviation A79-36065 Some main points about general-aviation design practice A79-37047 LOW LEVEL TURBULENCE The effects of low-lewel wind shear on the approach and go-around performance of a landing net aircraft [SAE PAPER 790568] A79-36708 LOW SPEED The science and technology of low speed and motorless flight, part 1 [NASA-CP-2085] 179-23889 Low-speed single-element airfoil synthesis N79-23890 Generation and breakdown of aerodynamic lift: Physical mechanism 179-23894 Introduction to the arcopter arc wing and the Bertelsen effect for positive pitch stability and control N79-23895 LOW SPEED WIND TUNNELS Low-speed wind tunnel results for a modified 13-percent-thick airfoil [NASA-TM-X-74018] LUBRICANT TESTS N79-24960 Effects of extended oil changes on aircraft piston engine wear and oil characteristics [SAE PAPER 790629] 179-36756 LUBRICATING OILS Effects of extended oil changes on aircraft piston engine wear and oil characteristics [SAE PAPER 790629] Diagnostics of wear in aeronautical systems A79-36756 A79-39805 Water absorption of fluids/oils --- contamination of aircraft engine oils and inhibitors [AD-A065915] N79-24158 Aircraft engine oil analysis by neutron activation techniques [AD-A066202] N79-24169 LUBRICATION SYSTEMS Dry friction in the aerospace industry A79-39873 Μ MAGNETIC INDUCTION

Analytical modeling of the dynamics of brushless dc motors for aerospace applications: A conceptual framework [NASA-TH-80445] N79-25310 MAGNETIC RIGIDITY Vertical cutoff rigidity and the intensity distribution of cosmic rays near Cape Town 179-37468 HAGEBTIC SUSPENSION Measurement of the drag of slender cones in hypersonic flow at low Reynolds numbers using a magnetic suspension and balance [OUEL-1235/78] N79-23 N79-23938 MAINTAINABILITY The F-16 RIW program --- Reliability Improvement Warranty A79-39889 Lower avionic temperature - Lower life cycle cost A79-39914 Reliability and maintainability contribution to Hornet mission success A79-39915 MATNTEWANCE The test pilot in the airline industry or 'My bags are packed and I'm ready to go' 179-38478 Evaluation of materials for post-attack pavement repair [AD-A066516] N79-25251

HAN MACHINE SYSTEMS Computer graphics create the new wave of design 179-37046 Tachystoscopic testing of onboard instruments A79-38817 MAN OPERATED PROPULSION SYSTEMS A case study in design - The Gossamer Condor 179-37050 MANAGEMENT PLANNING Life cycle cost analysis concepts and procedures N79-25408 BANUAL CONTROL Sidestick/Throttle Controller - An alternate approach 179-38476 MANUALS VOLAR: A digital computer program for simulating VSTOL aircraft launch and recover from small Volume 2: Appendices ships. [AD-A066173] N79-23955 MARKET RESEARCH Some main points about general-aviation design practice A79-37047 BARKETIEG Airbus picks up speed - and the junior A310 takes off A79-36774 MATERIALS TESTS Installation for studying fatigue strength of materials in acoustic loading --- for aircraft skins A79-39070 HATHENATICAL HODELS Some possible applications of identification theory techniques in telemetry --- for aircraft communication A79-36589 Design of quiet efficient propellers [SAE PAPER 790584] A79-36719 A comparison of hydraulic, pneumatic, and electro-mechanical actuators for general aviation flight controls [SAE PAPER 790623] A79-36751 A tire runway interface friction prediction model concept A79-38137 Development of a gas turbine combustor dilution zone design analysis [AIAA PAPER 79-1194] A79-38979 Methodology for prediction of V/STOL propulsion induced forces in ground effect [AIAA PAPER 79-1281] A79-3901 Development of in-flight steady-state failure rates A79-39017 A79-39912 The production function and airframe cost estimation [AD-A065570] N79-23952 A simplified rotor system mathematical model for piloted flight dynamics simulation [NASA-TH-78575] N79-23977 Recent experience in the development and application of LCC models N79-25410 NATHENATICAL PROGRAMMING Wing shape optimization for maximum cross-country speed, with mathematical programming N79-23899 MATRICES (MATHBEATICS) An aircraft simulation using a product of exponentials as matrizant A79-38885 NECHANICAL DRIVES Electromechanical actuation for business aircraft [SAE PAPER 790622] A79-36 Driveshaft alignment indicator [AD-A065988] N79-23 A79-36750 N79-23973 MECHANICAL PROPERTIES Generation and breakdown of aerodynamic lift: Physical mechanism N79-23894 NETAL BONDING A new light twin using bonded metal construction [SAE PAPER 790603] A79-36735 HRTAL PATIGUE

HETAL FATIOUE Application of electron-beam welding to aviation production --- tests of turbine engine parts welded by electron beam N79-20940

NETAL SURPACES X-ray determination of internal stress states due to surface treatment of TiAl6V4 and TiAl6V6Sn2 A79-36003 SETAL-BETAL BONDING Bonding and durability --- for airframe structures [SAE PAPER 790561] A79-36702 Adhesive bonded structure of new pressurized piston twin alrcraft [SAE PAPER 790563] A79-36704 **HETROROLOGY** Forcasting the quantitative characteristics of aircraft icing [BLL-TRANS-1364-(9022.549)] N79-24971 METHOD OF CHARACTERISTICS Airfoil optimization for transonic flow using the methods of finite elements and characteristics [HBB-UFE-1362-0] N79-23937 MTCROPROCESSORS Byperbolic positioning per se is passe ---navigation computations from range measurements using microprocessor A79-36070 Digital flight control research using microprocessor technology A79-38533 Exploring team avionics systems by simulation A79-38882 The application of microprocessor technology to in-flight computation N79-23902 MICROWAVE INTERPEROMETERS Satellite interferometer as an advanced navigation/communication system A79-39602 MICROWAVE LANDING SYSTEMS Advanced braking controls for business aircraft [SAE PAPER 790599] A79-HILITARY AIRCRAFT A79-36731 Dassault-Brequet - The Mirage 2000 A79-36974 The impact of operational requirements on V/STOL propulsion concept selection [AIAA PAPER 79-1283] A79-39018 Development of in-flight steady-state failure rates 179-39912 Optimum frequencies for aircraft classification [AD-A065697] The impact of alternate fuels on aircraft N79-24220 configuration characteristics --- military aircraft [AD-A066983] 179-25244 HILITARY HELICOPTERS Nap-of-the-earth communication program for US Army helicopters [AD-A063089] N79-24232 MINI COMPUTERS A general aviation flight test application of the on-board computer [SAE PAPER 790583] A79-36718 General aviation aircraft design for performance using small computers [SAE PAPER 790614] 179-36743 Aerospace computer systems. Part 1: Avionics applications, volume 2. A bibliography with abstracts [NTIS/PS-79/0312/3] N79-23959 Aerospace computer systems. Part 1: Avionics applications, volume 3. A bibliography with abstracts [NTIS/PS-79/0313/1] N79-23960 SINIAUN DRAG Minimization theory of induced drag subject to constraint conditions [NASA-CR-3140] N79-23923 BOISTURE CONTENT Formation of water-fuel emulsions in tanks of grounded aircraft 179-36587 NOTION SICKNESS Notion in flight simulation: An annotated bibliography [AD-A061687] N79-25042 HOTION SINULATORS Notion in flight simulation: An annotated bibliography [AD-A061687] N79-25042

A family of air traffic control radars
A79-3853
BECA AIECEAFT
Development of an airborne military system (HRCA system)
[NBB-UFE-1322-0] N79-2390
stbr
Development of in-flight steady-state failure rates
A79-3991
Reliability and maintainability contribution to Hornet mission success
179-3991

Ν

WACELLES Factors influencing nacelle design on the 747 [AIAA PAPER 79-1236] NASA PROGRAMS 179-38996 NASA general aviation crashworthiness seat development [SAE PAPER 7905911 179-36725 WAVIGATION A system for providing an integrated display of instantaneous information relative to aircraft attitude, heading, altitude, and horizontal situation [NASA-CASE-FRC-11005-1] N79-24988 HAVIGÀTION AIDS Ryperbolic positioning per se is passe ---navigation computations from range measurements using microprocessor 179-36070 Loran C - Its future in the shadow of Navstar GPS 179-36071 Theoretical fundamentals of radio altimetry ---Russian book 179-38145 An evaluation of turn anticipation techniques and offset flying procedures using a single-waypoint RNAN system [AD-A066555] N79-24974 NAVIGATION TECHNOLOGY SATELLITES Recent results in navigation systems utilizing signal aiding from Navstar satellites A79-36096 WAVSTAR SATELLITES Loran C - Its future in the shadow of Navstar GPS 179-36071 Recent results in navigation systems utilizing signal aiding from Navstar satellites 179-36096 NEAR FIELDS High frequency near field scattering by an elliptic disk [AD-A065586] WETWORK AWALTSIS N79-24214 The estimation of induced-voltage peak magnitude and energy level under LTA/EMP excitation of low-loss aircraft cabling --- Lightning Transit Analysis/Electro-Magnetic Pulse A79-37238 NEUTRON ACTIVATION ANALYSIS Aircraft engine oil analysis by neutron activation techniques [AD-A066202] N79-24169 BICKEL COATINGS Internally coated air-cooled gas turbine blading [NASA-CR-159574] N79-2 N79-25018 HIGHT PLIGHTS (AIRCRAFT) Night/Adverse Weather A-10 evaluator program 179-38479 WITRIC OXIDE Effect of fuel/air nonuniformity on nitric oride emissions N79-25004 Optical in situ versus probe measurements of nitric oxide concentration as a function of axial position in a combustor exhaust [AD-A067329] N79-25025 NITROGEN OXIDES The effect of fuel sprays on emissions from a gas turbine combustor [AIAA PAPER 79-1321] A79-39037

HOISE INTENSITY

NOTSE INTENSITY Statistical comparisons of aircraft flyover noise adjustment procedures for different weather conditions [NASA-TP-1430] N79-24773 Tone noise of three supersonic helical tip speed propellers in a wind tunnel [NASA-TM-79167] HOISE MEASUREMENT N79-25840 Summary of noise reduction characteristics of typical general aviation materials [SAE PAPER 790627] A study of the evolution of noise exposure under A79-36755 different hypotheses of regulation [ONERA, TP NO. 1979-44] A79-Validation of aircraft noise prediction program [NASA-CR-159047] N79-A79-39093 N79-25843 BOISE POLLUTION A study of the evolution of noise exposure under different hypotheses of regulation [ONERA, TP NO. 1979-44] Alertaft sonic boom: Effects on buildings. A A79-39093 bibliography with abstracts [NTIS/PS-79/0265/3] HOISE PROPAGATION N79-24201 Propeller aircraft noise around general aviation airports SAE PAPER 7905941 A79-36728 An experimental study of propeller-induced structural vibration and interior noise [SAE PAPER 790625] Status of knowledge of sonic booms [NASA-TH-80113] A79-36753 N79-24955 NOISE REDUCTION Design of quiet efficient propellers [SAE PAPER 790584] A79-3671 The impact of noise regulations on propeller design 179-36719 [SAE PAPER 790593] 179-36727 Propeller aircraft noise around general aviation airports [SAE PAPER 790594] A79-36728 Clean General Aviation Turbofan [SAE PAPER 790596] A79-36 A79-36729 Engine induced structural-borne noise in a general aviation aircraft [SAE PAPER 790626] A79-36754 Summary of noise reduction characteristics of Summary of noise reduction characteristics of typical general aviation materials [SAE PAPER 790627] A79-3675 Designing with damping materials to reduce noise and structural fatigue --- of aircraft components A79-36755 [SAE PAPER 790631] A79-36758 [SAE PAPER /90631] A/9-36 A study of the evolution of noise exposure under different hypotheses of regulation [ONERA, TP NO. 1979-44] A79-39 Aircraft engine nozzle [NASA-CASE-ARC-10977-1] N79-23 Aircraft sonic boom: Studies on aircraft flight, A79-39093 N79-23971 aircraft design, and measurement. A bibliography with abstracts [NTIS/PS-79/0264/6] N79-24780 Relicopter transmission vibration and noise reduction program. Volume 3: Evaluation of fiber PP metal-matrix housing specimens [AD-A066794] N79 Aircraft and airport noise reduction N79-24983 [GPO-29-661] N79-25038 BOISE SPECTRA Statistical comparisons of aircraft flyover noise adjustment procedures for different weather conditions [NASA-TP-1430] NONDESTRUCTIVE TESTS N79-24773 Definition and non-destructive detection of critical adhesive bond-line flaws [AD-A065584] N79-24163 Non-destructive inspection methods for propulsion systems and components [AGAND-LS-103] N79-2 State-of-the-art of nondestructive inspection of N79-25412 aircraft engines N79-25413 Non-destructive methods for the early detection of fatigue damage in aircraft components N79-25417 Broad-band transducers for nondestructive inspection of aeronautical components N79-25419

SUBJECT INDEX

NONEQUILIBRIUM FLOW Theory of thin wing in a supersonic flow with consideration of the non-equilibrium state of excitation of oscillating degrees of freedom [AD-A065992] N79-23928 NOSE FINS Investigation of aerodynamic characteristics of subsonic wings [NASA-CR-158661] N79-23921 NOZZLE DESIGN Partially variable area turbine nozzle [AIAA PAPER 79-1227] A79-38992 Static test of a large scale swivel nozzle thrust deflector [AIAA PAPER 79-1285] A79-39020 Evaluation of ground-launch firings for the improved 2.75-inch rocket [AIAA PAPER 79-1297] A79-39027 Aircraft engine nozzle [NASA-CASE-ARC-10977-1] HOZZLE FLOW N79-23971 Velocity slip and temperature difference of gas mixtures in quasi-one-dimensional nozzle flows A79-36423 Profiling of two-dimensional and three-dimensional nozzles and calculation of their flows A79-38168 NOZZLE GRONETRY Profile of a nozzle shaping the free-molecule flow intended to investigate air-intakes and cascades A79-36122 A parametric study of support system interference effects on nozzle/afterbody throttle dependent effects on nozzle/alterbody throtte dependent drag in wind tunnel testing [ATAA PAPER 79-1168] A79-38 Assessment at full scale of nozzle/wing geometry A79-38968 effects on OTW aeroacoustic characteristics · Over The Wing STOL engine configurations 179-39802 Theoretical fan velocity distortions due to inlets and nozzles --- in V/STOL aircraft [NASA-TH-79150] N79-23911 Assessment at full scale of nozzle/wing geometry effects on OTW aero-acoustic characteristics short takeoff aircraft noise [NASA-TM-79168] N79-25841 WOZZLES Evaluation of methods for prediction of propulsion system drag [AIAA PAPER 79-1148] A79-38961 NUCLEAR BHULSIONS Observation of atmospheric interactions at aeroplane altitude --- gamma ray emulsion experiments A79-37573 NUCLEAR EXPLOSIONS NOVA-25, a stiffened panel extension of the NOVA-2 computer program [AD-A066038] N79-23951 NUCLBONS Vertical cutoff rigidity and the intensity distribution of cosmic rays near Cape Town A79-37468 NUMERICAL CONTROL Digital flight control research using microprocessor technology A79-38533 Application of digital controls on the quiet clean short haul experimental engines [AIAA PAPER 79-1203] A79-. Multivariable control altitude demonstration on A79-38984 the P100 turbofan engine [AIAA PAPER 79-1204] Multifunction keyboard implementation study A79-39814 [AD-A066140] N79-25046 NUMERICAL PLON VISUALIZATION Numerical calculation of inviscid transonic flow through rotors and fans N79-23906

0

OMEGA NAVIGATION SYSTEM Internationalization of OMEGA

A79-36069 The MX 1105, an integrated Transit/Omega navigator A79-36072

PERFORMANCE TESTS

ONBOARD EQUIPHENT	
A general aviation flight test application	of the
on-board computer	
[SAE PAPER 790583]	179-36718
Aerospace computer systems. Part 1: Avior	
applications, volume 2. A bibliography	
abstracts	ercu.
[NTIS/PS-79/0312/3]	770 33050
	N79-23959
Aerospace computer systems. Part 1: Avion	
applications, volume 3. A bibliography w	rith
abstracts	
[NTIS/PS-79/0313/1]	N79-23960
OPERATING TEMPERATURE	
Engine demonstration test of a cooled lamin	nated
arıal turbine	
[AIAA PAPER 79-1229]	∆ 79-38993
OPTICAL COMBUNICATION	
An optical-fiber multiterminal data system	for
aircraft	
	A79-36484
Air Force Space Laser Communications	1.5 00.00
THE FOLGE OF HER BADON COMMANDER CONS	179-38706
OPTICAL MEASUREMENT	AT) 30700
Naking fluid flows visible	
Haking fidia 11045 VISIDIE	170 16172
	179-36373
OPTIBAL CONTEOL	. .
Active control for the Total-In-Flight sime	ilator
(ACTIFS)	
[NASA-CR-3118]	N79-23978
Time optimal control of a jet engine using	a
quasi-Hermite interpolation model	
[NA SA-CR-158711]	N79-25019
Optimal placement of regional flight simula	
[AD~A060450]	N79-25043
OPTIMIZATION	
Optimal selection of the geometrical characteristics of the reversing channel	of a
small-scale turbine with readmission of t	the gas
for aircraft auxiliary power systems	the gas
tor arrelate auxiliary power systems	N79-36583
The design and coloction of optimum propoll	
The design and selection of optimum propell	Let S TOT
general aviation aircraft	
[SAE PAPER 790575]	179-36711
Proper aircraft tire size selection - Optim	un
performance with minimum maintenance	
[SAE PAPER 790598]	A79-36 7 30
Minimization theory of induced drag subject constraint conditions	: to
[NASA-CR-3140]	N79-23923
Substructuring methods for design sensitive analysis and structural optimization	ity
analysis and structural optimization	
[AD~A065935]	N79-23949
ORIFICE FLOW	
Chilled FLOW	
	a
Determination of cooling air mass flow for horizontally-opposed aircraft engine inst	
Determination of cooling air mass flow for	
Determination of cooling air mass flow for horizontally-opposed aircraft engine inst	tallation
Determination of cooling air mass flow for horizontally-opposed aircraft engine inst [SAE PAPER 790609] OSCILLATING CYLINDERS	tallation A79-36740
Determination of cooling air mass flow for horizontally-opposed aircraft engine inst [SAB PAPER 790609]	tallation A79-36740
Determination of cooling air mass flow for horizontally-opposed aircraft engine inst [SAE PAPER 790609] OSCILLATING CYLINDERS	tallation A79-36740 ceview
Determination of cooling air mass flow for horizontally-opposed aircraft engine inst [SAE PAPER 790609] OSCILLATING CYLINDERS Vorter-induced oscillations - A selective r OSCILLATING FLOW	tallation 179-36740 teview 179-39751
Determination of cooling air mass flow for horizontally-opposed aircraft engine inst [SAB PAPER 790609] OSCILLATING CYLINDERS Vortex-induced oscillations - A selective m OSCILLATING PLOW Theoretical analysis of transonic flow past	tallation 179-36740 teview 179-39751
Determination of cooling air mass flow for horizontally-opposed aircraft engine inst [SAE PAPER 790609] OSCILLATING CYLINDERS Vortex-induced oscillations - A selective r OSCILLATING PLOW Theoretical analysis of transonic flow past unstaggered oscillating cascades	tallation A79-36740 teview A79-39751
Determination of cooling air mass flow for horizontally-opposed aircraft engine inst [SAE PAPER 790609] OSCILLATING CYLINDERS Vortex-induced oscillations - A selective m OSCILLATING PLOW Theoretical analysis of transonic flow past unstaggered oscillating cascades [AD-A063083]	tallation 179-36740 teview 179-39751
Determination of cooling air mass flow for horizontally-opposed aircraft engine inst [SAE PAPER 790609] OSCILLATING CYLINDERS Vortex-induced oscillations - A selective m OSCILLATING FLOW Theoretical analysis of transonic flow past unstaggered oscillating cascades [AD-A063083] OSCILLATIONS	xallation A79-36740 x79-39751 x79-39751 x79-24963
Determination of cooling air mass flow for horizontally-opposed aircraft engine inst (SAE PAPER 790609] OSCILLATING CYLINDERS Vortex-induced oscillations - A selective r OSCILLATING PLOW Theoretical analysis of transonic flow past unstaggered oscillating cascades [AD-A063083] OSCILLATIONS An introduction to dynamic derivatives. 2:	:allation A79-36740 A79-39751 A79-24963 : The
Determination of cooling air mass flow for horizontally-opposed aircraft engine inst [SAP PAPER 790609] OSCILLATING CYLINDERS Vortex-induced oscillations - A selective m OSCILLATING PLOW Theoretical analysis of transonic flow past unstaggered oscillating cascades [AD-A063083] OSCILLATIONS An introduction to dynamic derivatives. 2: equations of motion for wind tunnel pitcl	:allation A79-36740 A79-39751 A79-24963 : The
Determination of cooling air mass flow for horizontally-opposed aircraft engine inst [SAE PAPER 790609] OSCILLATING CYLINDERS Vortex-induced oscillations - A selective r OSCILLATING FLOW Theoretical analysis of transonic flow past unstaggered oscillating cascades [AD-A063083] OSCILLATIONS An introduction to dynamic derivatives. 2: equations of motion for wind tunnel pitch oscillation rigs	allation A79-36740 eview A79-39751 t N79-24963 t The h-yaw
Determination of cooling air mass flow for horizontally-opposed aircraft engine inst [SAE PAPER 790609] OSCILLATING CYLINDERS Vortex-induced oscillations - A selective r OSCILLATING PLOW Theoretical analysis of transonic flow past unstaggered oscillating cascades [AD-A063083] OSCILLATIONS An introduction to dynamic derivatives. 2: equations of motion for wind tunnel pitc! oscillation rigs [ARL-AERO-NOTE-377]	:allation A79-36740 A79-39751 A79-24963 : The
Determination of cooling air mass flow for horizontally-opposed aircraft engine inst [SAP PAPER 790609] OSCILLATING CYLINDERS Vortex-induced oscillations - A selective r OSCILLATING PLOW Theoretical analysis of transonic flow past unstaggered oscillating cascades [AD-A063083] OSCILLATIONS An introduction to dynamic derivatives. 2: equations of motion for wind tunnel pitch oscillation rigs [ARL-AERO-NOTE-377] OUTLET FLOW	allation A79-36740 evlew A79-39751 t N79-24963 t The 1-yaw N79-23982
Determination of cooling air mass flow for horizontally-opposed aircraft engine inst [S&PAPER 790609] OSCILLATING CYLINDERS Vortex-induced oscillations - A selective m OSCILLATING FLOW Theoretical analysis of transonic flow past unstaggered oscillating cascades [AD-A063083] OSCILLATIONS An introduction to dynamic derivatives. 2: equations of motion for wind tunnel pitch oscillation rigs [ARL-AERO-NOTE-377] OUTLET FLOW Turbulence measurements in the compressor of	allation A79-36740 evlew A79-39751 t N79-24963 t The 1-yaw N79-23982
Determination of cooling air mass flow for horizontally-opposed aircraft engine inst [SAP PAPER 790609] OSCILLATING CYLINDERS Vortex-induced oscillations - A selective r OSCILLATING PLOW Theoretical analysis of transonic flow past unstaggered oscillating cascades [AD-A063083] OSCILLATIONS An introduction to dynamic derivatives. 2: equations of motion for wind tunnel pitch oscillation rigs [ARL-AERO-NOTE-377] OUTLET FLOW	allation A79-36740 evlew A79-39751 t N79-24963 t The 1-yaw N79-23982
Determination of cooling air mass flow for horizontally-opposed aircraft engine inst [S&PAPER 790609] OSCILLATING CYLINDERS Vortex-induced oscillations - A selective m OSCILLATING FLOW Theoretical analysis of transonic flow past unstaggered oscillating cascades [AD-A063083] OSCILLATIONS An introduction to dynamic derivatives. 2: equations of motion for wind tunnel pitch oscillation rigs [ARL-AERO-NOTE-377] OUTLET FLOW Turbulence measurements in the compressor of	allation A79-36740 evlew A79-39751 t N79-24963 t The 1-yaw N79-23982
Determination of cooling air mass flow for horizontally-opposed aircraft engine inst [S&PAPER 790609] OSCILLATING CYLINDERS Vortex-induced oscillations - A selective m OSCILLATING FLOW Theoretical analysis of transonic flow past unstaggered oscillating cascades [AD-A063083] OSCILLATIONS An introduction to dynamic derivatives. 2: equations of motion for wind tunnel pitch oscillation rigs [ARL-AERO-NOTE-377] OUTLET FLOW Turbulence measurements in the compressor of	<pre>allation A79-36740 eview A79-39751 t N79-24963 t The -yaw N79-23982 exit</pre>
Determination of cooling air mass flow for horizontally-opposed aircraft engine inst [SAP PAPER 790609] OSCILLATING CYLINDERS Vortex-induced oscillations - A selective r OSCILLATING PLOW Theoretical analysis of transonic flow past unstaggered oscillating cascades [AD-A063083] OSCILLATIONS An introduction to dynamic derivatives. 2: equations of motion for wind tunnel pitch oscillation rigs [ARL-AERO-NOTE-377] OUTLET FLOW Turbulence measurements in the compressor of flow of a General Electric CP6-50 engine OVERPRESSURE	allation A79-36740 eview A79-39751 t N79-24963 The h-yaw N79-23982 exit N79-24996
Determination of cooling air mass flow for horizontally-opposed aircraft engine inst (SAE PAPER 790609] OSCILLATING CYLINDERS Vortex-induced oscillations - A selective r OSCILLATING PLOW Theoretical analysis of transonic flow past unstaggered oscillating cascades [AD-A063083] OSCILLATIONS An introduction to dynamic derivatives. 2: equations of motion for wind tunnel pitch oscillation rigs [ARL-AERO-NOTE-377] OUTLET FLOW Turbulence measurements in the compressor of flow of a General Electric CP6-50 engine OVERPRESSURE NOVA-2S, a stiffened panel extension of the	allation A79-36740 eview A79-39751 t N79-24963 The h-yaw N79-23982 exit N79-24996
Determination of cooling air mass flow for horizontally-opposed aircraft engine inst (SAE PAPER 790609] DSCILLATING CYLINDERS Vortez-induced oscillations - A selective r OSCILLATING FLOW Theoretical analysis of transonic flow past unstaggered oscillating cascades (AD~A063083] OSCILLATIONS An introduction to dynamic derivatives. 2: equations of motion for wind tunnel pitch oscillation rigs [ARL-AERO-NOTE-377] OUTLET FLOW Turbulence measurements in the compressor of flow of a General Electric CF6-50 engine OVERPRESSURE NOVA-2S, a stiffened panel extension of the computer program	allation A79-36740 eview A79-39751 t N79-24963 The h-yaw N79-23982 exit N79-24996
Determination of cooling air mass flow for horizontally-opposed aircraft engine inst (SAE PAPER 790609] OSCILLATING CYLINDERS Vortex-induced oscillations - A selective r OSCILLATING PLOW Theoretical analysis of transonic flow past unstaggered oscillating cascades [AD-A063083] OSCILLATIONS An introduction to dynamic derivatives. 2: equations of motion for wind tunnel pitch oscillation rigs [ARL-AERO-NOTE-377] OUTLET FLOW Turbulence measurements in the compressor of flow of a General Electric CP6-50 engine OVERPRESSURE NOVA-2S, a stiffened panel extension of the	allation A79-36740 eview A79-39751 t N79-24963 t The yaw N79-23982 exit N79-24996 exit N79-24996
Determination of cooling air mass flow for horizontally-opposed aircraft engine inst (SAE PAPER 790609] DSCILLATING CYLINDERS Vortez-induced oscillations - A selective r OSCILLATING FLOW Theoretical analysis of transonic flow past unstaggered oscillating cascades (AD~A063083] OSCILLATIONS An introduction to dynamic derivatives. 2: equations of motion for wind tunnel pitch oscillation rigs [ARL-AERO-NOTE-377] OUTLET FLOW Turbulence measurements in the compressor of flow of a General Electric CF6-50 engine OVERPRESSURE NOVA-2S, a stiffened panel extension of the computer program	allation A79-36740 eview A79-39751 t N79-24963 t The yaw N79-23982 exit N79-24996 exit N79-24996

Ρ

P-3 AIRCRAFT The operational impact of Navy's first TAAF program P-3C Test, Analyze and Fix
179-39890
PANELS
NOVA-25, a stiffened panel extension of the NOVA-2
computer program
[AD-A066038] N79-23951

PARACHUTES Effects of a spin chute installation on spin characteristics --- of light general aviation aircraft SAE PAPER 7905641 179-36705 PARANETERTZATION Life cycle cost analysis concepts and procedures N79-25408 PARTICLE INTERACTIONS Observation of atmospheric interactions at aeroplane altitude --- gamma ray emulsion experiments 179-37573 PASSENGER AIRCRAFT A European view on gas turbine engine monitoring of present and future civil aircraft [ATAM PAPER 79-1200] The airport performance model. Volume 1: Extensions, validations, and applications A79-38982 [AD-A062863] \$79-25040 PAVENENTS Evaluation of materials for post-attack pavement repair [AD-A066516] N79-25251 PERFORMANCE PREDICTION Evaluation of GPS performance for low-cost general aviation A79-36065 Reliability, performance, and fault isolation considerations in the design of interconnected navigation systems A79-36077 The design and selection of optimum propellers for general aviation aircraft [SAE PAPER 790575] A79-36711 The analysis of propellers including interaction effects --- for general aviation aircraft [SAE PAPER 790576] A79-30 A79-36712 Selection of aircraft turbocharger systems [SAE PAPER 790608] A79-3 General aviation aircraft design for performance A79-36739 using small computers [SAE PAPER 790614] A79-: Fossil fuel heat pumps for domestic, commercial and industrial space heating A79-36743 A79-37852 A tire runway interface friction prediction model concept 179-38137 The multiple application core engine - Sizing and usage criteria --- high-pressure rotors in jet engines [AITA PAPER 79-1123] A novel correlation of centrifugal compressor performance for off-design prediction [AITA PAPER 79-1159] A7 A79-38953 A79-38965 Damage tolerant design - An approach to reducing the life cycle cost of gas turbine engine disks [AIAA PAPER 79-1189] A79-38 A79-38976 Methodology for prediction of V/STOL propulsion induced forces in ground effect [AIAA PAPER 79-1281] A79-39017 [AIAA PAPER /9-1281] What small turbine engine does the small helicopter need, or The road to hell is paved with good intentions --- fuel consumption, performance, environmental and engine reliability and acceptability considerations subordinating advanced turbine engine development for small helicopters [AIAA PAPER 79-1314] A79-39032 improved method for predicting the effects of flight on jet mixing noise Δn A79-39803 Regression Simulation of turbine engine performance: [AD-A066398] Accuracy improvement (task 4) N79-25027 PERFORMANCE TESTS The impact of noise regulations on propeller design [SAE PAPER 790593] 179-36727 Determination of cooling air mass flow for a [SAE PAPER 790609] AT wass flow for a horizontally-opposed aircraft engine installation A79-3674 A79-36740 A canister fuel pump for general aviation aircraft [SAE PAPER 790624] A79-367 An experimental study of propeller-induced A79-36752

[SAE FAFER 750524] An experimental study of propeller-induced structural vibration and interior noise [SAE FAFER 790625] A79-36753

Wind tunnel performance of four energy efficient propellers designed for Mach 0.8 cruise [SAE PAPER 790573] A79-36759 Model study of aircraft disk brakes A79-38816 Tachystoscopic testing of onboard instruments A79-38817 Test verification of a turbofan partial swirl afterburner [AIAA PAPER 79-1199] A79-38981 Partially variable area turbine nozzle [AIAA PAPER 79-1227] 179-38992 Engine demonstration test of a cooled laminated axial turbine [ATAN PAPER 79-1229] Evaluation of ground-launch firings for the improved 2.75-inch_rocket A79-38993 [AIAA PAPER 79-1297] A79-39027 Emission characteristics of a premix combustor fueled with a simulated partial-oxidation product gas [AIAA PAPER 79-1322] 179-39038 PERSONNEL DEVELOPMENT The dynamics of a general aviation pilot promotion campaign A79-38886 PERTURBATION The effect of disturbance on a wing N79-23893 PHOTOVOLTAIC CONVERSION Photovoltaics and environmental impact considerations N79-25496 PIEZOELECTRIC TRANSDUCERS Broad-band ultrasonic transducers for non-destructive inspection of aeronautical components [ONERA, TP NO. 1979-45] PILOT SELECTION A79-39094 The dynamics of a general aviation pilot promotion campaign A79-38886 PILOT TRAINING Contributions of platform motion to simulator training effectiveness. Study 2: Aerobatics [AD-A064305] N79-23985 PISTON BUGINES Concepts for reducing exhaust emissions and fuel consumption of the aircraft piston engine [SAE PAPER 790605] [SAE PAPER 790605] A79-3673 Determination of cooling air mass flow for a horizontally-opposed aircraft engine installation [SAE PAPER 790609] A79-3674 Effects of extended oil changes on aircraft piston engine wear and oil characteristics [SAE PAPER 790629] A79-3675. What small turbine engine does the small A79-36737 179-36740 A79-36756 What small turbine engine does the small helicopter need, or The road to hell is paved with good intentions --- fuel consumption, performance, environmental and engine reliability and acceptability considerations subordinating advanced turbine engine development for small helicopters [AIRA PAPER 79-1314] A79-1 Exhaust emissions characteristics for a general A79-39032 aviation light-aircraft Avco Lycoming 10-360-A1B6D piston engine [AD-A066556] N79-25544 Exhaust emissions characteristics for a general aviation light-aircraft Avco-Lycoming 10-360-BiBD piston engine [AD-A0665891 179-25545 PITCE (INCLINATION) Introduction to the arcopter arc wing and the Bertelsen effect for positive pitch stability and control N79-23895 An introduction to dynamic derivatives. 2: The equations of motion for the equations of motion for wind tunnel pitch-yaw oscillation rigs [ARL-AERO-NOTE-377] N79-23982 PITCHING HOMENTS Some theoretical considerations of a stall proof airplane [SAE PAPER 790604] A79-3 179-36736 PLANAR STRUCTURES Minimization theory of induced drag subject to constraint conditions [#ASA-CR-3140] ₩79-23923

SUBJECT INDEX

PLANE WAVES An asymptotic result for the scattering of a plane wave by a smooth convex cylinder [AD-A065588] N79+24229 PLASTIC COATINGS An exploratory investigation of the effect of plastic coating on the profile drag of a practical-metal-construction sailplane airfoil N79-23891 PLASTICS Aircon electrically heated acrylic --- for ice formation prevention on aircraft transparencies [SAE PAPER 790600] A79-36 PLATES (STRUCTURAL BEHBERS) 179-36732 A variational theorem for laminated composite plates of nonlinear materials and applications to postbuckling N79-24977 PLUG NOZZLES Effect of shocks on film cooling of a full scale turbojet exhaust nozzle having an external expansion surface [NASA-TM-79157] N79-23966 PNBUMATIC CONTROL A comparison of hydraulic, pneumatic, and electro-mechanical actuators for general aviation flight controls [SAE PAPER 790623] POLLUTION CONTROL **X79-36751** LUTION CONTROL Concepts for reducing exhaust emissions and fuel consumption of the aircraft piston engine [SAE PAPER 790605] A79-30 Lean, premixed, prevaporized combustion for aircraft gas turbine engines [AIAA PAPER 79-1318] A79-33 Contribution to the development of motor emission A79-36737 179-39034 Contribution to the development of motor emission regulations [ONERA, TP NO. 1979-43] A79-3909 Advanced low emissions catalytic combustor program at General Electric A79-39092 179-25011 Advanced low emissions catalytic combustor program at Pratt and Whitney N79-25012 Lean, premixed, prevaporized combustor conceptual design study N79-25013 N79-25 Lean, premixed, prevaporized combustor conceptual design study N79-25014 **POLYTETRAFLUOROETHYLENE** Transient ablation of Teflon in intense radiative and convective environments A79-38123 POLYURETHANE FOAM Development of an aircraft composite propeller [SAE PAPER 790579] POTENTIAL FLOW 179-36714 The computation of transonic flow in wind tunnels at inlets and cascades using the finite element method [MBB-UFE-1421-0] N79-24970 POWDER METALLURGY The application of rapid solidification rate superalloys to radial wafer turbine blades [AIAA PAPER 79-1226] A A79-38991 POWER CONDITIONING Electromechanical actuation for business aircraft [SAE PAPER 790622] A79-36 POWER EPPICIENCY A79-36750 Manufacturers developing fuel-efficient engines A79-36380 Effectiveness of readmission of the gas in high-pressure-ratio small-scale turbines --- for aircraft auxiliary power systems A79-36584 POWER LINES. Identification of voltage transients on aircraft cabling under LTA excitation --- Lightning Transient Analysis A79-38531 POWER SPECTRA Application of advanced data reduction methods to gas turbine dynamic analysis A79-36024 Prediction of the angular response power spectral density of aircraft structures [AD-A066141] N79-23956

A-30

PREDICTION ANALYSIS TECHNIQUES The effect of endless burn-in on reliability growth projections --- for solid state aviation electronics equipment A79-39920 Validation of aircraft noise prediction program [HASA-CR-159047] PREMIXED FLAMES N79-25843 [NASA-CP-2078] N79-2 N79-24994 PRESSURE DISTRIBUTION Evaluation of an ejector-powered engine simulator at transonic Mach numbers [AIAA PAPER 79-1165] A79-38967 Combined pressure and temperature distortion effects on internal flow of a turbofan engine [WASA-TH-79136] N79-23963 Interactional aerodynamics of the single rotor helicopter configuration. Volume 2B: Harmonic analysis of airframe surface pressure data, runs 7-14, mid section [AD-A061860] N79-24967 PRESSURE EFFECTS Influence of the flow angle on the characteristics of an elbow-shaped air intake --- of gas turbine engines A79-36585 Combined pressure and temperature distortion effects on internal flow of a turbofan engine [AIAA PAPER 79-1309] A79-Å79-39031 [AIAA PAPEx /3-1309] Predicted P100 engine response to circumferential pressure and temperature distortion [AIAA PAPER 79-1310] Effect of steady-state pressure distortion on flow characteristics entering a turbofan engine frict.mm.7013h A79-39819 [NASA-TM-79134] N79-23969 PRESSURE GAGES Feasibility and cost effectiveness of airborne tire pressure indicating systems [AD-A065513] PRESSURE OSCILLATIONS N79-24981 Bifects of steady-state pressure distortion on the stall margin of a J85-21 turbojet engine [NASA-TH-79123] N79-239 N79-23968 PRESSURE SEESORS Conversion of Wing surface pressures into normalized lift coefficient [SAE PAPER 790567] PRESSURIZED CABINS A79-36707 Adhesive bonded structure of new pressurized piston twin alrcraft [SAE PAPER 790563] A79-36704 PRIMERS (COATINGS) Evaluation of new bonding systems for depot-level maintenance of aircraft honeycomb panels [AD-A066117] PROBABILITY DENSITY FUNCTIONS N79-24161 Application of advanced data reduction methods to gas turbine dynamic analysis A79-36024 PRODUCT DEVELOPMENT The Rockwell International Sabreliner-65: Case study in aircraft design --- Book A79-36645 Development of the Beechcraft Model 77 [SAE PAPER 790617] A79-General aviation turbine engine /GATE/ concepts [ATAA PAPER 79-1157] A79-Turborin design for general aviation - The A79-36745 A79-38964 Turbo-fan design for general aviation - The evolution of the RB.401 [AIAA PAPER 79-1160] PRODUCTION ENGIBERRING A79-38966 Development of the Beechcraft Hodel 77 [SAE PAPER 790617] A79-36745 Computer graphics create the new wave of design A79-37046 Some main points about general-aviation design practice A79-37047 Design, meet production --- aircraft cost and performance tradeoff considerations A79-37048 Life cycle cost analysis concepts and procedures N79-25408 PROGRAM TREND LINE ANALYSIS A review of the icing situation from the standpoint of general aviation N79-23918

PROGRAM VEHIFICATION (COMPUTERS) Experimental verification of program KRASE - A mathematical model for general aviation structural crash dynamics [SAE PAPER 790589] A79-36723 Validation of alrcraft noise prediction program [HASA-CR-159047] PROGRAMMING LANGUAGES N79-25843 Exploring team avionics systems by simulation A79-38882 PROJECT NANAGRARM The operational impact of Navy's first TAMP program P-3C Test, Analyze and Fix A79-39890 PROJECT PLANNING Is the AV-8B Advanced Harrier aircraft ready for full-scale development [PB-290826/7] N79-24987 PROPRILER BLADES The design and selection of optimum propellers for general aviation aircraft [SAE PAPER 790575] A79-36711 The analysis of propellers including interaction effects --- for general aviation aircraft [SAE PAPER 790576] 179-36712 Development of an aircraft composite propeller [SAE PAPER 790579] A79-36714 Practical design of minimum induced loss propellers 179-36714

 Practical design of minimum induced loss properters

 [SAE PAPER 790585]

 The impact of noise regulations on propeller design

 [SAE PAPER 790593]

 A79-3672'

 In experimental study of propeller-induced

 179-36720 179-36727 structural vibration and interior noise [SAE PAPER 790625] A79-36 Tone noise of three supersonic helical tip speed 179-36753 propellers in a wind tunnel A79-39801 Interference effects of aircraft components on the local blade angle of attack of a wing-mounted propeller [NASA-TM-78587] N79-25021 [NASA 14 10507] Tone noise of three supersonic helical tip speed propellers in a wind tunnel [NASA-TH-79167] N79-25 N79-25840 PROPELLER DRIVE Experimental data on the dynamic properties of several propeller wanes --- turbulence measurement in wind tunnel 179-38903 PROPELLER EFFICIENCY The design and selection of optimum propellers for general aviation aircraft [SAE PAPER 790575] N79-3671 Practical design of minimum induced loss propellers 179-36711 [SAE PAPER 790585] 179-36720 [SAK PAPER 790585] A79-3673 Wind tunnel performance of four energy efficient propellers designed for Mach 0.8 cruise [SAE PAPER 790573] A79-3679 The application of the Prop-Fan concept in preliminary design of a very advanced technology light twin /VATLIT '85/ [AIAA PAPER 79-1343] A79-3900 179-36759 179-39047 PROPELLER PANS The application of the Prop-Fan concept in preluminary design of a very advanced technology light tvin /VATLIT '85/ [AIAA PAPER 79-1343] A79-390 179-39047 Design study and performance analysis of a high-speed multistage variable-geometry fan for a variable cycle engine [NASA-CR-159545] N79-25020 PROPELLERS Design of quiet efficient propellers [SAE PAPER 790584] 179-36719 Design of propellers for motorsoarers N79-23903 Simulated propeller slipstream effects on a supercritical wing N79-25024 [NASA-CR-152138] PROPULSTON Advanced General Aviation Turbine Engine (GATE) concepts [NASA-CR-159603] PROPULSION SYSTEM CONFIGURATIONS N79-25017 The impact of operational requirements on V/STOL propulsion concept selection [AIAA PAPER 79-1283] 179-39018

PROPULSION SYSTEM PERFORMANCE

PROPULSION SYSTEM PERFORMANCE	
The design and selection of optimum propel	lers for
general aviation aircraft	
[SAE PAPER 790575]	A79-36711
Propulsion system sensitivities for a strat	tegic
aircraft	
[AIAA PAPER 79-1121]	A79-38952
A European view on gas turbine engine monit	toring
of present and future civil aircraft	
[AIAA PAPER 79-1200]	X79-38982
Design study and performance analysis of a	
high-speed multistage variable-geometry	tan for
a variable cycle engine	
[NASA-CR-159545]	N79-25020
PSYCHOPHYSIOLOGY	
Notion in flight simulation: An annotated	
bibliography	
[AD-A061687]	N79-25042
PULSED LASERS	
Small hole drilling and inspection with pu	
laser systems in air-cooled aircraft	engine
structures	170 20042
[AIAA PAPER 79-1268]	A79-39012
•	

Q

QUADRATIC PROGRAMMING A computer program for double sweep optimal smoothing	L
[AD-A066512]	N79-25278
QUIET ENGINE PROGRAM Preliminary QCGAT program test results Clean General Aviation Turbofan	Quiet,
[SAE PAPER 790596]	A79-36729

R

RADAR BEACONS	
Discrete address beacon system. A bibliogra	aphv
with abstracts	
[NTIS/PS-79/0244/8]	N79-23945
RADAR DETECTION	N/J 23343
The intercept of covert radar	
The incercept of covert radar	A79-38132
	A/9-30132
A family of air traffic control radars	
	A79-38532
RADAR BQUIPHENT	
CERT technology applied to an airborne rada	ar
Combined Environment Reliability Testing	
	A79-39893
RADAR RANGE	
A family of air traffic control radars	
· · · · · · · · · · · · · · · · · · ·	A79-38532
RADAR TARGETS	
A family of air traffic control radars	
A family of all claime concroi fadars	A79-38532
RADAR TRACKING	A19-30332
A computer program for double sweep optimal	L
smoothing	
[AD-A066512]	N79-25278
RADIAL DISTRIBUTION	
Radial equilibrium in axial turbomachines	
	A79-37828
RADIANT PLUX DENSITY	
Vertical cutoff rigidity and the intensity	
distribution of cosmic rays near Cape To	
	¥n
dicolination of copiet rajo four outo to	
	νn λ79-37468
RADIATIVE HEAT TRANSFER	179-37468
RADIATIVE HEAT TRANSFER Transient ablation of Teflon in intense rad	179-37468
RADIATIVE HEAT TRANSFER	λ 79-37468 liati v e
BADIATIVE HEAT TRANSFER Transient ablation of Teflon in intense rad and convective environments	179-37468
RADIATIVE HEAT TRANSFER Transient ablation of Teflon in intense rad and convective environments RADIO ALTIMETERS	A79-37468 liative A79-38123
 RADIATIVE HEAT TRANSFER Transient ablation of Teflon in intense rad and convective environments RADIO ALTIMETERS Theoretical fundamentals of radio altimetry 	A79-37468 liative A79-38123
RADIATIVE HEAT TRANSFER Transient ablation of Teflon in intense rad and convective environments RADIO ALTIMETERS	A79-37468 liative A79-38123 y
 RADIATIVE HEAT TRANSFER Transient ablation of Teflon in intense rad and convective environments RADIO ALTIMETERS Theoretical fundamentals of radio altimetry Russian book 	A79-37468 liative A79-38123
 RADIATIVE HEAT TRANSFER Transient ablation of Teflon in intense rad and convective environments RADIO ALTIMETERS Theoretical fundamentals of radio altimetry Russian book RADIO NAVIGATION 	A79-37468 liative A79-38123 y
 RADIATIVE HEAT TRANSFER Transient ablation of Teflon in intense rad and convective environments RADIO ALTIMETERS Theoretical fundamentals of radio altimetry Russian book 	A79-37468 liative A79-38123 y A79-38145
 RADIATIVE HEAT TRANSFER Transient ablation of Teflon in intense rad and convective environments RADIO ALTIMETERS Theoretical fundamentals of radio altimetry Russian book RADIO NAVIGATION 	A79-37468 liative A79-38123 y
 RADIATIVE HEAT TRANSFER Transient ablation of Teflon in intense rad and convective environments RADIO ALTIMETERS Theoretical fundamentals of radio altimetry Russian book RADIO NAVIGATION 	A79-37468 liative A79-38123 y A79-38145
 RADIATIVE HEAT TRANSFER Transient ablation of Teflon in intense rad and convective environments RADIO ALTIMETERS Theoretical fundamentals of radio altimetry Russian book RADIO HAVIGATION Internationalization of OMEGA RADIO TELEMETRY 	A79-37468 liative A79-38123 y A79-38145 A79-36069
 RADIATIVE HEAT TRANSFER Transient ablation of Teflon in intense rad and convective environments RADIO ALTIMETERS Theoretical fundamentals of radio altimetry Russian book RADIO NAVIGATION Internationalization of OMEGA RADIO TELEMETRY Some possible applications of identification 	A79-37468 diative A79-38123 y A79-38145 A79-36069 on
 RADIATIVE HEAT TRANSFER <pre>Transient ablation of Teflon in intense rad and convective environments</pre> RADIO ALTIMETERS Theoretical fundamentals of radio altimetry Russian book RADIO HAVIGATION Internationalization of OMEGA RADIO TELEMETRY 	A79-37468 diative A79-38123 y A79-38145 A79-36069 on
 RADIATIVE HEAT TRANSFER Transient ablation of Teflon in intense rad and convective environments RADIO ALTINETERS Theoretical fundamentals of radio altimetry Russian book RADIO NAVIGATION Internationalization of OMEGA RADIO TELEMETRY Some possible applications of identificatio theory techniques in telemetry for a:	A79-37468 diative A79-38123 y A79-38145 A79-36069 on
 RADIATIVE HEAT TRANSFER Transient ablation of Teflon in intense radiand convective environments RADIO ALTIMETERS Theoretical fundamentals of radio altimetry Russian book RADIO NAVIGATION Internationalization of OMEGA RADIO TELEMETRY Some possible applications of identification theory techniques in telemetry for ac communication 	A79-37468 diative A79-38123 y A79-38145 A79-36069 on Ircraft
 RADIATIVE HEAT TRANSFER Transient ablation of Teflon in intense rad and convective environments RADIO ALTINETERS Theoretical fundamentals of radio altimetry Russian book RADIO NAVIGATION Internationalization of OMEGA RADIO TELEMETRY Some possible applications of identification theory techniques in telemetry for a communication RADIO TRANSHITTERS 	A79-37468 liative A79-38123 y A79-38145 A79-36069 Dn Ircraft A79-36589
 RADIATIVE HEAT TRANSFER Transient ablation of Teflon in intense rad and convective environments RADIO ALTINETERS Theoretical fundamentals of radio altimetry Russian book RADIO HAVIGATION Internationalization of OMEGA RADIO TELEMETRY Some possible applications of identification theory techniques in telemetry for as communication RADIO TRANSMITTERS Evaluation of an FM/CW range measurement sy 	A79-37468 liative A79-38123 y A79-38145 A79-36069 Dn Ircraft A79-36589
 RADIATIVE HEAT TRANSFER Transient ablation of Teflon in intense rad and convective environments RADIO ALTINETERS Theoretical fundamentals of radio altimetry Russian book RADIO NAVIGATION Internationalization of OMEGA RADIO TELEMETRY Some possible applications of identification theory techniques in telemetry for a communication RADIO TRANSHITTERS 	A79-37468 liative A79-38123 y A79-38145 A79-36069 Dn Ircraft A79-36589

SUBJECT INDEX

RADIOGRAPPY High resolution radiography in the aero-en-	gine
1ndustry	N79-25414
RANGE ERRORS Hyperbolic positioning per se is passe navigation computations from range measur using microprocessor	rements
	A79-36070
RANGE FINDERS Evaluation of an FM/CW range measurement s for VTOL landing	ystem
	A79-36086
RANGEPINDING Stability analysis of relative navigation = TDMA system for multi-member aircraf	
communities	A79-36090
REDUNDANT COMPONENTS Electronic system safety - Testing reality	for
avionics [SAE PAPEE 790570]	A79-36710
BEFRACTORY HETAL ALLOYS The strainrange partitioning behavior of a	n
advanced gas turbine disk alloy, AF2-1DA [AIAA PAPER 79-1192]	A79-38977
REGRESSION ANALYSIS Regression Simulation of turbine engine	
performance: Accuracy improvement (task [AD-A066398]	4) N79-25027
Recent experience in the development and application of LCC models	
REINFORCED PLASTICS	N79-25410
Composite applications at Bell Helicopter [SAE PAPER 790578]	A79-36713
RELIABILITY RTCA standards - Improved specs. and regula	ations
in avionics equipment	A79-39919
RELIABILITY ANALYSIS CERT technology applied to an airborne rada	ar
Combined Environment Reliability Testing	A79-39893
RELSIN-A systems reliability simulation co	le A79-39900
Lower avionic temperature - Lower life cyc Reliability and maintainability contribution	A79-39914
Hornet mission success	∆79-39915
The effect of endless burn-in on reliabili growth projections for solid state a	
electronics equipment	A79-39920
RELIABILITY ENGINEERING Reliability, performance, and fault isolat:	
considerations in the design of intercom navigation systems	nected
Changing requirements in aircraft design	A79-36077
Fault-tolerant, high reliability electronic	A79-37044 c engine
control system [NIAN PAPER 79-1202]	A79-38983
The F-16 RIW program Reliability Improv Warranty	venent
The operational impact of Navy's first TAA P-3C Test, Analyze and Fix	A79-39889 ? program
RENOTE CONTROL	A79-39890
Drone formation control system /DFCS/ - A : generation test range system	new
	A79-36084
REMOTELY PILOTED VEHICLES Drone formation control system /DFCS/ - A p	Je w
generation test range system	A79-36084
RESEARCH AIRCRAFT A unique facility for V/STOL aircraft hove:	testing 179-37296
Aeroelastic stability analysis of the AD-1 oblique-wing aircraft	manned
Digital flight control research using	A79-38136
microprocessor technology	∆79-38533

SUBJECT INDEX

RESEARCE AND DEVELOPMENT A review of Curtiss-Wright rotary engine developments with respect to general aviation potential [SAE PAPER 790621] Research and development activities in Italy in the field of aerospace structures and materials A79-36749 [AGARD-R-675] N79-24202 RESIDUAL STRESS I-ray determination of internal stress states due to surface treatment of TiAl6V4 and TiAl6V6Sn2 A79-36003 RESISTANCE HEATING Aircon electrically heated acrylic --- for ice formation prevention on aircraft transparencies [SAE PAPER 790600] A79-36 A79-36732 ROCKET FIRING Evaluation of ground-launch firings for the improved 2.75-inch rocket [AIAA PAPER 79-1297] A79-39027 ROCKET NOZZLES Evaluation of ground-launch firings for the improved 2.75-inch rocket [AIAA PAPER 79-1297] A79-39027 ROLLING BORRNTS Some observations on the mechanism of aircraft wing rock A79-38135 ROTARY WING AIRCRAFT Advanced rotorcraft technology: Task force report [NASA-TM-80541] N79-24951 ROTARY WINGS Rotor blade stability in turbulent flows. I A79-38118 A79-3 An investigation of a full-scale rotor with four blade tip planform shapes --- in Ames Research Center 40 by 80 Poot Wind Tunnel [NASA-TH-78580] N79-2 N79-23922 Interactional aerodynamics of the single rotor helicopter configuration. Volume 6B: One-third octave band spectrograms of wake single film data, basic configuration wake explorations [AD-A061861] N79-23931 simplified rotor system mathematical model for piloted flight dynamics simulation A [NASA-TH-78575] N79-23977 Helicopter rotor airfoil [NASA-CASE-LAR-12396-1] N79 Interactional aerodynamics of the single rotor N79-24958 helicopter configuration. Volume 3B: Flow angle and velocity wake profiles in low frequency band, air ejector systems and other devices [AD-A061767] N79-24966 Interactional aerodynamics of the single rotor helicopter configuration. Volume 2B: Harmonic analysis of airframe surface pressure data, runs 7-14, mid section [AD-A061860] N79-24967 Interactional aerodynamics of the single rotor helicopter configuration. Volume 68: One-third octave band spectrograms of wake single film data, basic configuration wake explorations [AD-A061861] N79-24968 Aeroelastically conformable rotor mission analysis [AD-A067338] N79-24985 An experimental investigation of the effect of rotor tip shape on helicopter blade-slap noise --- in the langley v/stol wind tunnel [NASA-TH-80066] N79-25844 ROTOR ABRODYNAMICS Experimental analysis methods for unsteady flows In turbomachines [ONERA, TP NO. 1979-59] A79-39 An investigation of a full-scale rotor with four blade tip planform shapes --- in Ames Research Center 40 by 80 Poot Wind Tunnel [NASA-TM-78580] N79-22 Interactional aerodynamics of the single rotor A79-39095 N79-23922 Interactional aerodynamics of the single rotor helicopter configuration. Volume 6B: One-third octave band spectrograms of wake single film data, basic configuration wake explorations [AD-A061861] N79-23931 Interactional aerodynamics of the single rotor angle and velocity wake profiles in low frequency band, basic investigations and hub variations FAD-A0617661 N79-23932

Interactional aerodynamics of the single rotor helicopter configuration. Volume 3B: angle and velocity wake profiles in low Flow frequency band, air ejector systems and other devices [AD-A061767] N79-23933 Interactional aerodynamics of the single rotor helicopter configuration. Volume 28: Harmonic analyses of airframe surface pressure data, runs 7 - 14, midsection [AD-A061860] 879-23934 Interactional aerodynamics of the single rotor helicopter configuration. Volume 3B: Plow angle and velocity wake profiles in low frequency band, air ejector systems and other devices [AD-A061767] N79-24966 Interactional aerodynamics of the single rotor helicopter configuration. Volume 2B: Harmonic analysis of airframe surface pressure data, runs 7-14, mid section [AD-A061860] N79-2490 Interactional aerodynamics of the single rotor N79-24967 helicopter configuration. Volume 65: One-third octave band spectrograms of wake single film data, basic configuration wake explorations [AD-A061861] N79-24968 An experimental investigation of the effect of rotor tip shape on helicopter blade-slap noise --- in the langley v/stol wind tunnel [NASA-TH-80066] N79-25844 ROTOR BLADES (TURBOHACHINERY) Helicopter rotor airfoil [NASA-CASE-LAR-12396-1] N79-24958 ROTORS The multiple application core engine - Sizing and usage criteria --- high-pressure rotors in jet engines [AÍAA PAPER 79-1123] A79-38953 The monorotor gas turbine [AIAA PAPER 79-1230] A79-38994 Numerical calculation of inviscid transonic flow through rotors and fans N79-23906 RUBWAY CONDITIONS A tire runway interface friction prediction model concept A79-38137 RUNWAYS Evaluation of materials for post-attack pavement repair [AD-A066516] N79-25251 Ground winds for Kennedy Space Center, Plorida, 1979 revision [NASA-TH-78229] N79-25662 S S-N DIAGRAMS The strainrange partitioning behavior of an advanced gas turbine disk alloy, AF2-1DA [AIAA PAPER 79-1192] A79-38977 S-3 AIRCRAFT Analysis of the impact of a 270 VDC power source on the avionic power supplies in the S-3A aircraft RD-A0665263 N79-24989 SAILWINGS A comparison of the aerodynamic characteristics of eight sailwing airfoil sections

 N79-23897

 SATELLITE NAVIGATION STSTENS

 Satellite interferometer as an advanced

 navigation/communication system

 SATELLITE-BORNE INSTRUMENTS

 Satellite interferometer as an advanced

 navigation/communication system

 SCALE HODELS

 Model diffuser investigation for propulsion vind

 tunnel 16T
 10-A065822]

 N79-23984
 SBALERS

 Dynamic evaluation of experimental integral

fuel-tank sealants, part 2 [AD-A066592] N79-25236

SEATS Seat/Occupant crash dynamic analysis verification test program [SAE PAPER 790590] A79-36724 NASA general aviation crashworthiness seat development [SAE PAPER 790591] A79-36725 SERVICE LIFE Effects of extended oil changes on aircraft piston engine wear and oil characteristics [SAE PAPER 790629] 179-36756 Changing requirements in aircraft design A79-37044 SHIPS VOLAR: A digital computer program for simulating VSTOL aircraft launch and recovery from small ships. Volume 1: Program description [AD-A066172] N79-23954 VOLAR: A digital computer program for simulating VSTOL aircraft launch and recover from small ships. Volume 2: Appendices [AD-A066173] N79-23955 SHOCK TESTS Effect of shocks on film cooling of a full scale turbojet exhaust nozzle having an external expansion surface [NASA-TH-79157] N79-23966 SHOCK WAVE PROPAGATION Thermospheric propagation of sonic booms from the Concorde supersonic transport [AD-A067201] N79-25855 SHOCK WAVES Effect of shocks on film cooling of a full scale turbojet exhaust nozzle having an external expansion surface [AIAA PAPER 79-1170] Status of knowledge of sonic booms A79-38969 [NASA-TH-80113] N79-24955 SHORT HAUL AIRCRAFT Boeing 757/767 - On-the-spot report A79-36374 Application of digital controls on the quiet clean Short haul experimental engines [AIAA PAPER 79-1203] SHORT TAKBOFF AIRCRAFT 179-38984 Calculation of a laminar wall jet in a wake A79-36582 Assessment at full scale of nozzle/wing geometry effects on OTW aeroacoustic characteristics --Over The Wing STOL engine configurations A79-39802 Assessment at full scale of nozzle/wing geometry effects on OTW aero-acoustic characteristics short takeoff aircraft noise [NASA-TM-79168] N79-25841 SIGNAL PROCESSING Recent results in navigation systems utilizing signal aiding from Navstar satellites A79-36096 SIGNATURE ANALYSIS Infrared signature measurement techniques and simulation methods for aircraft survivability [AIAA PAPER 79-1186] SILICON CARBIDES 179-38975 ittle materials design, nign temperature turbine: Ceramic turbine rotor technology N79-25029 Brittle materials design, high temperature gas SILICON NITRIDES Brittle materials design, high temperature gas turbine: Ceramic turbine rotor technology [AD-A067176] N79 **1**79-25029 SIMILARITY THEOREM Aeroelastic models for cryogenic wind tunnels [ONERA, TP NO. 1979-39] A7 A79-39088 SINULATORS Evaluation of an ejector-powered engine simulator at transonic Mach numbers [AIAA PAPER 79-1165] SINGLE CRYSTALS 179-38967 Directionally solidified blades - Greater strength A79-36248 SITTING POSITION Seat/Occupant crash dynamic analysis verification test program [SAE PAPER 790590] SIZE DETERMINATION A79-36724 Proper aircraft tire size selection - Optimum performance with minimum maintenance [SAE PAPER 790598] A79-36730

The multiple application core engine - Sizing and usage criteria --- high-pressure rotors in jet engines [AIAA PAPER 79-1123] A79-38953 SKIN (STRUCTURAL MEMBER) Adhesive bonded structure of new pressurized piston twin aircraft [SAE PAPER 790563] A79-36704 SLENDER COMES Measurement of the drag of slender cones in hypersonic flow at low Reynolds numbers using a magnetic suspension and balance [OUBL-1235/78] N79-23938 SLIPSTBEAMS Calculation of a laminar wall jet in a wake A79-36582 Simulated propeller slipstream effects on a supercritical wing [NASA-CR-152138] N79-25024 SLOT ANTENNAS An iterative approach for computing an antenna aperture distribution from given radiation pattern data [AD-A065590] N N79-24217 SOARING The science and technology of low speed and motorless flight, part 1 [NASA-CP-2085] N79-23889 Design of propellers for motorsoarers N79-23903 SOLAR ELECTRIC PROPULSION Project Sunrise --- solar-powered aircraft flight demonstration [AIAA PAPER 79-1264] SOLAR ENERGY CONVERSION A79-39010 Photovoltaics and environmental impact considerations N79-25496 SOLID STATE DEVICES The effect of endless burn-in on reliability growth projections --- for solid state aviation electronics equipment A79-39920 SOLID STATE LASERS Small hole drilling and inspection with pulsed laser systems --- in air-cooled aircraft engine structures [AIAA PAPER 79-1268] A' SOLID-SOLID INTERPACES Fretting fatigue, with reference to aircraft A79~39012 structures [SAE PAPER 790612] A79-36741 A tire runway interface friction prediction model concept A79-38137 A The application of rapid solidification rate superalloys to radial wafer turbine blades [AIAA PAPER 79-1226] SONIC BOOMS A79-38991 Aircraft sonic boom: Effects on buildings. Aircraft sonic boom: Effects on buildings. A bibliography with abstracts [NTIS/PS-79/0265/3] N79-24. Aircraft sonic boom: Studies on aircraft flight, aircraft design, and measurement. A bibliography with abstracts [NTIS/PS-79/0264/6] N79-24 Status of knowledge of sonic booms N79-24201 N79-24780 [NASA-TH-80113] N79-24955 Thermospheric propagation of sonic booms from the Concorde supersonic transport [AD-A067201] N79-25855 SPACECRAFT COMMUNICATION Satellite interferometer as an advanced navigation/communication system A79-39602 SPARK IGNITION The effect of hydrogen addition on ignition delays and flame propagation in spark ignition engines A79-38387 SPECTROGRAMS Interactional aerodynamics of the single rotor helicopter configuration. Volume 6B: One-third octave band spectrograms of wake single film data, basic configuration wake explorations [AD-A061861] N79-23931

SPECTRUM ANALYSIS	
Application of advanced data reduction met gas turbine dynamic analysis	nous to
· · · ·	A79-36024
SPEED CONTROL	• -
Sidestick/Throttle Controller - An alterna approach	te
«FpLOuch	A79-38476
SPEED INDICATORS	
Theoretical fundamentals of radio altimetr Russian book	y
Russian book	A79~38145
SPIN STABILIZATION	
Spin flight research summary	
[SAE PAPER 790565] SPIN TESTS	A79-36706
Effects of a spin chute installation on sp	in
characteristics of light general avi	ation
alrcraft [SAE PAPER 790564]	A79~36705
SPOILERS	
Some theoretical considerations of a stall	proof
alrplane [SAE PAPER 790604]	A79-36736
STABDARDIZATION	A13-30130
Avionics standardization potential analysi	
[AD-A066138] STANDARDS	N79-23958
RTCA standards - Improved specs. and regul	ations
in avionics equipment	
	A79-39919
STATIC PRESSURE Conversion of wing surface pressures into	
normalized lift coefficient	
[SAE PAPER 790567]	A79~36707
Effect of steady-state pressure distortion	on flow
characteristics entering a turbofan engi [NASA-TM-79134]	N79~23969
STATIC STABILITY	
Control considerations for CCV fighters at	high
angles of attack	179-37295
STATIC TESTS	
Static test of a large scale swivel nozzle deflector	thrust
[AIAA PAPER 79-1285]	179-39020
STATISTICAL AMALYSIS	
Safety hazard of aircraft icing	N79-23916
Statistical comparisons of aircraft flyove	
adjustment procedures for different weat	her
conditions [NASA-TP-1430]	₩79~24773
Porcasting the guantitative characteristic	
alrcraft icing	
[BLL-TRANS-1364-(9022.549)] STATORS	N79-24971
The monorotor gas turbine	
[AIAA PAPER 79-1230]	179-38994
STIFFEESS MATRIX	
NOVA-2S, a stiffened panel extension of th computer program	e NUVA-Z
[AD-A066038]	N79-23951
STOCHASTIC PROCESSES	-
Rotor blade stability in turbulent flows.	I 179~38118
STORAGE STABILITY	
Stability characteristics of hydrocarbon f	uels
from alternative sources [BETC/RI-78/23]	N79-24178
STRESS ANALYSIS	217 24170
The strainrange partitioning behavior of a	n
advanced gas turbine disk alloy, AF2-1DA [AIAA PAPER 79-1192]	179~38977
Aircraft engine design using experimental	
analysis techniques	
[AIAA PAPER 79-1193]	179~38978
STRESS-STRAIN DIAGRAMS A variational theorem for laminated compos	ite
plates of nonlinear materials and applic	ations
to postbuckling	
STRBSS-STRAIN RELATIONSHIPS	N79~24977
Cost benefits from improved hot section li	fe
prediction technology for aircraft e	ngine
Combustor and turbine parts [AIAA PAPER 79-1154]	179-38963
form runne is iidel	

STRUCTURAL ABALYSIS		
Arcraft engine design using experimental stress		
analysis techniques [NINA PAPER 79-1193] N79-38978		
Partially variable area turbine nozzle {AIAA PAPER 79-1227] A79-38992		
Low-speed single-element airfoil synthesis #79-23890		
Some new airfoils N79-23896		
ANALYZE: Analysis of aerospace structures with membrane elements		
[AD-A065633] H79-24379		
Aeroelastically conformable rotor mission analysis [AD-A067338] N79-24985		
User's guide: Computer program with interactive graphics for analysis of plane frame structures		
(CFRAND) [AD-A067349] 879-25428		
STRUCTURAL DESIGN		
Design description of a four-place business jet using two WR+19 engines		
[SAE PAPER 790580] A79-36715 A starter for gas turbine engines		
A79+36797 The role of three-dimensional flow analysis in the		
design of turbomachinery		
[AIAA PAPER 79-1231] A79-38995 Low-speed single-element airfoil synthesis		
N79-23890 Optimum tail plane design for sailplanes		
N79-23892 Introduction to the arcopter arc wing and the		
Bertelsen effect for positive pitch stability and control		
N79-23895		
Some new airfoils W79-23896		
Design of propellers for motorsoarers 179-23903		
Substructuring methods for design sensitivity analysis and structural optimization		
[AD-A065935] N79-23949 Fail-safe optimal design of structures with		
substructuring		
The application of structured design and		
distributed techniques to avionics information processing architectures		
N79-25991 STRUCTURAL DESIGN CRITERIA		
Experimental verification of program KRASH - A mathematical model for general aviation		
structural crash dynamics		
[SAE PAPER 790589] A79-36723 Damage tolerant design - An approach to reducing		
the life cycle cost of gas turbine engine disks [AINA PAPER 79-1189] A79-38976		
STRUCTORAL BUGINEERING Dynamic structural analysis with substructures		
[AD-A065937] N79-24378		
STRUCTURAL RELIABILITY Aircraft design and strength /2nd revised and enlarged edition/ Russian book		
A79-38140		
Structural properties of adhesives, volume 1 [AD-A065500] N79-24155		
STRUCTURAL STABILITY Aeroelastic stability analysis of the AD-1 manned		
oblique-wing aircraft A79-38136		
STRUCTURAL VIBRATION		
Model verification of force determination for measuring vibratory loads of rotors on		
helicopters A79-36379		
An experimental study of propeller-induced structural vibration and interior noise		
[SAE PAPER 790625] A79-36753		
Designing with damping materials to reduce noise and structural fatigue of aircraft components		
[SAE PAPER 790631] A79-36758 STRUCTURAL WEIGHT		
The evaluation of the weight of engine installations on transport aırcraft		
A79-37827		

SUBSONIC AIRCRAFT Advanced low emissions catalytic combustor program at Pratt and Whitney 879-25012 SUBSONIC FLOW Numerical optimization techniques for bound circulation distribution for minimum induced drag of nonplanar wings: Basic formulations [NASA-CR-3154] N79-23924 SUBSONIC SPEED Self stabilizing sonic inlet [NASA-CASE-LEW-11890-1] N79-24976 SUBSTITUTES The impact of alternate fuels on aircraft configuration characteristics --- military aircraft [AD-A066983] N79-25244 SUBSTRUCTORES Substructuring methods for design sensitivity analysis and structural optimization [AD-A065935] N79-23949 SUPERCHARGERS Effects of air injection on a turbocharged Teledyne Continental Motors TSIO-360-C engine [SAE PAPER 790607] Ā79-36760 Two-stage supercharger sets: Efficiency and head distribution under full- and part-load conditions [RTS-11613] N79-24342 SUPERCRITICAL WINGS Simulated propeller slipstream effects on a supercritical wing [NASA-CR-152138] N79-25024 SUPERHIGH FREQUENCIES Evaluation of an PE/CW range measurement system for VTOL landing A79-36086 SUPERSONIC COMBUSTION Ignition of liquid fuel jets in a supersonic air stream [AIAA PAPER 79-1238] SUPERSONIC COMBUSTION RANJET ENGINES 179-38997 Autoignition of hydrogen injected transverse to a supersonic airstream [AIAA PAPER 79-1239] SUPERSONIC FLOW 179-39818 Theory of thin wing in a supersonic flow with consideration of the non-equilibrium state of excitation of oscillating degrees of freedom [AD-A065992] N79-23928 [AD-A065992] N/9-239. Supersonic flow in the area of antisymmetric thin cruciform wings with supersonic leading edges in a horizontal plane, with consideration of flow separation on the edges [AD-A065993] N79-2392 N79-23929 SUPERSONIC SPEEDS Tone noise of three supersonic helical tip speed propellers in a wind tunnel [NASA-TM-79167] N79-2 SUPERSONIC TRANSPORTS N79-25840 Characteristics of the advanced supersonic technology AST-105-1 configured for transpacific range with Pratt and Whitney aircraft variable stream control engines [NASA-TM-78818] SUPERSONIC TURBINES N79-23888 Rolls-Royce RB.401-07 turbofan engine for business aircraft in the 1980's [SAE PAPER 790620] A79-367 A79-36748 SUPPORTS Balance and sting design for cryogenic wind tunnels [ONERA, TP NO. 1979-40] A79-3908 A79-39089 SURFACE FINISHING X-ray determination of internal stress states due to surface treatment of TiAl6V4 and TiAl6V6Sn2 A79-36003 SURFACE HAVIGATION Internationalization of OMEGA A79-36069 SURFACE ROUGHNESS The effect of disturbance on a wing N79-23893 SURFACES Construction of an initial approximation for the solution of the integral equation of a lifting surface A79-35928

SUBJECT INDEX

SWIRLING		
Test verification of a turbofan partial swift		
afterburner [AIAA PAPER 79-1199] SWIVELS	A79-38981	
Static test of a large scale swivel nozzle	thrust	
deflector [AIAA PAPER 79-1285] SYNCHROHOUS SATELLITES	A79-39020	
Satellite interferometer as an advanced navigation/communication system		
	A79-39602	
SYSTERS ANALYSIS Drone formation control system /DPCS/ - A generation test range system	new	
STSTERS ENGINEERING	A79-36084	
Reliability, performance, and fault isolat considerations in the design of intercon navigation systems		
A Demonstration Advanced Avionics System f	A79-36077	
general aviation [SAE PAPER 790569]	A79-36709	
A family of air traffic control radars	A79-38532	
Active control for the Total-In-Plight sim (ACTIPS)		
[NASA-CR-3118] SYSTEMS STABILITY	N79-23978	
Stability analysıs of relative navıgatıon TDMA system for multi-member aircraf communities		
	A79-36090-	
Т		
T-39 AIRCRAFT		
The Rockwell International Sabreliner-65: study in aircraft design Book		
TACAN	A79-36645	
A navigation filter for an integrated GPS/JTIDS/INS system for a tactical airc Joint Tactical Information Distribution		
TACHISTOSCOPES	A79-36087	
Tachystoscopic testing of onboard instrume	nts A79-38817	
Fail-safe optimal design of structures wit	h	
substructuring [AD-A065936]	N79-23950	
TARGET ACQUISITION Night/Adverse Weather A-10 evaluator progr		
A79-38479 TARGET RECOGNITION		
Optimum frequencies for aircraft classific [AD-A065697]	ation N79-24220	
TECHNOLOGICAL FORECASTING Rolls-Royce RB.401-07 turbofan engine for	business	
aırcraft ın the 1980's [SAE PAPER 790620]	A79-36748	
Impact of advanced technologies on aircraf	t design A79-37045	
TECHNOLOGY ASSESSMENT New opportunities for future small civil t	urbine	
engines - Overviewing the GATE studies [SAE PAPER 790619]	A79-36747	
Propulsion system sensitivities for a stra aircraft		
[AIAA PAPER 79-1121]	A79-38952	
The science and technology of low speed an motorless flight, part 1	.u.	
[NASA-CP-2085] Overview of helicopter ice protection syst	N79-23889 em	
developments	N79-23919	
Premixed Prevaporized Combustor Technology [WASA-CP-2078]	N79-24994	
Advanced low emissions catalytic combustor at Pratt and Whitney	-	
Non-destructive methods for the early dete fatique damage in aircraft components	N79-25012 ction of	
N79-25417 TECHNOLOGY UTILIZATION		
New technologies for general aviation airc [SAE PAPER 790613]	raft A79-36742	

bry friction in the aerospace industry 179-39873 Research and development activities in Italy in the field of aerospace structures and materials [AGARD-R-675] N79-24202 Advanced low emissions catalytic combustor program at General Electric N79-25011 Recent experience in the development and application of LCC models 179-25410 TEPLON (TRADEMARK) Transient ablation of Teflon in intense radiative and convective environments 179-38123 TEMPERATURE REPECTS Combined pressure and temperature distortion effects on internal flow of a turbofan engine [ATAN PAPER 79-1309] A79-39(Predicted P100 engine response to circumferential pressure and temperature distortion [ATAN PAPER 79-1310] A79-39(MORENTRE TEXPERSIONS A79-39031 A79-39819 TEMPERATURE INVERSIONS Combined pressure and temperature distortion effects on internal flow of a turbofan engine [NASA-TM-79136] N79-N79-23963 TEMPERATURE REASUREMENT Inflight fuel tank temperature survey data [NASA-CR-159569] TERMINAL COMPIGURED VEHICLE PROGRAM N79-23940 Capturing and tracking performance of the borizontal guidance and control systems of the terminal configured vehicle [NASA-TM-80068] N79-2 N79-25034 TEST BOUIPHENT Survivability in aircraft fires - New standards are needed A79-38091 Some observations on the mechanism of aircraft wing rock A79-38135 Evaluation of an ejector-powered engine simulator at transonic Mach numbers [AIAA PAPER 79-1165] 179-38967 TEST PACILITIES A unique facility for V/STOL aircraft hower testing 179-37296 A streamlined control system development process --- to optimize aircraft propulsion system performance [AINA PAPER 79-1344] Dynamic evaluation of experimental integral 179-39048 fuel-tank sealants, part 2 [AD-A066592] N79-Ground winds for Kennedy Space Center, Florida, 1979 revision N79-25236 [NASA-TM-78229] N79-25662 TEST PILOTS The test pilot in the airline industry or 'Ny bags are packed and I'm ready to go' A79-38478 TEST BANGES Drone formation control system /DFCS/ - A new generation test range system A79-36084 TEXTBOOKS Aerodynamics [NASA-TT-F-765] . N79-23908 TP-30 BEGINE Combined pressure and temperature distortion effects on internal flow of a turbofan engine [AIAA PAPER 79-1309] A79-Á79-39031 THERMAL CONTROL COATINGS Industry tests of NASA ceramic thermal barrier coating --- for gas turbine engine applications [NA SA-TP-1425] N79-25023 THERBOSPHERE Thermospheric propagation of sonic booms from the Concorde supersonic transport [AD-A067201] N79-25 N79-25855 THIN WINGS Second approximation in theory of a finite-span thin wing in a hypersonic gas flow A79-35927 Theory of thin wing in a supersonic flow with consideration of the non-equilibrium state of excitation of oscillating degrees of freedom N79-23928 [AD-A065992]

Supersonic flow in the area of antisymmetric thin cruciform wings with supersonic leading edges in a horizontal plane, with consideration of flow separation on the edges [AD-A065993] #79-239: THREE DIMENSIONAL BOONDARY LAYER A method for the calculation of 3D boundary layers on practical wing configurations 179-23929 179-38906 THREE DIMENSIONAL FLOW Profiling of two-dimensional and three-dimensional nozzles and calculation of their flows 179-38168 Development of a gas turbine combustor dilution zone design analysis [AIAA PAPER 79-1194] A79-38979 The role of three-dimensional flow analysis in the design of turbomachinery [AIAA PAPER 79-1231] A79-38995 THROTTLING Sidestick/Throttle Controller - An alternate approach A79-38476 THRUST Energy maneuverability display validation --- P-16 aircraft [AFFDL-TR-78-35-VOL-1] N79-23947 THRUST ABASUREMENT Recent results obtained with a new method for measuring aircraft power and drag in flight [SAB PAPER 790616] A7 A79-36744 THRUST WECTOR CONTROL Static test of a large scale swivel nozzle thrust deflector [AIAA PAPER 79-1285] A79-39020 THRUST-WEIGHT RATIO A wind shear/downdraft drift angle warning system A79-38477 · TIME DIVISION BULTIPLE ACCESS Stability analysis of relative navigation systems --- TDMA system for multi-member aircraft communities A79-36090 TIME DIVISION MULTIPLEXING An optical-fiber multiterminal data system for aircraft A79+36484 TIME OPTIMAL CONTROL The time budget as a criterion for the workload of air traffic controllers [MBB-UPE-1353-0] TIME SHARING N79-23943 Turbine design system [AD-A066092] TIP SPEED N79-23974 The impact of noise regulations on propeller design [SAE PAPER 790593] A79-36727 Tone noise of three supersonic helical tip speed propellers in a wind tunnel A79-39801 TITANIUM ALLOYS X-ray determination of internal stress states due to surface treatment of TiAl6V4 and TiAl6V6Sn2 A79-36003 Advanced forging process for gas turbine engine fan blades [AIAA PAPER 79-1269] A79-39013 TORSIONAL VIBRATION Rotor blade stability in turbulent flows. I A79-38118 TRACKING (POSITION) Precision controllability of the F-15 airplane [NASA-TH-72861] TRACKING RADAR N79-23979 The intercept of covert radar A79-38132 TRAILING BDGES Low-speed wind-tunnel investigation of wing fins as trailing-vortex-alleviation devices on a transport airplane model [NASA-TP-1453] TRAINING SINULATORS N79-24961 Contributions of platform motion to simulator training effectiveness. Study 2: Aerobatics [AD-A064305] N79-23985 N/9-Optimal placement of regional flight simulators [AD-A060450] N79-N79-25043

TRANSPER OF TRAINING Contributions of platform motion to simulator training effectiveness. Study 2: Aerobatics [AD-A064305] N79-: N79-23985 TRANSIENT RESPONSE The estimation of induced-voltage peak magnitude and energy level under LTA/EMP excitation of low-loss aircraft cabling --- Lightning Transit Analysis/Electro-Magnetic Pulse A79-37238 Identification of voltage transients on aircraft cabling under LTA excitation --- Lightning Transient Analysis A79-38531 Model study of transient processes in a hydraulic power amplifier A79-38814 TRANSIT SATELLITES The MX 1105, an integrated Transit/Omega navigator 179-36072 TRANSIT TIME The airport performance model. Volume 1: Extensions, validations, and applications [AD-A062863] N79-25040 TRANSMISSIONS (MACHINE BLEMENTS) Diagnostics of wear in aeronautical systems A79-39805 Helicopter transmission vibration and noise reduction program. Volume 3: Evaluation of fiber PP metal-matrix housing specimens [AD-A066794] N79 N79-24983 TRANSONIC FLOW Application of Laser Doppler Anemometry to aeroacoustic research A79-39500 Numerical calculation of inviscid transonic flow through rotors and fans N79-23906 A finite element method for the computation of the transonic potential flow past airfoils [MBB-UPE-1352-0] N79-239 Airfoil optimization for transonic flow using the N79-23935 methods of finite elements and characteristics [MBB-UF2-1362-0] N79-2: Theoretical analysis of transonic flow past unstaggered oscillating cascades N79-23937 [AD-A063083] N79-24963 The computation of transonic flow in wind tunnels at inlets and cascades using the finite element method [MBB-UFE-1421-0] N79-24970 TRANSONIC FLUTTER Determination of subcritical frequency and damping from B-1 flight flutter test data [NASA-CR-3152] N79-25426 TRANSONIC WIND TUNNELS Some observations on the mechanism of aircraft wing rock A79-38135 Model diffuser investigation for propulsion wind tunnel 16T [AD-A065822] N79-23984 Some remarks on the design of transonic tunnels with low levels of flow unsteadiness [NASA-CR-2722] N79-N79-25039 TRANSPORT AIBCRAFT The results of synthesizing and evaluating potential solutions for Multi-Function Inertial Reference Assembly /MIRA/ candidate configurations - for transport and fighter aircraft 179-36082 Bonding and durability --- for airframe structures [SAE PAPER 790561] 179-36702 The evaluation of the weight of engine installations on transport aircraft A79-37827 Westland unveils WG30 transport helicopter A79-38092 Low-speed wind-tunnel investigation of wing fins as trailing-vortex-alleviation devices on a as trailing-vortex-alleviation devices on a transport airplane model [NASA-TP-1453] N79-2496 The influence of fleet variability on crack growth tracking procedures for transport/bomber aircraft [AD-A066596] N79-2543 N79-24961 N79-25433 TRANSPORTATION Cargo Logistics Airlift Systems Study (CLASS). Volume 2: Case study approach and results N79-24978 [NASA-CR-158913]

SUBJECT INDEX

TRAPEZOIDAL WINGS Investigation of aerodynamic characteristics of subsonic wings [NASA-CR-158661] N79-23921 TURBINE BLADES Directionally solidified blades - Greater strength A79-36248 A method of reducing aircraft turbine blade vibrations A79-38819 Damage-tolerant fan blade design [AIAA PAPEB 79-1119] A' The application of rapid solidification rate 179-38951 superalloys to radial wafer turbine blades [AIAA PAPER 79-1226] 179-38991 Advanced forging process for gas turbine engine fan blades A79-39013 [AIAA PAPER 79-1269] Method of determining non-steady-state force characteristics and flywheel effect of turbine blades from the streamflow pattern A79-39071 Internally coated air-cooled gas turbine blading [NASA-CR-159574] N79-2 N79-25018 TURBINE BRGINES New opportunities for future small civil turbine engines - Overviewing the GATE studies [SAE PAPER 790619] A79-30 A79-36747 [SAE FARER (50019] General aviation turbine engine /GATE/ concepts [AIAA PAPER 79-1157] What small turbine engine does the small helicopter need, or The road to hell is paved with good intentions --- fuel consumption, 179-38964 performance, environmental and engine reliability and acceptability considerations subordinating advanced turbine engine development for small helicopters [ATAA PAPER 79-1314] A79-3 Application of electron-beam welding to aviation production --- tests of turbine engine parts 179-39032 welded by electron beam ¥79-24940 Self stabilizing sonic inlet [NASA-CASE-LEW-11890-1] N79-24976 Advanced General Aviation Turbine Engine (GATE) concepts [NASA-CR-159603] ₩79-25017 Regression Simulation of turbine engine performance: Accuracy improvement (task 4) AD-A066398] N79-25027 TURBINE EXHAUST NOZZLES Partially variable area turbine nozzle [AIAA PAPER 79-1227] A79-38992 TURBINE WHEELS Damage tolerant design - An approach to reducing the life cycle cost of gas turbine engine disks [AIAA PAPER 79-1189] A79-38 The strainrange partitioning behavior of an advanced gas turbine disk alloy, AF2-1DA [AIAA PAPER 79-1192] A79-38 A79-38976 A79-38977 TURBINES Engine demonstration test of a cooled laminated axial turbine [AIAA PAPER 79-1229] The monorotor gas turbine [AIAA PAPER 79-1230] A79-38993 A79-38994 TURBOCOMPRESSORS Allowing for the wall boundary layer in an axial compressor stage A79-36586 Selection of aircraft turbocharger systems [SAE PAPER 790608] Effects of air injection on a turbocharged A79-36739 Teledyne Continental Motors TSI0-360-C engine [SAE PAPER 790607] A79-Combined pressure and temperature distortion effects on internal flow of a turbofan engine A79-36760 [AIAA PAPER 79-1309] Á79-39031 Two-stage supercharger sets: Efficiency and head distribution under full- and part-load conditions [RTS-11613] 879-24342 TURBOFAN BAGINES Manufacturers developing fuel-efficient engines A79-36380 Design description of a four-place business jet using two WR-19 engines [SAE PAPER 790580] A79-3 A79-36715

Preliminary QCGAT program test results	Quiet,
Clean General Aviation Turbofan [SAE PAPER 790596]	A79-36729
Rolls-Royce RB.401-07 turbofan engine for	
aircraft in the 1980's	DEDIGOS
[SAE PAPER 790620]	A79-36748
Damage-tolerant fan blade design	
[AIAA PAPER 79-1119] Propulsion system sensitivities for a strat	A79-38951
aircraft	regic
[AIAA PAPER 79-1121]	A79-38952
Turbo-fan design for general aviation - The	e
evolution of the RB.401 [AIAA PAPER 79-1160]	
Test verification of a turbofan partial sw	A79-38966
afterburner	
[AIAA PAPER 79-1199]	A79-38981
The impact of operational requirements on '	V/STOL
propulsion concept selection	
[AIAA PAPER 79-1283] Multivariable control altitude demonstratio	A79-39018
the F100 turbofan engine	
[AIAA PAPER 79-1204]	A79-39814
Predicted P100 engine response to circumfer	rential
pressure and temperature distortion	.70 .0040
[AIAA PAPER 79-1310] Characteristics of the advanced supersonic	∆7 9-39819
technology AST-105-1 configured for trans	spacific
range with Pratt and Whitney aircraft va	
stream control engines	
[NASA-TH-78818]	N79-23888
Combined pressure and temperature distortion effects on internal flow of a turbofan e	
[NASA-TH-79136]	N79-23963
Effect of steady-state pressure distortion	
characteristics entering a turbofan engu	
[NASA-TH-79134]	N79-23969
Multivariable control altitude demonstration the P100 turbofan engine	
[NASA-TH-79183]	N79-25015
Operating condition and geometry effects of	n
low-frequency afterburner combustion ins	tabılíty
	-
in a turbofan at altitude	
[NASA-TP-1475]	N79-25022
[NASA-TP-1475] TURBOFANS Advanced forging process for gas turbine en	N79-25022
[NASA-TP-1475] TUBBOPANS Advanced forging process for gas turbine en fan blades	N79-25022
[NASA-TP-1475] TUBBOPANS Advanced forging process for gas turbine en fan blades [AINA PAPER 79-1269]	N79-25022
[NASA-TP-1475] TURBOFANS Advanced forging process for gas turbine en fan blades [AIAA PAPER 79-1269] TURBOJET ENGINE COHTROL	N79-25022 ngine N79-39013
[NASA-TP-1475] TUBBOPANS Advanced forging process for gas turbine en fan blades [AINA PAPER 79-1269]	N79-25022 ngine N79-39013
[NASA-TP-1475] TURBOFANS Advanced forging process for gas turbine en fan blades [AIAA PAPER 79-1269] TURBOJET ENGINE CONTROL Hultivariable control altitude demonstration the F100 turbofan engine [AIAA PAPER 79-1204]	N79-25022 ngine N79-39013
[NASA-TP-1475] TURBOPANS Advanced forging process for gas turbine en fan blades [AIAA PAPER 79-1269] TURBOJET ENGINE CONTROL Bultivariable control altitude demonstration the P100 turbofan engine [AIAA PAPER 79-1204] TURBOJET ENGINES	N79-25022 ngine A79-39013 DD ON A79-39814
[NASA-TP-1475] TUBBOPANS Advanced forging process for gas turbine en fan blades [AIAA PAPER 79-1269] TUBBOJET ENGINE CONTROL Hultvariable control altitude demonstration the F100 turbofan engine [AIAA PAPER 79-1204] TURBOJET ENGINES The multiple application core engine - Siz:	N79-25022 ngine A79-39013 on on A79-39814 ing and
[NASA-TP-1475] TURBOPANS Advanced forging process for gas turbine en fan blades [AIAA PAPER 79-1269] TURBOJET ENGINE CONTROL Bultivariable control altitude demonstration the P100 turbofan engine [AIAA PAPER 79-1204] TURBOJET ENGINES	N79-25022 ngine A79-39013 on on A79-39814 ing and
[NASA-TP-1475] TURBOPANS Advanced forging process for gas turbine en fan blades [AIAA PAPER 79-1269] TURBOJET ENGINE CONTROL Hultivariable control altitude demonstration the F100 turbofan engine [AIAA PAPER 79-1204] TURBOJET ENGINES The multiple application core engine - Siz: usage criteria high-pressure rotors : engines [AIAA PAPER 79-1123]	N79-25022 ngine A79-39013 on on A79-39814 ing and in jet A79-38953
[NASA-TP-1475] TURBOPANS Advanced forging process for gas turbine en fan blades [AIAA PAPER 79-1269] TUBBOJET ENGINE CONTROL Multivariable control altitude demonstration the P100 turbofan engine [AIAA PAPER 79-1204] TURBOJET ENGINES The multiple application core engine - Siz: usage criteria high-pressure rotors : engines [AIAA PAPER 79-1123] Effect of shocks on film cooling of a full	N79-25022 ngine A79-39013 on on A79-39814 in jet A79-38953 scale
[NASA-TP-1475] TURBOPANS Advanced forging process for gas turbine en fan blades [AIAA PAPER 79-1269] TURBOJET ENGINE CONTROL Bultivariable control altitude demonstration the F100 turbofan engine [AIAA PAPER 79-1204] TURBOJET ENGINES The multiple application core engine - Siz: usage criteria high-pressure rotors : engines [AIAA PAPER 79-1123] Effect of shocks on film cooling of a full turbojet exhaust nozzle having an external	N79-25022 ngine A79-39013 on on A79-39814 in jet A79-38953 scale
[NASA-TP-1475] TUBBOPANS Advanced forging process for gas turbine en fan blades [AIAA PAPER 79-1269] TUBBOJET ENGINE CONTROL Multivariable control altitude demonstration the F100 turbofan engine [AIAA PAPER 79-1204] TUBBOJET ENGINES The multiple application core engine - Siz: usage criteria high-pressure rotors : engines [AIAA PAPER 79-1123] Effect of shocks on film cooling of a full turbojet exhaust nozzle having an externa- expansion surface	N79-25022 ngine A79-39013 on on A79-39814 ing and in jet A79-38953 scale al
[NASA-TP-1475] TURBOPANS Advanced forging process for gas turbine en fan blades [AIAA PAPER 79-1269] TURBOJET ENGINE CONTROL Bultivariable control altitude demonstration the F100 turbofan engine [AIAA PAPER 79-1204] TURBOJET ENGINES The multiple application core engine - Siz: usage criteria high-pressure rotors : engines [AIAA PAPER 79-1123] Effect of shocks on film cooling of a full turbojet exhaust nozzle having an external	N79-25022 ngine A79-39013 on on A79-39814 in jet A79-38953 scale al A79-38969
[NASA-TP-1475] TURBOPANS Advanced forging process for gas turbine en fan blades [AIAA PAPER 79-1269] TURBOJET ENGINE CONTROL Multivariable control altitude demonstration the F100 turbofan engine [AIAA PAPER 79-1204] TURBOJET ENGINES The multiple application core engine - Siz: usage criteria high-pressure rotors : engines [AIAA PAPER 79-1123] Effect of shocks on film cooling of a full turbojet exhaust nozzle having an externa expansion surface [AIAA PAPER 79-1170] Effect of shocks on film cooling of a full turbojet exhaust nozzle having an externa	N79-25022 ngine A79-39013 on on A79-39814 in jet A79-38953 scale A79-38969 scale
<pre>[NASA-TP-1475] TURBOPANS Advanced forging process for gas turbine en fan blades [AIAA PAPER 79-1269] TURBOJET ENGINE CONTROL Multivariable control altitude demonstration the P100 turbofan engine [AIAA PAPER 79-1204] TURBOJET ENGINES The multiple application core engine - Siz: usage criteria high-pressure rotors : engines [AIAA PAPER 79-1123] Effect of shocks on film cooling of a full turbojet exhaust nozzle having an externa ezpansion surface [AIAA PAPER 79-1170] Effect of shocks on film cooling of a full turbojet exhaust nozzle having an externa ezpansion surface</pre>	N79-25022 ngine A79-39013 on on A79-39814 in jet A79-38953 scale al A79-38969 scale al
[NASA-TP-1475] TURBOFANS Advanced forging process for gas turbine en fan blades [AIAA PAPER 79-1269] TURBOJET ENGINE CONTROL Multivariable control altitude demonstration the F100 turbofan engine [AIAA PAPER 79-1204] TURBOJET ENGINES The multiple application core engine - Siz: usage criteria high-pressure rotors : engines [AIAA PAPER 79-1123] Effect of shocks on film cooling of a full turbojet exhaust nozzle having an externa expansion surface [AIAA PAPER 79-1170] Effect of shocks on film cooling of a full turbojet exhaust nozzle having an externa expansion surface [NSA-TF.79157]	N79-25022 ngine A79-39013 on on A79-39814 in jet A79-38953 scale A79-38969 scale
<pre>[NASA-TP-1475] TURBOPANS Advanced forging process for gas turbine en fan blades [AIAA PAPER 79-1269] TURBOJET ENGINE CONTROL Multivariable control altitude demonstration the P100 turbofan engine [AIAA PAPER 79-1204] TURBOJET ENGINES The multiple application core engine - Siz: usage criteria high-pressure rotors : engines [AIAA PAPER 79-1123] Effect of shocks on film cooling of a full turbojet exhaust nozzle having an externa ezpansion surface [AIAA PAPER 79-1170] Effect of shocks on film cooling of a full turbojet exhaust nozzle having an externa ezpansion surface</pre>	N79-25022 ngine A79-39013 on on A79-39814 in jet A79-38953 scale al A79-38969 scale al
[NASA-TP-1475] TURBOPANS Advanced forging process for gas turbine en fan blades [AIAA PAPER 79-1269] TURBOJET ENGINE CONTROL Multivariable control altitude demonstration the F100 turbofan engine [AIAA PAPER 79-1204] TURBOJET ENGINES The multiple application core engine - Siz: usage criteria high-pressure rotors : engines [AIAA PAPER 79-1123] Effect of shocks on film cooling of a full turbojet exhaust nozzle having an externa expansion surface [AIAA PAPER 79-1170] Effect of shocks on film cooling of a full turbojet exhaust nozzle having an externa expansion surface [NASA-TH-79157] TURBONACHINERY Radial equilibrium in axial turbomachines	N79-25022 ngine A79-39013 on on A79-39814 in jet A79-38953 scale al A79-38969 scale al N79-23966 A79-37828
[NASA-TP-1475] TURBOPANS Advanced forging process for gas turbine en fan blades [AIAA PAPER 79-1269] TURBOJET ENGINE CONTROL Multivariable control altitude demonstration the F100 turbofan engine [AIAA PAPER 79-1204] TURBOJET ENGINES The multiple application core engine - Siz: usage criteria high-pressure rotors : engines [AIAA PAPER 79-1123] Effect of shocks on film cooling of a full turbojet exhaust nozzle having an externa expansion surface [AIAA PAPER 79-1170] Effect of shocks on film cooling of a full turbojet exhaust nozzle having an externa expansion surface [NASA-TF-79157] TURBOMACHINERY Radial equilibrium in axial turbomachines The role of three-dimensional flow analysis	N79-25022 ngine A79-39013 on on A79-39814 in jet A79-38953 scale al A79-38969 scale al N79-23966 A79-37828
<pre>[NASA-TP-1475] TURBOPANS Advanced forging process for gas turbine en fan blades [AIAA PAPER 79-1269] TURBOJET ENGINE CONTROL Multivariable control altitude demonstration the P100 turbofan engine [AIAA PAPER 79-1204] TURBOJET ENGINES The multiple application core engine - Siz: usage criteria high-pressure rotors : engines [AIAA PAPER 79-1123] Effect of shocks on film cooling of a full turbojet exhaust nozzle having an externa expansion surface [AIAA PAPER 79-1170] Effect of shocks on film cooling of a full turbojet exhaust nozzle having an externa expansion surface [AIAA PAPER 79-1170] Effect of shocks on film cooling of a full turbojet exhaust nozzle having an externa expansion surface [NASA-TH-79157] TURBOMACHINERY Radial equilibrium in axial turbomachines The role of three-dimensional flow analysis design of turbomachinery</pre>	N79-25022 ngine A79-39013 on on A79-39814 ing and in jet A79-38953 scale al A79-38969 scale al N79-23966 A79-37828 s in the
<pre>[NASA-TP-1475] TURBOPANS Advanced forging process for gas turbine en fan blades [AIAA PAPER 79-1269] TURBOJET ENGINE CONTROL Multivariable control altitude demonstration the F100 turbofan engine [AIAA PAPER 79-1204] TURBOJET ENGINES The multiple application core engine - Siz: usage criteria high-pressure rotors : engines [AIAA PAPER 79-1123] Effect of shocks on film cooling of a full turbojet exhaust nozzle having an externa expansion surface [AIAA PAPER 79-1170] Effect of shocks on film cooling of a full turbojet exhaust nozzle having an externa expansion surface [NASA-TM-79157] TURBOMACHINENT Radial equilibrium in axial turbomachines The role of three-dimensional flow analysis design of turbomachinery [AIAA PAPER 79-1231]</pre>	N79-25022 ngine A79-39013 on on A79-39814 in jet A79-38953 scale al A79-38969 scale al N79-23966 A79-37828 s in the A79-38995
<pre>[NASA-TP-1475] TURBOPANS Advanced forging process for gas turbine en fan blades [AIAA PAPER 79-1269] TURBOJET ENGINE CONTROL Multivariable control altitude demonstration the P100 turbofan engine [AIAA PAPER 79-1204] TURBOJET ENGINES The multiple application core engine - Siz: usage criteria high-pressure rotors : engines [AIAA PAPER 79-1123] Effect of shocks on film cooling of a full turbojet exhaust nozzle having an externa expansion surface [AIAA PAPER 79-1170] Effect of shocks on film cooling of a full turbojet exhaust nozzle having an externa expansion surface [AIAA PAPER 79-1170] Effect of shocks on film cooling of a full turbojet exhaust nozzle having an externa expansion surface [NASA-TH-79157] TURBOMACHINERY Radial equilibrium in axial turbomachines The role of three-dimensional flow analysis design of turbomachinery [AIAA PAPER 79-1231] Experimental analysis methods for unsteady in turbomachines</pre>	N79-25022 ngine A79-39013 on on A79-39814 in jet A79-38953 scale al N79-38969 scale al N79-23966 A79-37828 s in the A79-38995 flows
<pre>[NASA-TP-1475] TURBOPANS Advanced forging process for gas turbine en fan blades [AIAA PAPER 79-1269] TURBOJET ENGINE CONTROL Multivariable control altitude demonstration the F100 turbofan engine [AIAA PAPER 79-1204] TURBOJET ENGINES The multiple application core engine - Siz: usage criteria high-pressure rotors : engines [AIAA PAPER 79-1123] Effect of shocks on film cooling of a full turbojet exhaust nozzle having an externa expansion surface [AIAA PAPER 79-1170] Effect of shocks on film cooling of a full turbojet exhaust nozzle having an externa expansion surface [AIAA PAPER 79-1170] Effect of shocks on film cooling of a full turbojet exhaust nozzle having an externa expansion surface [NASA-TM-79157] TURBONACHINERY Radial equilibrium in axial turbomachines The role of three-dimensional flow analysis design of turbomachinery [AIAA PAPER 79-1231] Experimental analysis methods for unsteady in turbomachines [ONERA, TP NO. 1979-59]</pre>	N79-25022 ngine A79-39013 on on A79-39814 in jet A79-38953 scale al A79-38969 scale al N79-23966 A79-37828 s in the A79-38995
[NASA-TP-1475] TURBOPANS Advanced forging process for gas turbine en fan blades [AIAA PAPER 79-1269] TURBOJET ENGINE CONTROL Bultivariable control altitude demonstration the F100 turbofan engine [AIAA PAPER 79-1204] TURBOJET ENGINES The multiple application core engine - Siz: usage criteria high-pressure rotors : engines [AIAA PAPER 79-1123] Effect of shocks on film cooling of a full turbojet exhaust nozzle having an externa expansion surface [AIAA PAPER 79-1170] Effect of shocks on film cooling of a full turbojet exhaust nozzle having an externa expansion surface [NASA-TH-79157] TURBOMACHINERY Radial equilibrium in axial turbomachines The role of three-dimensional flow analysis: design of turbomachinery [AIAA PAPER 79-1231] Experimental analysis methods for unsteady in turbomachines [ONERA, TP NO. 1979-59] TURBOROF AIRCHAPT	N79-25022 ngine A79-39013 on on A79-39814 in jet A79-38953 scale A1 N79-23966 A79-37828 s in the A79-38995 flows A79-39095
<pre>[NASA-TP-1475] TURBOPANS Advanced forging process for gas turbine en fan blades [AIAA PAPER 79-1269] TURBOJET ENGINE CONTROL Multivariable control altitude demonstration the P100 turbofan engine [AIAA PAPER 79-1204] TURBOJET ENGINES The multiple application core engine - Siz: usage criteria high-pressure rotors : engines [AIAA PAPER 79-1123] Effect of shocks on film cooling of a full turbojet exhaust nozzle having an externa expansion surface [AIAA PAPER 79-1170] Effect of shocks on film cooling of a full turbojet exhaust nozzle having an externa expansion surface [AIAA PAPER 79-1170] Effect of shocks on film cooling of a full turbojet exhaust nozzle having an externa expansion surface [NASA-TH-79157] TURBOMACHINERY Radial equilibrium in axial turbomachines The role of three-dimensional flow analysis design of turbomachinery [AIAA PAPER 79-1231] Experimental analysis methods for unsteady in turbomachines [ONERA, TP NO. 1979-59] TURBOPROP AIRCRAFT Interference effects of aircraft components</pre>	N79-25022 ngine A79-39013 on on A79-39814 in jet A79-38953 scale al N79-38969 scale al N79-23966 A79-37828 s in the A79-38995 flows A79-39095 s on the
[NASA-TP-1475] TURBOPANS Advanced forging process for gas turbine en fan blades [AIAA PAPER 79-1269] TURBOJET ENGINE CONTROL Bultivariable control altitude demonstration the F100 turbofan engine [AIAA PAPER 79-1204] TURBOJET ENGINES The multiple application core engine - Siz: usage criteria high-pressure rotors : engines [AIAA PAPER 79-1123] Effect of shocks on film cooling of a full turbojet exhaust nozzle having an externa expansion surface [AIAA PAPER 79-1170] Effect of shocks on film cooling of a full turbojet exhaust nozzle having an externa expansion surface [NASA-TH-79157] TURBOMACHINERY Radial equilibrium in axial turbomachines The role of three-dimensional flow analysis: design of turbomachinery [AIAA PAPER 79-1231] Experimental analysis methods for unsteady in turbomachines [ONERA, TP NO. 1979-59] TURBOROF AIRCHAPT	N79-25022 ngine A79-39013 on on A79-39814 in jet A79-38953 scale al N79-38969 scale al N79-23966 A79-37828 s in the A79-38995 flows A79-39095 s on the
<pre>[NASA-TP-1475] TURBOPANS Advanced forging process for gas turbine en fan blades [AIAA PAPER 79-1269] TUBBOJET ENGINE CONTROL Multivariable control altitude demonstration the P100 turbofan engine [AIAA PAPER 79-1204] TURBOJET ENGINES The multiple application core engine - Siz: usage criteria high-pressure rotors : engines [AIAA PAPER 79-1123] Effect of shocks on film cooling of a full turbojet exhaust nozzle having an externa ezpansion surface [AIAA PAPER 79-1170] Effect of shocks on film cooling of a full turbojet exhaust nozzle having an externa ezpansion surface [AIAA PAPER 79-1170] Effect of shocks on film cooling of a full turbojet exhaust nozzle having an externa ezpansion surface [NASA-TH-79157] TURBOMACHIWERY Radal equilibrium in axial turbomachines The role of three-dimensional flow analysis design of turbomachinery [AIAA PAPER 79-1231] Experimental analysis methods for unsteady in turbomachines [ONERA, TP NO. 1979-59] TUBBOPROP AIRCRAFT Interference effects of aircraft component: local blade angle of attack of a wing-mot propeller [NASA-TH-78567]</pre>	N79-25022 ngine A79-39013 on on A79-39814 in jet A79-38953 scale al N79-38969 scale al N79-23966 A79-37828 s in the A79-38995 flows A79-39095 s on the
<pre>[NASA-TP-1475] TURBOPANS Advanced forging process for gas turbine en fan blades [AIAA PAPER 79-1269] TURBOJET ENGINE CONTROL Multivariable control altitude demonstration the F100 turbofan engine [AIAA PAPER 79-1204] TURBOJET ENGINES The multiple application core engine - Siz: usage criteria high-pressure rotors : engines [AIAA PAPER 79-1123] Effect of shocks on film cooling of a full turbojet exhaust nozzle having an externa expansion surface [AIAA PAPER 79-1170] Effect of shocks on film cooling of a full turbojet exhaust nozzle having an externa expansion surface [NASA-TM-79157] TURBOMACHINENT Radial equilibrium in axial turbomachines The role of three-dimensional flow analysis design of turbomachinery [AIAA PAPER 79-1231] Experimental analysis methods for unsteady in turbomachines [ONERA, TP NO. 1979-59] TURBOPROP AIRCEMPT Interference effects of aircraft component: local blade angle of attack of a wing-mor propeller [NASA-TM-78567] TURBOP SNGINES</pre>	N79-25022 ngine A79-39013 on on A79-39814 in jet A79-38953 scale A79-38969 scale A79-23966 A79-37828 s in the A79-38995 flows A79-39095 s on the unted N79-25021
<pre>[NASA-TP-1475] TURBOPANS Advanced forging process for gas turbine en fan blades [AIAA PAPER 79-1269] TURBOJET ENGINE CONTROL Bultivariable control altitude demonstration the P100 turbofan engine [AIAA PAPER 79-1204] TURBOJET ENGINES The multiple application core engine - Siz: usage criteria high-pressure rotors : engines [AIAA PAPER 79-1123] Effect of shocks on film cooling of a full turbojet exhaust nozzle having an externa expansion surface [AIAA PAPER 79-1170] Effect of shocks on film cooling of a full turbojet exhaust nozzle having an externa expansion surface [NASA-TH-79157] TURBORCHINERY Radial equilibrium in axial turbomachines The role of three-dimensional flow analysis design of turbomachinery [AIAA PAPER 79-1231] Experimental analysis methods for unsteady in turbomachines [ONERA, TP NO. 1979-59] TURBORPO AIRCAPT Interference effects of aircraft component; local blade angle of attack of a wing-mo propeller [NASA-TH-7857] TURBOPAOP BEGINES Wind turnel performance of four energy eff:</pre>	N79-25022 ngine A79-39013 on on A79-39814 in jet A79-38953 scale A79-38969 scale A79-23966 A79-37828 s in the A79-38995 flows A79-39095 s on the unted N79-25021
<pre>[NASA-TP-1475] TURBOPANS Advanced forging process for gas turbine en fan blades [AIAA PAPER 79-1269] TURBOJET ENGINE CONTROL Multivariable control altitude demonstration the P100 turbofan engine [AIAA PAPER 79-1204] TURBOJET ENGINES The multiple application core engine - Siz: usage criteria high-pressure rotors : engines [AIAA PAPER 79-1123] Effect of shocks on film cooling of a full turbojet exhaust nozzle having an externa expansion surface [AIAA PAPER 79-1170] Effect of shocks on film cooling of a full turbojet exhaust nozzle having an externa expansion surface [NASA-TH-79157] TURBOMACHINERY Radial equilibrium in axial turbomachines The role of three-dimensional flow analysis design of turbomachinery [AIAA PAPER 79-1231] Experimental analysis methods for unsteady in turbomachines [ORERA, TP NO. 1979-59] TURBOPROP AIRCRAFT Interference effects of aircraft component: local blade angle of attack of a wing-mor propeller [NASA-TH-78587] TURBOPROP BEGINES Wind tunnel performance of four energy effi propellers designed for Mach 0.8 cruise</pre>	N79-25022 ngine A79-39013 on on A79-39814 in jet A79-38953 scale A1 A79-38969 scale A1 N79-23966 A79-37828 s in the A79-38995 flows A79-39095 s on the unted N79-25021 icient
<pre>[NASA-TP-1475] TURBOPANS Advanced forging process for gas turbine en fan blades [AIAA PAPER 79-1269] TURBOJET ENGINE CONTROL Bultivariable control altitude demonstration the P100 turbofan engine [AIAA PAPER 79-1204] TURBOJET ENGINES The multiple application core engine - Siz: usage criteria high-pressure rotors : engines [AIAA PAPER 79-1123] Effect of shocks on film cooling of a full turbojet exhaust nozzle having an externa expansion surface [AIAA PAPER 79-1170] Effect of shocks on film cooling of a full turbojet exhaust nozzle having an externa expansion surface [NASA-TH-79157] TURBORCHINERY Radial equilibrium in axial turbomachines The role of three-dimensional flow analysis design of turbomachinery [AIAA PAPER 79-1231] Experimental analysis methods for unsteady in turbomachines [ONERA, TP NO. 1979-59] TURBORPO AIRCAPT Interference effects of aircraft component; local blade angle of attack of a wing-mo propeller [NASA-TH-7857] TURBOPAOP BEGINES Wind turnel performance of four energy eff:</pre>	N79-25022 ngine A79-39013 on on A79-39814 in jet A79-38953 scale A79-38969 scale A79-23966 A79-37828 s in the A79-38995 flows A79-39095 s on the unted N79-25021 icient A79-36759
<pre>[NASA-TP-1475] TURBOPANS Advanced forging process for gas turbine en fan blades [AIAA PAPER 79-1269] TURBOJET ENGINE CONTROL Multivariable control altitude demonstration the F100 turbofan engine [AIAA PAPER 79-1204] TURBOJET ENGINES The multiple application core engine - Siz: usage criteria high-pressure rotors : engines [AIAA PAPER 79-1123] Effect of shocks on film cooling of a full turbojet exhaust nozzle having an externa expansion surface [AIAA PAPER 79-1170] Effect of shocks on film cooling of a full turbojet exhaust nozzle having an externa expansion surface [NASA-TM-79157] TURBOMACHINENT Radial equilibrium in axial turbomachines The role of three-dimensional flow analysis design of turbomachinery [AIAA PAPER 79-1231] Experimental analysis methods for unsteady in turboachines [ONERA, TP NO. 1979-59] TURBOPROP AIRCEMPT Interference effects of aircraft component: local blade angle of attack of a wing-mor propeller [NASA-TM-78587] TURBOPROP BEGINES Wind tunnel performance of four energy effi propellers designed for Mach 0.8 cruise [SAE PAPER 790573]</pre>	N79-25022 ngine A79-39013 on on A79-39814 in jet A79-38953 scale A1 A79-38969 scale A1 N79-23966 A79-37828 s in the A79-38995 flows A79-39095 s on the unted N79-25021 icient A79-36759 speed
<pre>[NASA-TP-1475] TURBOPANS Advanced forging process for gas turbine en fan blades [AIAA PAPER 79-1269] TURBOJET ENGINE CONTROL Bultivariable control altitude demonstration the P100 turbofan engine [AIAA PAPER 79-1204] TURBOJET ENGINES The multiple application core engine - Siz: usage criteria high-pressure rotors : engines [AIAA PAPER 79-1123] Effect of shocks on film cooling of a full turbojet exhaust nozzle having an externa expansion surface [AIAA PAPER 79-1170] Effect of shocks on film cooling of a full turbojet exhaust nozzle having an externa expansion surface [NASA-TH-79157] TURBORCHINERY Radial equilibrium in axial turbomachines The role of three-dimensional flow analysis design of turbomachinery [AIAA PAPER 79-1231] Experimental analysis methods for unsteady in turbomachines [ONERA, TP NO. 1979-59] TURBORPA INCEMPT Interference effects of aircraft component: local blade angle of attack of a wing-mo propeller [NASA-TH-7857] TURBOROP BIGINES Wind tunnel performance of four energy eff: propellers designed for Mach 0.8 cruise [SAE PAPER 790573] Tome noise of three supersonic helical tip</pre>	N79-25022 ngine A79-39013 on on A79-39814 in jet A79-38953 scale A79-38969 scale A79-23966 A79-37828 s in the A79-38995 flows A79-39095 s on the unted N79-25021 icient A79-36759

TURBULENCE	
Turbulence characteristics of compressor dis	cnarge
flows JT9D engine tests	20 35005
-	79-24995
Turbulence measurements in the compressor ex	lt
flow of a General Electric CF6-50 engine	
	179-24996
TURBULENT BOUNDARY LAYER	
A method for the calculation of 3D boundary	layers
on practical wing configurations	
-	79-38906
TURBULENT DIFFUSION	
Turbulence characteristics of compressor dis	charge
flows JT9D engine tests	
	79-24995
TURBULERT PLOW	
Rotor blade stability in turbulent flows. I	
	79-38118
Methodology for prediction of V/STOL propuls	ion
induced forces in ground effect	
	79-39017
TURBULENT JETS	
Noise characteristics of heated high velocit	
rectangular jets jet engine applicatio	
-	79-38399
TURBULENT WAKES	- · ·
Turbulent wake measurements with a laser vel	
	79-38058
TWO DIMENSIONAL FLOW	
Profiling of two-dimensional and three-dimen	sional
nozzles and calculation of their flows	
٨	79-38168
<u>'</u>	
TETRASONIC TRSTS	

ULTRASONIC TESTS Broad-band ultrasonic transducers for non-destructive inspection of aeronautical components [ONERA, TP NO. 1979-45] ULTRASONIC WAVE TRANSDUCERS Broad-band ultrasonic transducers for A79-39094 non-destructive inspection of aeronautical components [ONERA, TP NO. 1979-45] Broad-band transducers for nondestructive A79-39094 inspection of aeronautical components N79-25419 UNSTRADY FLOW The analysis of propellers including interaction effects --- for general aviation aircraft [SAE PAPER 790576] A79-36712 Analysis of an unsteady aerodynamic force on a blade due to ununiform amplitude gusts 179-39059 Experimental analysis methods for unsteady flows In turbomachines [ONERA, TP NO. 1979-59] A79-Some remarks on the design of transonic tunnels A79-39095 with low levels of flow unsteadiness [NASA-CR-2722] N79-25039 USER ANUALS (COMPUTER PROGRAMS) Fuselage-mounted antenna code: User's manual [AD-A065587] N79-24 User's guide: Computer program with interactive graphics for analysis of plane frame structures N79-24215 (CPRAME) [AD-A0673491 N79-25428 V

V/STOL AIRCRAFT The British Aerospace Harrier: Case study in aircraft design --- Book A79-36644 A unique facility for V/STOL aircraft hover testing A79-37296 Investigation of a laser Doppler velocimeter Investigation of a laser Doppler velocimeter system to measure the flow field of a large scale V/STOL aırcraft in ground effect [AIAA PAPER 79-1184] A79-38 Hethodology for prediction of V/STOL propulsion induced forces in ground effect [AIAA PAPER 79-1281] A79-39 The impact of operational requirements on V/STOL propulsion concept selection [AIAA PAPER 79-133] A79-39 A79-38974 A79-39017 [AIAA PAPER 79-1283] A79-39018

VALIDITY

SUBJECT INDEX

V/STOL aircraft configuration effects on exhaust

 gas ingestion
 [AIAA PAPER 79-1284]
 A79-390'

 Theoretical fan velocity distortions due to inlets
 and nozles -- in V/STOL aircraft
 N79-2391

 [NSA-TH-79150]
 N79-2391

 A79-39019 N79-23911 VALIDĪTY Validation of aircraft noise prediction program [NASA-CR-159047] N79-25843 VAPORIZING Lean, premixed, prevaporized combustion for aircraft gas turbine engines [NASA-TH-79148] N79-23964 Effect of degree of fuel vaporization upon emissions for a premixed prevaporized combustion system --- for gas turbine engines [NASA-TM-79154] N79-23965 Premixed Prevaporized Combustor Technology Forum [NASA-CP-2078] N79-24994 VABLABLE CYCLE ENGINES Multivariable control altitude demonstration on the F100 turbofan engine [AIAA PAPER 79-1204] Regression Simulation of turbine engine A79-39814 performance: Accuracy improvement (task 4) [AD-A066398] 179-25027 VARIABLE GEORETRY STRUCTURES VARIABLE GROAFTHI STRUCTURES Partially variable area turbine nozzle [AIAA PAPER 79-1227] A79-38 VARIABLE SWEEP WINGS Aeroelastic stability analysis of the AD-1 manned A79-38992 oblique-wing aircraft A79-38136 VATOL AIRCRAPT The impact of operational requirements on V/STOL propulsion concept selection [AIAA PAPER 79-1283] A79-39018 VECTOR ANALYSIS A vector-continuous loading concept for aerodynamic panel methods [NASA-TM-80104] VELOCITY DISTRIBUTION N79-24956 Theoretical fan velocity distortions due to inlets and nozzles --- in V/STOL aircraft [NASA-TH-79150] N79-239 N79-23911 Interactional aerodynamics of the single rotor helicopter configuration. Volume 3B: Flow angle and velocity wake profiles in low frequency band, air ejector systems and other devices [AD-A061767] VELOCITY HEASUREMENT N79-24966
 ATAL PAPER 79-1087]
 A79-38058
 VERTICAL AIR CURRENTS A wind shear/downdraft drift angle warning system A vind shear/downdraft drift angle warning system A79-38477 VERTICAL DISTRIBUTION Vertical cutoff rigidity and the intensity distribution of cosmic rays near Cape Town A79-37468 VERTICAL LANDING Evaluation of an FM/CW range measurement system for VTOL landing A79-36086 VERTICAL MOTION Theoretical fundamentals of radio altimetry ---Russian book A79-38145 VERTICAL TAKEOFF AIRCRAFT Evaluation of an FM/CW range measurement system for VTOL landing A79-36086 Technical evaluation report on the 27th Guidance and Control Panel Symposium on the V/STOL Alcoraft at Night and in Poor Visibility [AGARD-AR-142] N79-23946 VIBRATION Prediction of the angular response power spectral density of aircraft structures [AD-A066141] N79-23956 Helicopter transmission vibration and noise reduction program. Volume 3: Evaluation of fiber PP metal-matrix housing specimens [AD-A066794] 479 179-24983 VIBRATION DAMPING Designing with damping materials to reduce noise and structural fatigue --- of aircraft components 179-36758 [SAE PAPER 790631]

A method of reducing aircraft turbine blade vibrations. A79-38819 Determination of subcritical frequency and damping from B-1 flight flutter test data [NASA-CR-3152] N79-25426 VIBRATION EFFECTS Engine induced structural-borne noise in a general aviation aircraft [SAE PAPER 790626] VIBRATION MEASUREMENT 179-36754 Model verification of force determination for measuring vibratory loads --- of rotors on helicopters A79-36379 VIBRATION TESTS Model verification of force determination for measuring vibratory loads --- of rotors on helicopters A79-36379 Engine demonstration test of a cooled laminated axial turbine [AIAA PAPER 79-1229] A79-38993 VIBRATORY LOADS Model verification of force determination for measuring vibratory loads --- of rotors on helicopters A79-36379 VOICE COMMUNICATION Nap-of-the-earth communication program for US Army helicopters [AD-A063089] N79-24232 VORTEX BREAKDOWN Investigation of aerodynamic characteristics of subsonic wings [NASA-CR-158661] N79-23921 VORTEX SHERTS The 'cloud-in-cell' technique applied to the roll up of vortex sheets A79-37725 VORTICES Practical design of minimum induced loss propellers [SAE PAPER 790585] A79-36720 Vortex-induced oscillations - A selective review A79-39751 Aircraft wake vortices. A bibliography with abstracts [NTIS/PS-79/0166/3] N79-2 Low-speed wind-tunnel investigation of wing fins N79-23939 as trailing-vortex-alleviation devices on a transport airplane model [NASA-TP-1453] VULWERABILITY N79-24961 NOVA-25, a stiffened panel extension of the NOVA-2 computer program [AD-A066038] N79-239 N79-23951

W

WAKES Interactional aerodynamics of the single rotor helicopter configuration. Volume 3B: Flow angle and velocity wake profiles in low frequency band, air ejector systems and other devices [AD-A061767] N79-24966 Interactional aerodynamics of the single rotor helicopter configuration. Volume 6B: One-third octave band spectrograms of wake single film data, basic configuration wake explorations [AD-A061861] N7 N79-24968 Allowing for the wall boundary layer in an axial compressor stage A79-36586 WALL JETS Calculation of a laminar wall jet in a wake A79-36582 WANKEL BEGINES A review of Curtiss-Wright rotary engine developments with respect to general aviation potential [SAE PAPER 790621] A79-36749 WARNING SYSTEMS A wind shear/downdraft drift angle warning system A79-38477 Peasibility and cost effectiveness of airborne tire pressure indicating systems [AD-A065513] N79-24981

WATER Water absorption of fluids/oils --- contamination of aircraft engine oils and inhibitors [AD-A065915] N79-24158 WEAPON STSTEES Reliability and maintainability contribution to Hornet mission success 179-39915 WRAR Diagnostics of wear in aeronautical systems [NASA-TH-79185] WEAR TESTS N79-24350 Effects of extended oil changes on aircraft piston engine wear and oil characteristics [SAE PAPER 790629] A79-36756 Diagnostics of wear in aeronautical systems A79-39805 Aircraft engine oil analysis by neutron activation techniques [AD-A066202] N79-24169 WEIGHT REDUCTION Industry seeks lighter aircraft weight --aircraft design performance A79-36100 Composite applications at Bell Helicopter [SAB PAPER 790578] **179-36713** Impact of advanced technologies on aircraft design A79-37045 Propulsion system sensitivities for a strategic aircraft [AIAA PAPER 79-1121] A79~38952 Aircraft engine nozzle FNASA-CASE-ARC-10977-1] N79-23971 A variational theorem for laminated composite plates of nonlinear materials and applications to postbuckling N79-24977 WELD TESTS Application of electron-beam welding to aviation production --- tests of turbine engine parts welded by electron beam N79-24940 WELDED JOINTS Application of electron-beam welding to aviation production --- tests of turbine engine parts welded by electron beam N79-24940 WESTLAND AIRCRAFT Westland unveils WG30 transport helicopter A79-38092 WHEEL BRAKES Model study of aircraft disk brakes 179-38816 WIND SHEAR The effects of low-level wind shear on the approach and go-around performance of a landing jet aircraft [SAE PAPER 790568] A79-36708 A wind shear/downdraft drift angle warning system A79-38477

 WIND TUNNEL MODELS
 Acroelastic models for cryogenic wind tunnels

 [ONERA, TP NO. 1979-39]
 A79-39

 WIND TUNNEL TESTS
 Pull-scale wind-tunnel investigation of an Ayres

 S2R-800 Thrush Agricultural Airplane
 A79-30

 A79-39088 [SAE PAPER 790618] A79-36746 Wind tunnel performance of four energy efficient propellers designed for Mach 0.8 cruise [SAE PAPER 790573] A79-36759 Control considerations for CCV fighters at high angles of attack A79-37295 Experimental data on the dynamic properties of several propeller vanes --- turbulence measurement in wind tunnel A79-38943 Evaluation of an ejector-powered engine simulator at transonic Mach numbers [AIAA PAPER 79-1165] A79-38' A parametric study of support system interference effects on nozzle/afterbody throttle dependent A79-38967 drag in wind tunnel testing [AIAA PAPER 79-1168] A79-36 V/STOL aircraft configuration effects on exhaust 179-38968 gas ingestion

[AIAA PAPER 79-1284] A79-39019

Tone noise of three supersonic helical tip speed propellers in a wind tunnel A79-39801 Introduction to the arcopter arc wing and the Bertelsen effect for positive pitch stability and control N79-23895 An investigation of a full-scale rotor with four blade tip planform shapes --- in Ames Research Center 40 by 80 Poot Wind Tunnel [WASA-TH-78580] W79-2. N79-23922 Low-speed wind-tunnel investigation of wing fins as trailing-vortex-alleviation devices on a transport airplane model [NASA-TP-1453] N79-24 The computation of transonic flow in wind tunnels at inlets and cascades using the finite element N79-24961 method [BBB-0FE-1421-0] N79-24970 Tone noise of three supersonic helical tip speed propellers in a wind tunnel [NASA-TH-79167] N79-25840 experimental investigation of the effect of λn --- in the langley v/stol wind tunnel [NASA-TH-80066] 179-25844 NIND TUNNELS Making fluid flows visible 179-36373 An introduction to dynamic derivatives. 2: The equations of motion for wind tunnel pitch-yaw oscillation rigs [ARL-AERO-NOTE-377] N79-23982 WIND VANES Experimental data on the dynamic properties of several propeller vanes --- turbulence measurement in wind tunnel A79-38943 WIND VELOCITY BEASUREMENT Experimental data on the dynamic properties of several propeller wanes --- turbulence measurement in wind tunnel A79-38943 WING PLAPS The 'cloud-in-cell' technique applied to the roll up of vortex sheets A79-37725 WING LOADING The 'cloud-in-cell' technique applied to the roll up of vortex sheets 179-37725 WING NACELLE CONFIGURATIONS Interference effects of aircraft components on the local blade angle of attack of a wing-mounted propeller [NASA-TH-78587] N79-25021 Assessment at full scale of nozzle/wing geometry effects on OTW aero-acoustic characteristics --short takeoff aircraft noise [NASA-TH-79168] N79-25841 WING OSCILLATIONS Some observations on the mechanism of aircraft wing rock 179-38135 Aeroelastic stability analysis of the AD-1 manned oblique-wing aircraft 179-38136 VING PANELS A vector-continuous loading concept for aerodynamic panel methods [NASA-TH-80104] ₦79-24956 VING PLANFORMS Minimization theory of induced drag subject to constraint conditions [NASA-CR-3140] N79-23923 WING PROFILES Wing shape optimization for maximum cross-country speed, with mathematical programming N79-23899 An annular wing [NASA-CASE-PRC-11007-2] WING SPAN N79-24959 Second approximation in theory of a finite-span thin wing in a hypersonic gas flow 179-35927

VING TIPS	
A parametric study of support system inter-	Ference
effects on nozzle/afterbody throttle dep	
drag in wind tunnel testing	
[AIAA PAPER 79-1168]	A79-38968
WINGLETS	A13-30300
The Learjet 'Longhorn' series - The first '	lota
with winglets	jets
[SAE PAPER 790581]	179-36716
VINGS	A/9-30/10
Effect of forward acceleration on aerodynamic	10
characteristics of wings	- 20 - 00 40 4
	A79-38124
A method for the calculation of 3D boundar on practical wing configurations	y layers
	A79-38906
Assessment at full scale of nozzle/wing get	Daetry
effects on OTW aeroacoustic characterist;	Lcs
Over The Wing STOL engine configurations	
	A79-39802
The effect of disturbance on a wing	
	N79-23893
Introduction to the arcopter arc wing and t	
Bertelsen effect for positive pitch stab	
and control	
	N79-23895
Numerical optimization techniques for bound	
circulation distribution for minimum indu	
drag of nonplanar wings: Basic formulati	
[NASA-CR-3154]	N79-23924
Low-speed wind-tunnel investigation of wind	
as trailing-vortex-alleviation devices of	
transport airplane model	i a
[NASA-TP-1453]	N79-24961
	8/3-24901
WORKLOADS (PSYCHOPHYSIOLOGY) The time budget as a criterion for the work	1 3 6
air traffic controllers	10 0001
Alf traific controllers [MBB-UFB-1353-0]	N70 33083
[U-CCCI = 2 10-0 0 1	N79-23943
X	

Χ

I RAY STRESS MEASUREMENT I-ray determination of internal stress states due to surface treatment of TiAl6V4 and TiAl6V6Sn2 A79-36003

Y

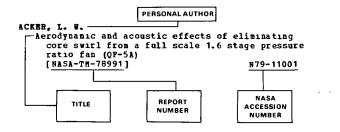
YAW An introduction to dynamic derivatives. 2: The equations of motion for wind tunnel pitch-yaw oscillation rigs [AL-AERO-NOTE-377] YF-16 BIRCRAFT Factors influencing the accuracy of aerodynamic hinge-moment prediction [AD-A066606] N79-24 N79-23982 N79-24965

PERSONAL AUTHOR INDEX

AERONAUTICAL ENGINEERING / A Continuing Bibliography (Suppl 113)

SEPTEMBER 1979

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 leg. NASA report translation NASA contractor report). The accession number is located beneath and to the right of the title eg. N79 11001. Under any one authors name the accession numbers are arranged in sequence with the *IAA* accession numbers appearing first.

A

ABRAHOVICH, K. G.	_
Forcasting the quantitative characteristic	sof
aircraft 1cing [BLL-TRANS-1364-(9022.549)]	N79-24971
ACURIO, J.	N/9-249/1
Materials and structural aspects of advanc	~ 1
gas-turbine helicopter engines	eu
gas-curbine nericopter engines	A79-39804
ADAMS, R. I.	R/3-35004
Overview of helicopter ice protection syst	0 m
developments	
d01020pm0200	N79-23919
AHRENS, D. J.	
Experimental verification of program KRASH	- A
mathematical model for general aviation	-
structural crash dynamics	
[SAE PAPER 790589]	A79-36723
AKSBNOV, Y. P.	
Theory of thin wing in a supersonic flow w	ıth
consideration of the non-equilibrium sta	te of
excitation of oscillating degrees of fre	edom
[AD-A065992]	N79-23928
ALFARO-BOU, E.	
NASA general aviation crashworthiness seat	
development	
[SAE PAPER 790591]	179-36725
ALIC, J. A.	
Fretting fatigue, with reference to aircra	ft
structures	
[SAE PAPER 790612]	A79-36741
ALJABRI, A. S.	_
The analysis of propellers including inter	action
effects	
[SAE PAPER 790576]	A79-36712
ANDERSEN, R. H.	
Partially variable area turbine nozzle [AIAA PAPER 79-1227]	
ANDERSON, R. E.	A79-38992
A variational theorem for laminated compos	
plates of nonlinear materials and applic.	lte
to postbuckling	ations
to postbuckling	N79-24977
ABDO, S.	R/J-245//
Effect of forward acceleration on aerodyna	nic
characteristics of wings	
Characteristics of Willys	A79-38124
ANDRISANI, D., II	a., 50.24
Active control for the Total-In-Flight sim	nlator
(ACTIPS)	414000
[NASA-CR-3118]	N79-23978

ARAI, W.	
Transient ablation of Teflon in intense r and convective environments	adiative
	A79-38123
ARIARATNAN, S. T. Rotor blade stability in turbulent flows.	
AREBRUSTER, H.	A79-38118
Dry friction in the aerospace industry	
ARESTRONG, T. J.	A79-39873
Crashworthiness analysis of field investi business aircraft accidents	gation of
[SAB PAPER 790587]	A79-36721
ARONSTANE, G. A. The selection of materials technologies f	or
full-scale development	
[AIAA PAPER 79-1152] Arora, J. S.	A79-38962
Substructuring methods for design sensiti	vity
analysis and structural optimization [AD-A065935]	N79-23949
Fail-safe optimal design of structures wi	th
substructuring [AD-A065936]	N79-23950
Dynamic structural analysis with substruc [AD-A065937]	tures N79-24378
ARVIN, J. R.	
Development of a gas turbine combustor di zone design analysis	lution
[AIAA PAPÉR 79-1194]	A79-38979
ASCHER, H. The aircraft air conditioner data revisit	eđ
···· ··· ··· ···· ···· ···· ···· ·····	A79-39895
_	

₿

BABER, H. T., JR.	
Characteristics of the advanced supersonic	
technology AST-105-1 configured for trans	pacific
range with Pratt and Whitney aircraft war	iable
stréam control engines	
[NASA-TH-78818]	N79-23888
BAKER, G. R.	
The 'cloud-in-cell' technique applied to th	e roll
up of wortex sheets	
	A79-37725
BAKER, R. R.	
Brittle materials design, high temperature	as
turbine: Ceramic turbine rotor technolog	
	n79-25029
BALABAN, H.	AV5 25025
The F-16 RIW program	
	A79-39889
BARAHOVSKY, S.	A75-55005
Ignition of liquid fuel jets in a supersoni	C 91r
stream	
	A79-38997
BARTLETT, P. D., JR.	A13-30331
Model verification of force determination f	
measuring vibratory loads	OL .
	A79-36379
	A/9-303/9
BATERAN, R. P.	
Multifunction keyboard implementation study	N79-25046
	M/9-25046
BAZIN, H.	
Balance and sting design for cryogenic wind	
	A79-39089
BEASLEY, W. D.	•
Low-speed wind tunnel results for a modifie	α
13-percent-thick airfoil	
[NASA-TH-X-74018]	N79-24960

BECKER, B. B. Exhaust emissions characteristics for a general aviation light-aircraft Avco Lycoming 10-360-A1B6D piston engine [AD-A066556] N79-25544 Exhaust emissions characteristics for a general aviation light-aircraft Avco-Lycoming 10-360-BiBD piston engine [AD-A066589] N79-25545 BEGGS, E. B. Avionics technology for tactical data handling N79-25979 BRHRIE, S. Executive summary of Aircraft Icing Specialists Workshop N79-23914 BELLANTONI, J. The airport performance model. Volume 1: Extensions, validations, and applications [AD-A062863] N79-25040 BENTLEY, R. Evaluation of ground-launch firings for the improved 2.75-inch rocket [AIAA PAPER 79-1297] A79-39027 BERESTNEWA, F. S. Allowing for the wall boundary layer in an axial compressor stage A79-36586 BERGBAUER, D. H. Evaluation of ground-launch firings for the improved 2.75-inch rocket [AIAA PAPER 79-1297] A79-39027 BRRGEY, K. H. New technologies for general aviation aircraft [SAN PAPER 790613] A79 A79-36742 BERGHAN, R. V. Evaluation of ground-launch firings for the improved 2.75-inch rocket [AIAA PAPER 79-1297] 179-39027 BERKSTRESSER, B. K. A Demonstration Advanced Avionics System for general aviation [SAE PAPER 790569] 179-36709 BERRY, F. C., JR. F-18 - A special report A79-38131 BERTELSEN, W. D. Introduction to the arcopter arc wing and the Bertelsen effect for positive pitch stability and control N79-23895 BEZAT, A. The effect of endless burn-in on reliability growth projections A79-39920 BILL, F. A. Driveshaft alignment indicator [AD-A065988] N79-23973 BINGBAN, G. J. Helicopter rotor airfoil [NASA-CASE-LAR-12396-1] N79-24 BINGHAM, L. W., JR. A new light twin using bonded metal construction [SAF PAPER 790603] N79-36 N79-24958 A79-36735 BIRD. D. K. Electromechanical actuation for business aircraft [SAE PAPER 790622] A79-36750 BLACK, G. T. Proceedings of AFFDL Flying Qualities Symposium [AD-A066493] N79-24982 BLACKWELL, R. H. Aeroelastically conformable rotor mission analysis [AD-A067338] N79-249 N79-24985 BLAHA, B. J. Wind tunnel performance of four energy efficient propellers designed for Mach 0.8 cruise [SAE PAPER 790573] A79-30 Tone noise of three supersonic helical tip speed propellers in a wind tunnel A79-36759 A79-39801 Aircraft icing [NASA-CP-2086] N79-23912 Tone noise of three supersonic helical tip speed propellers in a wind tunnel [NASA-TM-79167] N79-25840

PERSONAL AUTHOR INDEX

BLOEDEL, A. W. Experimental verification of program KRASH - A mathematical model for general aviation structural crash dynamics [SAE PAPER 790589] 179-36723 BOBULÀ, G. A. Effects of steady-state pressure distortion on the stall margin of a J85-21 turbojet engine [NASA-TH-79123] N79-239 N79-23968 Effect of steady-state pressure distortion on flow characteristics entering a turbofan engine [NASA-TM-79134] N N79-23969 BOGATRO, V. I. Second approximation in theory of a finite-span thin wing in a hypersonic gas flow A79-35927 BORGHEYER. C. H. A streamlined control system development process [AIAA PAPER 79-1344] A79-3 A79-39048

 Lata target and the target and selection of optimum propellers for general aviation aircraft

 [SkE PAPER 790575]

 179-36711 BORUFF, W. R. The impact of operational requirements on V/STOL propulsion concept selection [AIAA PAPER 79-1283] A79-39018 BOSSLER, R. B., JR. Driveshaft alignment indicator [AD-A065988] N79-23973 BOUCHER, R. J. Project Sunrise [AIAA PAPER 79-1264] A79-39010 BOWDEN, J. N. Stability characteristics of hydrocarbon fuels from alternative sources [BETC/RI-78/23] N79-24178 BOILE, D. Fuel on fire - Rapid response to a military problem A79-38090 179-38090 BOZUNG, H. G. Two-stage supercharger sets: Efficiency and head distribution under full- and part-load conditions [RTS-11613] N79-24342 BRAITHWAITE, W. S. Combined pressure and temperature distortion effects on internal flow of a turbofan engine [AIAA PAPER 79-1309] Å79-39031 Combined pressure and temperature distortion effects on internal flow of a turbofan engine [NASA-TH-79136] N79-N79-23963 BRASHBARS, M. R. ASHEARS, n. K. Investigation of a laser Doppler velocimeter system to measure the flow field of a large scale V/STOL aircraft in ground effect [AIAA PAPER 79-1184] A7 A79-38974 Ships. Volume 1: Program description [AD-A066172] VOLAR: A digital computer program for simulating VSTOL aircraft launch and recover from small N79-23954 Volume 2: Appendices ships. [AD-A066173] N79-23955 BREKHIM, N. I. Informativeness and effectiveness of digital command-generating devices A79-36588 BRENT. G. A. Exploring team avionics systems by simulation A79-38882 BRIDGRS. P. D. Determination of cooling air mass flow for a [SAE PAPER 790609] A79-36740 BRINKHAN, D. W. Stability characteristics of hydrocarbon fuels from alternative sources [BETC/RI-78/23] N79-24178 BROWN, B. T. The application of rapid solidification rate superalloys to radial wafer turbine blades [AINA PAPER 79-1226] 179-38991 BROWN, D. L. Prediction of the angular response power spectral density of aircraft structures [AD-A066141] N79-23956

DDOGR 0 A	
BROWN, S. C. Ground winds for Kennedy Space Center, Plon	
1979 revision	lua,
[NASA-TH-78229]	N79-25662
BRYAR, D. F.	873-23002
The influence of fleet variability on crac!	arouth
tracking procedures for transport/bomber	
[AD-A066596]	N79-25433
BRISON, R. J.	877 23433
Optical in situ versus probe measurements of) f
nitric oxide concentration as a function	of
axial position in a combustor exhaust	••
[AD-A067329]	N79-25025
BULLOCH, C.	
Survivability in aircraft fires - New stand	lards
are needed	
	A79-38091
BURBY, R. J.	
Cargo Logistics Airlift Systems Study (CLAS	5S).
Volume 2: Case study approach and result	s
[NASA-CR-158913]	179-24978
BURNS, R. C.	
The results of synthesizing and evaluating	
potential solutions for Hultz-Function In	
Reference Assembly /MIRA/ candidate confi	
	A79-36082
BURNSIDR, W. D.	
High frequency near field scattering by an	
elliptic disk	
[AD-A065586]	N79-24214
<pre>FuseLage-mounted antenna code: User's manu [AD-A065587]</pre>	N79-24215
Wing-mounted antenna code: User's manual	8/9-24215
[AD-A065589]	N79-24216
An iterative approach for computing an ante	
aperture distribution from given radiation	
pattern data	μ (1)
[AD-A065590]	N79-24217
BURROWS, B. J. C.	
Composite forward fuselage systems integrat	10n.
volume 2	
[AD-A066560]	179-24984

С

0	
CALHOUN, G. L.	
Multifunction keyboard implementation study	
	N79-25046
CALLAS, G. P.	
A Demonstration Advanced Avionics System fo	r
general aviation	
	A79-36709
CANEY, R. D.	
Turbine design system	
[AD-A066092]	N79-23974
CANNON, S. C.	
Ignition of liquid fuel jets in a supersoni	c alr
stream	
[AIAA PAPER 79-1238]	A79-38997
CANT, R. J.	
Rolls-Royce RB.401-07 turbofan engine for b	usiness
aircraft in the 1980's	
[SAE PAPER 790620]	A79-36748
CARLSON, R. W.	
Status of knowledge of sonic booms	
	N79-24955
CARLSON, W. A.	
Evaluation of an PM/CW range measurement sy	stem
for WTOL landing	
-	A79-36086
CARRIGAN, B.	
Aerospace computer systems. Part 1: Avion	105
applications, volume 2. A bibliography w	ith
abstracts	
[NTIS/PS-79/0312/3]	N79-23959
Aerospace computer systems. Part 1: Avion	ics
applications, volume 3. A bibliography w	ith
abstracts	
[NTIS/PS-79/0313/1]	N79-23960
CARUSO, H. J.	
CERT technology applied to an airborne rada	r
	A79-39893
CASSARINO, S. J.	
Aeroelastically conformable rotor mission a	nalysis
	N79-24985
CERNOCE, L.	
Damage-tolerant fan blade design	
	A79-38951

CERNY, R. S.	
Dual breakerless aircraft magneto [SAE PAPER 790606] CHAMDLER, R. F.	179-36738
Seat/Occupant crash dynamic analysis verif	ication
test program [SAE PAPER 790590]	A79-36724
CHEN, R. T. N. A simplified rotor system mathematical mod	el for
piloted flight dynamics simulation [NASA-TM-78575]	N79-23977
CHEVALIER, H. L. Some theoretical considerations of a stall	proof
airplane [SAE PAPER 790604]	- 179-36736
CHIZHOV, V. I. Theoretical fundamentals of radio altimetr	
	Å79-38145
CHOWN, H. An optical-fiber multiterminal data system	for
aircraft	A79-36484
CICHETTI, D. J. CERT technology applied to an airborne rad.	ar
CLARK, H. T.	A79-39893
Definition and hon-destructive detection o critical adhesive bond-line flaws	f
[AD-A065584]	N79-24163
CLARKE, H. D. Factors influencing the accuracy of aerody	Dam1C
hinge-moment prediction [AD-A066606]	N79-24965
CLAYTON, R. H. Emission characteristics of a premix combu-	stor
fueled with a simulated partial-oxidatio product gas	
[AIAA PAPER 79-1322] Cohem, B. B.	A79-39038
What small turbine engine does the small	
helicopter need, or The road to hell is with good intentions	
[AIAA PAPER 79-1314] COLLIN, G.	A79-39032
The Digibus multiplex at the heart of avio	A79-36975
COLVIN, D. R. Evaluation of an PM/CW range measurement s	ystem
for VTOL landing	A79-36086
COMASSAR, D. M. State-of-the-art of nondestructive inspect	10n of
aircraft engines	N79-25413
COMISKEY, J. G.	
Time optimal control of a jet engine using guasi-Hermite interpolation model	
[NASA-CR-158711] CONDELL, H.	N79-25019
The airport performance model. Volume 1: Extensions, Validations, and application	s
[AD-A062863] COOK, C. R.	N79-25040
Advanced forging process for gas turbine e fan blades	ngine
[AIAA PAPER 79-1269] COOPER, L. P.	A79-39013
Effect of degree of fuel vaporization upon	
emissions for a premixed prevaporized co system	
[NASA-TH-79154] COPPOLA, A.	N79-23965
Recent experience in the development and application of LCC models	
COSGROVE, D. V.	N79-25410
Effects of air injection on a turbocharged Teledyne Continental Motors ISIO-360-C e	0.0100
[SAE PAPER 790607]	A79-36760
COI, A. R. The application of rapid solidification ra-	
superalloys to radial wafer turbine blad [AIAA PAPER 79-1226]	es A79-38991
CRIMBRING, W. An evaluation of turn anticipation technig	
offset flying procedures using a single-	waypoint
RNAN system [Ad-A066555]	N79-24974

CRITOPH, R. E. Fossil fuel heat pumps for domestic, commercial and industrial space heating A79-3 179-37852 CROOM, D. R. Low-speed wind-tunnel investigation of wing fins as trailing-vortex-alleviation devices on a transport airplane model
 [NASA-TP-1453]
CROSS, B. J., JR.
 Determination of cooling air mass flow for a N79-24961 horizontally-opposed aircraft engine installation [SAE PAPER 790609] A79-3674 A79-36740 CROWDER, J. P. Simulated propeller slipstream effects on a supercritical wing [NASA-CR-152138] N79-25024 [NASA-CR-152138] CRUSE, T. A. Cost benefits from improved hot section life prediction technology [AIAA PAPER 79-1154] A7 A79-38963 [AIAA FAFEN 75-1134] CULLON, R. Test verification of a turbofan partial swirl afterburner [AIAA FAFEN 79-1199] A75 A79-38981 CULLON, R. R. Operating condition and geometry effects on low-frequency afterburner combustion instability in a turbofan at altitude [NASA-TP-1475] N79-25022 CULPEPPER, R. G. A unique facility for V/STOL aircraft hover testing A79-37296 CUNNINGHAM, R. M. Icing of aircraft Some remarks with an historical slant from a cloud physicist N79-23915 CUPPETT, D. The F-16 RIW program A79-39889

CURRY, C. B. Bffect of maintenince plan and engine durability on helicopter propulsion system ownership cost [AIAA PAPER 79-1317] A79-39033

D

DAINBKO, V. I. A starter for gas turbine engines	
A Statter for yas tarbine engines	A79-36797
DAMOULAKIS, J. N. Recent results in navigation systems utiliz	ina
signal aiding from Navstar satellites	1119
	A79-36096
DANIBLI, G. A. Radial equilibrium in axial turbomachines	
•	A79-37828
DANIELSSON, S. G. A European view on gas turbine engine monit	07180
of present and future civil aircraft	-
[AIÀA PAPER 79-1200] DASH, R.	A79-38982
Effects of forward velocity on sound radiat from convecting monopole and dipole source iet flow	
jet riow	A79-38393
DAVID, L. J.	
Model diffuser investigation for propulsion tunnel 16T	wind
[AD-A065822]	N79-23984
DAVIS, A. O. Blast induced distortion experiments on an	engine
inlet	-
[AD-A066811] DAVIS, D. G. M.	N79-25026
The impact of noise regulations on propelle [SAE PAPER 790593]	er design A79-36727
DE BELLEVAL, JF. Broad-band ultrasonic transducers for	
non-destructive inspection of aeronautica	1
components [ONERA, TP NO. 1979-45]	A79-39094
DE BOER, B.	A / 9- 39094
A method for the calculation of 3D boundary	layers
on practical wing configurations	1 79-38906
DE MICHELE, G.	
Radial equilibríum in axıal turbomachines	179-378 28

PERSONAL AUTHOR INDEX

DEBELLEVAL, J. F.	
Broad-band transducers for nondestructive	
inspection of aeronautical components	¥79-25419
DBHOFF, R. L. Multivariable control altitude demonstratio	n on
the F100 turbofan engine	A79-39814
Multivariable control altitude demonstratio	
the F100 turbofan engine [NASA-TH-79183]	N79-25015
DEJARNETTE, F. R. Investigation of aerodynamic characteristic	e Af
subsonic wings	
DENERDASE, N. A. O.	N79-23921
Analytical modeling of the dynamics of brus dc motors for aerospace applications: A	hless
conceptual framework	N79-25310
DENERY, D. G.	
A Demonstration Advanced Avionics System fo general aviation	Г
[SAE PAPER 790569] Dennis, A. J.	A79-36709
Cost benefits from improved hot section lif	e
prediction technology [AIAA PAPBR 79-1154]	A79-38963
DERKACZEW, A. Nodel study of aircraft disk brakes	
	A79-38816
Minimization theory of induced drag subject	to
	N79-23923
DICARLO, D. J. Spin flight research summary	
	A79-36706
A European view on gas turbine engine monit	oring
of present and future civil aircraft [AIAA PAPER 79-1200]	A79-38982
DITTMAR, J. H. Tone noise of three supersonic helical tip :	speed
propellers in a wind tunnel	A79-39801
Tone noise of three supersonic helical tip	
propellers in a wind tunnel [NASA-TH-79167]	N79-25840
DOBBS, S. K. Determination of subcritical frequency and	damping
from B-1 flight flutter test data	N79-25426
DODDS, W. J.	
Advanced low emissions catalytic combustor at General Electric	
DODSON, B. N.	N79-25011
Life cycle cost analysis concepts and proce	dares N79-25408
DRIEDONKS, A. G. M.	
Experimental data on the dynamic properties several propeller vanes	
DRISCOLL, J. F.	A79-38943
The effect of fuel sprays on emissions from turbine combustor	a gas
[AIAA PAPER 79-1321]	179-39037
DUBOIS, N. Balance and sting design for cryogenic wind	
[ONERA, TP NO. 1979-40] DUFFY, M. A.	A79-39089
The dynamics of a general aviation pilot pr campaign	omotion
• •	A79-38886
DULIKRAVICH, D. S. Numerical calculation of inviscid transonic	flow
through rotors and fans	N79-23906
DUNAEV, A. V. Method of determining non-steady-state forc	e
Method of determining non-steady-state force characteristics and flywheel effect of tu blades from the streamflow pattern	rbine
	179-39071
DUNN, E. G. Blast induced distortion experiments on an o	engine
inlet	N79-25026
[

,

Ē

EBERLE, A.	
A finite element method for the computatio transonic potential flow past airfoils	n of the
[MBB-UPE-1352-0]	¥79-23935
Airfoil optimization for transonic flow us	
methods of finite elements and character	
[MBB-UFE-1362-0]	179-23937
The computation of transonic flow in wind	tunnels
at inlets and cascades using the finite	element
method	
[NBB-02E-1421-0]	N79-24970
EDINGER, R.	
Development of an aircraft composite prope	
[SAE PAPER 790579]	A79-36714
EDSON, R.	
An electric control for an electrohydrauli	c active
control aircraft landing gear	
[NASA-CR-3113]	N79-23948
EDWARDS, W. T.	
Crash-resistant fuel systems for general a aircraft	Viation
[SAE PAPER 790592]	179-36726
EKSTEDT, B. B.	A/3-30/20
Lean, premixed, prevaporized combustor con	Centual
design study	ocpedat
j- 0+uuj	N79-25014
ELDREDGE, D.	
An evaluation of turn anticipation techniq	ues and
offset flying procedures using a single-	waypoint
RNAN system	
[AD-A066555]	₩79-24974
ELLIOTT, J. I.	
Development of the Beechcraft Model 77	
[SAE PAPER 790617]	179-36745
BNDBBS, J. H. Aircraft icing: Introduction	
Alectait icing: Introduction	N79-23913
ENGLANDER, I.	N/9-23913
The airport performance model. Volume 1:	
Extensions, validations, and application	s
[AD-A062863]	N79-25040
EPPLER, R.	
The effect of disturbance on a wing	
	N79-23893
Some new airfoils	
	N79-23896
ERICSSON, L. E.	
Technical evaluation report on the Fluid D	ynamics
Panel Symposium on Dynamic Stability par	
[AGARD-AR-137] EYSINK, H.	N79-23981
A comparison of hydraulic, pneumatic, and	
electro-mechanical actuators for general	
aviation flight controls	
[SAE PAPER 790623]	∆79-36751
F	

F

-	
PARRELL, J. R. The operational impact of Navy's first TAN	
	A79-39890
FARRINGTON, J. G.	
An optical-fiber multiterminal data system	for
alfcraft	101
	179-36484
PICIETTI D T	4/3 30404
PASANELLA, B. L.	
NASA general aviation crashworthiness seat	
development	
[SAE PAPER 790591]	N79-36725
	AIJ 30123
FEDER, A.	
Computer graphics create the new wave of d	esign
	A79-37046
PEDERSPIEL, J. F.	
Static test of a large scale swivel nozzle	thrust
deflector	
[AIAA PAPER 79-1285]	A79-39020
	R/3-33020
PBHBLB, A. C.	
Bonding and durability	
[SAE PAPER 790561]	A79-36702
FEINGOLD, H.	
The alrcraft air conditioner data revisite	4
The difficient and conditioner data revisited	_
	A79-39895
FERGUSON, J. H.	
Evaluation of ground-launch firings for the	e
improved 2.75-inch rocket	
[AIAA PAPER 79-1297]	A79-39027
	A/9-3902/

PEW, J. D.	
Optical in situ versus probe measurements nitric oxide concentration as a function axial position in a combustor exhaust	
[AD-A067329] FINNERTY, C. S.	N79-25025
A parametric study of support system inter effects on nozzle/afterbody throttle dep drag in wind tunnel testing	ference endent
[AIAA PAPER 79-1168] FIORENTINO, A. J.	A79-38968
Lean, premixed, prevaporized combustor con design study	ceptual
PLAKSHAH, IA. SE.	N79-25013
Profile of a nozzle shaping the free-molec intended to investigate air-intakes and	
FLANNELLY, W. G. Hodel verification of force determination	for
measuring wibratory loads FLORIO, G.	A79-36379
Radial equilibrium in axial turbomachines	A79-37828
FOLBY, W. H. Methodology for prediction of V/STOL propu	lsion
induced forces in ground effect	
[AIAA PAPER 79-1281] Porsyth, G. P.	A79-39017
An introduction to dynamic derivatives. 2 equations of motion for wind tunnel pitc oscillation rigs	: The h-ya v
[ARL-AERO-NOTE-377] POX, M. K.	N79-23982
<pre>Bnergy maneuverability display validation [APPDL-TR-78-35-VOL-1]</pre>	N79-23947
FOX, S. R. Recent results obtained with a new method	
<pre>measuring aircraft power and drag in fli [SAE PAPER 790616] POWER 7</pre>	A79-36744
FOZARD, J. W. The British Aerospace Barrier: Case study aircraft design	1N
PRANZ, H. B.	A79-36644
X-ray determination of internal stress sta to surface treatment of TiAl6V4 and TiAl	
FRECHE, J. C.	179-36003
Materials and structural aspects of advanc	eđ
gas-turbine helicopter engines	A79-39804
PRINK, N. T. Investigation of aerodynamic characteristi	cs of
subsonic wings	
[NASA-CR-158661] PUCHS, W. C.	N79-23921
RTCA standards - Improved specs. and regul FUERTES, L.	ations A79-39919
The airport performance model. Volume 1:	
	s N79-25040
FOJIMORI, Y. Rotor blade stability in turbulent flows.	
FUEURO, P.	179-38118
Observation of atmospheric interactions at aeroplane altitude	
PUNAKAWA, H.	179-37573
Analysis of an unsteady aerodynamıc force blade due to ununiform amplitude gusts	
	A79-39059
G	
GABRIELLI, G.	
The evaluation of the weight of engine installations on transport aircraft	

installations on transport aircraft A79-37827 GAIDACHUK, V. B. Differential method of designing rational aircraft frames made of composite materials A79-36592

GALBRAITH, A. D. Electric propulsion for high performance light aircraft [AIAA PAPER 79-1265] A79-39011 GARDNER, J. H. Thermospheric propagation of sonic booms from the Concorde supersonic transport [AD-A067201] N79-25855 GANNIS, E. A. Evaluation of new bonding systems for depot-level maintenance of aircraft honeycomb panels [AD-A066117] N79-24161 GARBARD, W. C. J. The Lockheed C-5: Case study in aircraft design 179-36646 GARRELTS, W. B. Effects of extended oil changes on aircraft piston engine wear and oil characteristics [SAE PAPER 790629] 179-36756 GATES, R. K. Avionics standardization potential analysis [AD-A066138] N79-23958 GBHBBTT, L. J. Proper aircraft tire size selection - Optimum performance with minimum maintenance [SAE PAPER 790598] A79-36730 GEORGE, D. B. The application of rapid solidification rate [AIAA PAPER 79-1226] x79-38991 GERSTEIN, N. Fundamentals of Gas Turbine combustion [NASA-CP-2087] N79-25016 GHOMI, N. A. Determination of cooling air mass flow for a horizontally-opposed aircraft engine installation [SAE PAPER 790609] A79-3674 A79-36740 GIACCARI, E. A family of air traffic control radars A79-38532 GIBBERT, V. P. Control considerations for CCV fighters at high angles of attack A79-37295 GLASS, D. R. The effect of fuel sprays on emissions from a gas turbine combustor [AIAA PAPER 79-1321] A79-39037 GOELZ, R. R. A canister fuel pump for general aviation aircraft [SAE PAPER 790624] A79-367 A79-36752 GOLDARV, I. P. Optimal selection of the geometrical characteristics of the reversing channel of a small-scale turbine with readmission of the gas A79-36583 Effectiveness of readmission of the gas in high-pressure-ratio small-scale turbines 179-36584 GOLDBERG, B. An evaluation of turn anticipation techniques and offset flying procedures using a single-waypoint RNAN system [AD-A066555] GOLOVANEV, IU. N. N79-24974 Installation for studying fatigue strength of materials in acoustic loading A79-39070 GOPALAPILLAI, G. S. Satellite interferometer as an advanced navigation/communication system A79-39602 GOVIL, A. K. Substructuring methods for design sensitivity analysis and structural optimization [AD-A065935] N7 N79-23949 Fail-safe optimal design of structures with substructuring [AD-A065936] N79-23950 GRAPTON, S. B. Control considerations for CCV fighters at high angles of attack A79-37295 GRANT. H. P. Turbulence characteristics of compressor discharge flows ₦79-24995

PERSONAL AUTHOR INDEX

GRAVELLE, A.

Aeroelastic models for cryogenic wind tunnels [ONERA, TP NO. 1979-39] A79-39088 GREEN, R. S., JR. Non-destructive methods for the early detection of fatigue damage in aircraft components N79-25417 GREENBERG, N. S. Stability analysis of relative navigation systems A79-36090 GREENE, R. A. The effects of low-level wind shear on the approach and go-around performance of a landing jet aircraft jet alfcrait [SAE PAPER 790568] A79-30700 A wind shear/downdraft drift angle warning system A79-38477 GREER, E. D. High frequency near field scattering by an elliptic disk [AD-A065586] N79-24214 GREGORY, P. Sidestick/Throttle Controller - An alternate approach A79-38476 GRIB, A. A. Second approximation in theory of a finite-span thin wing in a hypersonic gas flow A79-35927 GA, A. D. Influence of the flow angle on the characteristics GRIGA, of an elbow-shaped air intake 179-36585 GRIGORIEV, T. N. Theory of thin wing in a supersonic flow with consideration of the non-equilibrium state of excitation of oscillating degrees of freedom N79-23928 [AD-A065992] CROSSBECK, D. Assessment at full scale of nozzle/wing geometry effects on OTW aeroacoustic characteristics A79-39802 Assessment at full scale of nozzle/wing geometry effects on OTW aero-acoustic characteristics [NASA-TH-79168] 879-25891 GROSVELD, F. Summary of noise reduction characteristics of Summary of noise reduction characteristics of typical general aviation materials [SAE PAPER 790627] A79-3679 GROSVELD, P. H. W. A. The application of the Prop-Pan concept in preliminary design of a very advanced technology light twin /VATLIT '85/ [AIAA PAPER 79-1343] A79-3900 A79-36755 A79-39047 GYLYS, V. Recent results in navigation systems utilizing signal aiding from Navstar satellites A79-36096

Η

HABERCON, G. E., JR. Aircraft wake vortices. A bibliography with abstracts [NTIS/PS-79/0166/3]ft conic boom: Effects on buildings. abstracts N79-23939 Aircraft sonic boom: [NTIS/PS-79/0265/3] N79-24 rcraft sonic boom: Studies on aircraft flight, N79-24201 Aircraft sonic boom: aircraft design, and measurement. A bibliography with abstracts [NTIS/PS-79/0264/6] N79-24780 HACKNEY, R. D. Multivariable control altitude demonstration on the F100 turbofan engine [AIAA PAPER 79-1204] A79-Multivariable control altitude demonstration on A79-39814 the P100 turbofan engine [NASA-TM-79183] N79-25015 HABRTIG, J. Application of Laser Doppler Anemometry to aeroacoustic research 179-39500 HAGE, G. H. Nap-of-the-earth communication program for US Army helicopters [AD-A063089] 179-24232

PERSONAL AUTHOR INDEX

HAISLIP, D. T. Internationalization of ONEGA A79-36069 HALE, M. G. Nodel diffuser investigation for propulsion wind tunnel 16T [AD-A065822] N79-23984 HALPORD, G. R. The strainrange partitioning behavior of an advanced gas turbine disk alloy, AP2-1DA [AIAA PAPER 79-1192] 179-38977 HALL . C. L. V/STOL aircraft configuration effects on exhaust gas ingestion [AIAA PAPEB 79-1284] A79-39019 HANLOSER, K. J. Test verification of a turbofan partial swirl afterburner [AIAA PAPER 79-1199] A79-38981 HANSON, P. W. The science and technology of low speed and motorless flight, part 1 [NASA-CP-2085] N79-23889 BARDY, G. H. A Demonstration Advanced Avionics System for general aviation [SAE PAPER 790569] HARLAMERT, W. B. A79-36709 Development of an aircraft composite propeller [SAE PAPER 790579] 179-36714 HARBIS, W. T. Motion in flight simulation: An annotated bibliography [AD-A061687] N79-25042 HABRISON, G. The F-16 RIW program A79-39889 HARTMAN, J. P. User's guide: Computer program with interactive graphics for analysis of plane frame structures (CPRAME) [AD-A067349] N79-25428 HASLAF-JONES, T. P. Measurement of the drag of slender cones in hypersonic flow at low Reynolds numbers using a magnetic suspension and balance [OTEL-1235/78] N79-23938 HATCR, R. R. Hyperbolic positioning per se is passe A79-36070 HAUBERT, R. C. Partially variable area turbine nozzle [AIAA PAPER 79-1227] A79-38992 HAUG, E. J. Substructuring methods for design sensitivity analysis and structural optimization [AD-A065935] N79-23949 Pail-safe optimal design of structures with substructuring [AD-A065936] N79-23950 HAWK, J. D. Theoretical fan velocity distortions due to inlets and nozzles [NASA-TH-79150] N79-23911 HAYDUK, B. J. Nonlinear structural crash dynamics analyses [SAE PAPER 790588] A79-36722 BAIRS, P. C., JR. A filterability study of corrosion inhibited JP-4 w79-25 [AD-A066887] N79-25247 BELVIG, G. Wing shape optimization for maximum cross-country speed, with mathematical programming N79-23899 BENDERSON, M. L. Low-speed single-element airfoil synthesis N79-23890 HENG~CHENG, L. Optimum frequencies for aircraft classification [AD-A065697] ¥79-24220 BERROF, B. L. Rultifunction keyboard implementation study N79-25046 [AD-A066140] HILTON, D. A. Statistical comparisons of aircraft flyover noise adjustment procedures for different weather conditions [NASA-TP-1430] N79-24773

Boeing 757/767 - On-the-spot report 179-36374 HIRZEL, B. A. Advanced braking controls for business aircraft 179-36731

HOAD, D. R. Turbulent wake measurements with a laser velocimeter [AIAA PAPER 79-1087] A79-38058 An experimental investigation of the effect of rotor tip shape on helicopter blade-slap noise [NASA-TH-80066] N79-2 N79-25844 HOADLEY, A. W. Conversion of wing surface pressures into normalized lift coefficient [SAE PAPER 790567] A79-36707 HODSON, C. H. Determination of subcritical frequency and damping from B-1 flight flutter test data [NASA-CR-3152] N79-25426 ROPPHAN, A. C. Application of digital controls on the quiet clean short haul experimental engines [AIAA PAPER 79-1203] A79-389 179-38984 HOFMAN, L. G. Analysis of digital flight control systems with flying qualities applications. Volume 2: Technical report [AD-A067177] N79-25036 HOLBROOK, G. T. Low-speed wind-tunnel investigation of wing fins as trailing-vortex-alleviation devices on a transport airplane model [NASA-TP-1453] N79-24961 HOLCONB, N. L. Development of the Beechcraft Hodel 77 [SAE PAPER 790617] A79-HOPKINS, A. L., JR. A review of the 3H data base for fault-tolerant 179-36745 system incentives
[AD-A066697] N79-24990 LAD-NUGGOST, HOWELL, G. C. Technical evaluation report on the 27th Guidance and Control Panel Symposium on the V/STOL Aircraft at Night and in Poor Visibility N79-2. [AGARD-AR-142] N79-23946 HOWLETT, J. T. An experimental study of propeller-induced structural vibration and interior noise [SAE PAPER 790625] A79-36753 HSU, Ľ. Internally coated air-cooled gas turbine blading [NASA-CR-159574] N79~2 N79~25018 HUBBARD, H. H. Status of knowledge of sonic booms [NASA-TM-80113] N79~24955 HWANG, C. Some observations on the mechanism of aircraft wing rock

HIRST, B.

[SAE PAPER 790599]

179-38135

IALOVKIN, B. D. Formulation of empirical formulas for calculating the hydraulic resistance of networks 179~36593 ICHIKAWA, A. Bffect of forward acceleration on aerodynamic characteristics of wings 179-38124 IHARA, B. Observation of atmospheric interactions at aeroplane altitude 179-37573 ILIUMSKII, V. V. Optimal selection of the geometrical characteristics of the reversing channel of a small-scale turbine with readmission of the gas A79-36583 Effectiveness of readmission of the gas in high-pressure-ratio small-scale turbines A79~36584 ISBIHARA, K. Analysis of an unsteady aerodynamic force on a blade due to ununiform amplitude gusts A79-39059

I

IVANOV, H. IA. Profiling of two-dimensional and three-dimensional nozzles and calculation of their flows A79-38168 J JACKSON, C. T. A Demonstration Advanced Avionics System for general aviation [SAE PAPER 790569] A79-36709 JACKSON, G. C. The results of synthesizing and evaluating potential solutions for Hulti-Function Inertial Reference Assembly /MIRA/ candidate configurations A79-36082 JAMES, R. A system for providing an integrated display of instantaneous information relative to aircraft attitude, heading, altitude, and horizontal situation [NASA-CASE-FRC-11005-1] 179-24988 JANISON, R. G. Water absorption of fluids/oils [AD-A065915] N79-24158 JANOWSKA, G. Model study of transient processes in a hydraulic power amplifier A79-38814 JERACKI, R. J. Wind tunnel performance of four energy efficient propellers designed for Mach 0.8 cruise [SAE PAPER 790573] Tone noise of three supersonic helical tip speed propellers in a wind tunnel A79-36759 A79-39801 Tone noise of three supersonic helical tip speed propellers in a wind tunnel [NASA-TH-79167] N79-25840 JOBST, J. J. User's guide: Computer program with interactive graphics for analysis of plane frame structures (CFRAME) [AD-A067349] N79-25428 JOGLEKAR, A. N. Evaluation of GPS performance for low-cost general aviation A79-36065 JOHNSEN, R. L. Operating condition and geometry effects on low-frequency afterburner combustion instability in a turbofan at altitude N79-25022 [NASA-TP-1475] [NASA-TF-14/5] JOHNSON, D. L. Ground winds for Kennedy Space Center, Florida, 1979 revision [NASA-TH-78229] N79-N79-25662 [NASA-TH-78229] N/9-2: JOHNSON, J. L., JR. Full-scale wind-tunnel investigation of an Ayres S2R-800 Thrush Agricultural Airplane [SAE PAPER 790618] A79-30 A79-36746 JOHNSON, J. S. Regression Simulation of turbine engine performance: Accuracy improvement (task 4) [AD-A066398] NJ N79-25027

JOLLIS, A. U. Small hole drilling and inspection with pulsed laser systems [AIAA PAPER 79-1268] A79-39012 JOBES, C. A review of Curtiss-Wright rotary engine developments with respect to general aviation potential [SAE PAPER 790621] 179-36749 JOWES, J. L. AMES laboratory simulator requirements (A-7 alccraft) [AD-A066393] N79-25041 JONES, R. L. Design of an off-axis wide field-of-view visual display system for flight simulators [AD-A066530] N79-25044 JORDAN, A. J. Investigation of a laser Doppler velocimeter system to measure the flow field of a large scale V/STOL aircraft in ground effect [AIAA PAPER 79-1184] A79 A79-38974

PERSONAL AUTHOR INDEX

JORDAN, F. L., JR.	
Full-scale wind-tunnel investigation of an	Ayres
S2R-800 Thrush Agricultural Airplane	
[SAE PAPER 790618]	179-36746
JOHL, P. B.	
Application of advanced data reduction meth	nods to
gas turbine dynamic analysis	
	A79-36024
JUBPER, S. J.	
The analysis of propellers including intera	action
effects	
[SAE PAPER 790576]	A79-36712

Κ

KABHLER, H.	
Damage-tolerant fan blade design	179-38951
(AIAA PAPER 79-1119) Kahat, H. P.	N19-38931
Nonlinear structural crash dynamics analys	es
[SAE PAPER 790588]	Å79-36722
KANNAN, J. H.	
V/STOL aircraft configuration effects on e	rhaust
gas ingestion	
[AIAA PAPER 79-1284]	A79-39019
KANTIBATHI, A. Fretting fatigue, with reference to aircra	
structures	ii t
[SAE PAPER 790612]	A79-36741
KANTOLA, R. A.	
KANTOLA, R. A. Noise characteristics of heated high veloc	:ity
rectangular jets	
	A79-38399
KAPPBR, C. Y.	
Validation of aircraft noise prediction pr [NASA-CR-159047]	N79-25843
KARPOV, IA. S.	N73-23043
Differential method of designing rational	aircraft
frames made of composite materials	
•	A79-36592
KAUPPHAN, C. W.	
The effect of fuel sprays on emissions fro	n a gas
turbine combustor	170 20027
[AIAA PAPER 79-1321] Kazimibrska, Z.	A79-39037
Tachystoscopic testing of onboard instrume	nts
lacaystoscopic testing of onboard instrume	A79-38817
KEITH, J. S.	
Turbine design system	
[AD-A066092]	N79-23974
KEMP, W. B., JR.	
A vector-continuous loading concept for	
A vector-continuous loading concept for aerodynamic panel methods	N70-20956
[NASA-TH-80104]	N79-24956
[NASA-TH-80104] KEMPKE, E. E.	
[NASA-TH-80104] KEMPKE, B. B. Effects of air injection on a turbocharged Teledyne Continental Hotors TSIO-360-C e	ngine
[NASA-TH-80104] KEEPKE, B. B. Effects of air injection on a turbocharged Teledyne Continental Hotors TSIO-360-C e [SAE PAPER 790607]	I.
[NASA-TH-80104] KEMPKE, E. E. Effects of air injection on a turbocharged Teledyne Continental Motors TSIO-360-C e [SAE PAPER 790607] KEMPEDI, A. P.	ngine A79-36760
[NASA-TH-80104] KEMPKE, B. B. Effects of air injection on a turbocharged Teledyne Continental Motors TSIO-360-C e [SAE PAPER 790607] KENNEDY, A. P. Joint Airworthiness Requirements - Their h	ngine A79-36760
[NASA-TH-80104] KEMPKE, E. E. Effects of air injection on a turbocharged Teledyne Continental Motors TSIO-360-C e [SAE PAPER 790607] KEMPEDI, A. P.	ngine A79-36760 istory
[NASA-TH-80104] KEMPKE, E. E. Effects of air injection on a turbocharged Teledyne Continental Hotors TSIO-360-C e [SAE PAPER 790607] KEMPEDY, A. P. Joint Airworthiness Requirements - Their h and progress	ngine A79-36760
[NASA-TH-80104] KEBPKE, B. B. Effects of air injection on a turbocharged Teledyne Continental Motors TSIO-360-C e [SAE PAPER 790607] KENNEDY, A. P. Joint Airworthiness Requirements - Their h and progress KENNEDY, J. B.	ngine A79-36760 istory A79-37149
[NASA-TH-80104] KEMPKE, E. E. Effects of air injection on a turbocharged Teledyne Continental Motors TSIO-360-C e [SAE PAPER 790607] KEMBEDY, A. P. Joint Airworthiness Requirements - Their h and progress KEMBEDY, J. B. Lean stability augmentation for premixing, prevaporizing combustors	Engine A79-36760 Listory A79-37149
[NASA-TH-80104] KEBPKE, B. B. Effects of air injection on a turbocharged Teledyne Continental Motors TSIO-360-C e [SAE PAPER 790607] KENNEDY, A. P. Joint Airworthiness Requirements - Their h and progress KENNEDY, J. B. Lean stability augmentation for premixing, prevaporizing combustors [Ala PAPER 79-1319]	ngine A79-36760 istory A79-37149
[NASA-TH-80104] KEMPKE, B. B. Effects of air injection on a turbocharged Teledyne Continental Motors TSIO-360-C e [SAE PAPER 790607] KEMBEDY, A. P. Joint Airworthiness Requirements - Their h and progress KEMBEDY, J. B. Lean stability augmentation for premixing, prevaporizing combustors [AIAA PAPER 79-1319] KEMNY, D. P.	A79-36760 A79-36760 Listory A79-37149
<pre>[NASA-TH-80104] KEBPKE, E. E. Effects of air injection on a turbocharged Teledyne Continental Motors TSIO-360-C e [SAE PAPER 790607] KEBWBDY, A. P. Joint Airworthiness Requirements - Their h and progress KEBWBEDY, J. B. Lean stability augmentation for premixing, prevaporizing combustors [AIAA PAPER 79-1319] KEBNY, D. P. A novel correlation of centrifugal compress</pre>	A79-36760 A79-36760 Listory A79-37149
<pre>[NASA-TH-80104] KEBPKE, E. E. Effects of air injection on a turbocharged Teledyne Continental Motors TSIO-360-C e [SAE PAPER 790607] KEBWBDY, A. P. Joint Airworthiness Requirements - Their h and progress KEBWBEDY, J. B. Lean stability augmentation for premixing, prevaporizing combustors [AIAA PAPER 79-1319] KEBNY, D. P. A novel correlation of centrifugal compress</pre>	A79-36760 A79-36760 Lstory A79-37149 A79-39035 sor
[NASA-TH-80104] KEBPKE, B. B. Effects of air injection on a turbocharged Teledyne Continental Motors TSIO-360-C e [SAE PAPER 790607] KENNEDY, A. P. Joint Airworthiness Requirements - Their h and progress KENNEDY, J. B. Lean stability augmentation for premixing, prevaporizing combustors [AIAA PAPER 79-1319] KENNY, D. P. A novel correlation of centrifugal compress performance for off-design prediction [AIAA PAPER 79-1159]	A79-36760 A79-36760 Listory A79-37149
<pre>[NASA-TH-80104] KEHPKE, E. E. Effects of air injection on a turbocharged Teledyne Continental Motors TSIO-360-C e [SAE PAPER 790607] KEHPEDY, A. P. Joint Airworthiness Requirements - Their h and progress KEHBEDY, J. B. Lean stability augmentation for premixing, prevaporizing combustors [AIAA PAPER 79-1319] KEHNY, D. P. A novel correlation of centrifugal compress performance for off-design prediction [AIAA PAPER 79-1159] KINDL, H. J.</pre>	A79-36760 A79-36760 A1story A79-37149 A79-39035 sor A79-38965
[NASA-TH-80104] KEBPKE, B. B. Effects of air injection on a turbocharged Teledyne Continental Motors TSIO-360-C e [SAE PAPER 790607] KENNEDY, A. P. Joint Airworthiness Requirements - Their h and progress KENNEDY, J. B. Lean stability augmentation for premixing, prevaporizing combustors [AIAA PAPER 79-1319] KENNY, D. P. A novel correlation of centrifugal compress performance for off-design prediction [AIAA PAPER 79-1159]	A79-36760 A79-36760 A1story A79-37149 A79-39035 sor A79-38965
<pre>[NASA-TH-80104] KEHPKE, E. E. Effects of air injection on a turbocharged Teledyne Continental Motors TSIO-360-C e (SAE PAPER 790607] KEHPEDY, A. P. Joint Airworthiness Requirements - Their h and progress KEHBEDY, J. B. Lean stability augmentation for premixing, prevaporizing combustors [AIAA PAPER 79-1319] KEHNY, D. P. A novel correlation of centrifugal compress performance for off-design prediction [AIAA PAPER 79-1159] KINDL, H. J. The operational impact of Navy's first TAM KIEKLIM, P. W.</pre>	A79-36760 A79-36760 A79-37149 A79-39035 Sor A79-38965 P program
<pre>[NASA-TH-80104] KEBPKE, E. E. Effects of air injection on a turbocharged Teledyne Continental Motors TSIO-360-C e [SAE PAPER 790607] KENNEDY, A. P. Joint Airworthiness Requirements - Their h and progress KENNEDY, J. B. Lean stability augmentation for premixing, prevaporizing combustors [AIAA PAPER 79-1319] KENNY, D. P. A novel correlation of centrifugal compress performance for off-design prediction [AIAA PAPER 79-1159] KINDL, H. J. The operational impact of Navy's first TAA KIRKLIM, P. W. Pactors affecting electrostatic hazards</pre>	A79-36760 A79-36760 A79-37149 A79-39035 Sor A79-38965 P program A79-39890
<pre>[NASA-TH-80104] KEBPKE, E. E. Effects of air injection on a turbocharged Teledyne Continental Motors TSIO-360-C e [SAP PAPER 790607] KEWBEDT, A. P. Joint Airworthiness Requirements - Their h and progress KEWBEDT, J. B. Lean stability augmentation for premixing, prevaporizing combustors [AIAA PAPER 79-1319] KEWNY, D. P. A novel correlation of centrifugal compres performance for off-design prediction [AIAA PAPER 79-1159] KIMDL, H. J. The operational impact of Navy's first TAA KIRKLIM, P. W. Pactors affecting electrostatic hazards [AD-A066927]</pre>	A79-36760 A79-36760 A79-37149 A79-39035 Sor A79-38965 P program
<pre>[NASA-TH-80104] KEHPKE, E. E. Effects of air injection on a turbocharged Teledyne Continental Motors TSIO-360-C e (SAE PAPER 790607] KEHPEDY, A. P. Joint Airworthiness Requirements - Their h and progress KEHBEDY, J. B. Lean stability augmentation for premixing, prevaporizing combustors [AIAA PAPER 79-1319] KEHNY, D. P. A novel correlation of centrifugal compress performance for off-design prediction [AIAA PAPER 79-1159] KINDL, H. J. The operational impact of Navy's first TAM KIRKLIM, P. W. Pactors affecting electrostatic hazards [AD-A066927] KIZER, C.</pre>	A79-36760 A79-36760 A79-37149 A79-39035 Sor A79-38965 P program A79-39890 N79-25245
<pre>[NASA-TH-80104] KEBPKE, E. E. Effects of air injection on a turbocharged Teledyne Continental Motors TSIO-360-C e (SAE PAPER 790607] KEHNEDY, A. P. Joint Airworthiness Requirements - Their h and progress KEHNEDY, J. B. Lean stability augmentation for premixing, prevaporizing combustors [AIAA PAPER 79-1319] KEHNY, D. P. A novel correlation of centrifugal compress performance for off-design prediction [AIAA PAPER 79-1159] KINDL, H. J. The operational impact of Navy's first TAA KIRKLIM, P. W. Pactors affecting electrostatic hazards [AD-A066927] KIZER, C. The test pilot in the airline industry or</pre>	A79-36760 A79-36760 A79-37149 A79-39035 Sor A79-38965 P program A79-39890 N79-25245
<pre>[NASA-TH-80104] KEHPKE, E. E. Effects of air injection on a turbocharged Teledyne Continental Motors TSIO-360-C e (SAE PAPER 790607] KEHPEDY, A. P. Joint Airworthiness Requirements - Their h and progress KEHBEDY, J. B. Lean stability augmentation for premixing, prevaporizing combustors [AIAA PAPER 79-1319] KEHNY, D. P. A novel correlation of centrifugal compress performance for off-design prediction [AIAA PAPER 79-1159] KINDL, H. J. The operational impact of Navy's first TAM KIRKLIM, P. W. Pactors affecting electrostatic hazards [AD-A066927] KIZER, C.</pre>	A79-36760 A79-36760 A79-37149 A79-39035 Sor A79-38965 P program A79-39890 N79-25245
<pre>[NASA-TH-80104] KEBPKE, E. E. Effects of air injection on a turbocharged Teledyne Continental Motors TSIO-360-C e (SAE PAPER 790607] KEHNEDY, A. P. Joint Airworthiness Requirements - Their h and progress KEHNEDY, J. B. Lean stability augmentation for premixing, prevaporizing combustors [AIAA PAPER 79-1319] KEHNY, D. P. A novel correlation of centrifugal compress performance for off-design prediction [AIAA PAPER 79-1159] KINDL, H. J. The operational impact of Navy's first TAA KIRKLIM, P. W. Pactors affecting electrostatic hazards [AD-A066927] KIZER, C. The test plot in the airline industry or are packed and I'm ready to go' KLEPACKI, W.</pre>	A79-36760 A79-36760 A79-37149 A79-39035 sor A79-38965 P program A79-38890 N79-25245 'Hy bags A79-38478
<pre>[NASA-TH-80104] KEBPKE, E. E. Effects of air injection on a turbocharged Teledyne Continental Motors TSIO-360-C e [SAP PAPER 790607] KENBEDT, A. P. Joint Airworthiness Requirements - Their h and progress KEBNEDY, J. B. Lean stability augmentation for premixing, prevaporizing combustors [AIAA PAPER 79-1319] KENNY, D. P. A novel correlation of centrifugal compress performance for off-design prediction [AIAA PAPER 79-1159] KINDL, H. J. The operational impact of Navy's first TAM XIRKLIM, P. W. Pactors affecting electrostatic hazards [AD-A066927] KIZBR, C. The test pilot in the airline industry or are packed and I'm ready to go'</pre>	A79-36760 A79-36760 A79-37149 A79-39035 sor A79-38965 P program A79-38890 N79-25245 'Hy bags A79-38478
<pre>[NASA-TH-80104] KEBPKE, E. E. Effects of air injection on a turbocharged Teledyne Continental Motors TSIO-360-C e [SAE PAPER 790607] KEHNEDY, A. P. Joint Airworthiness Requirements - Their h and progress KEHNEDY, J. B. Lean stability augmentation for premixing, prevaporizing combustors [AIAA PAPER 79-1319] KEHNY, D. P. A novel correlation of centrifugal compress performance for off-design prediction [AIAA PAPER 79-1159] KINDL, H. J. The operational impact of Navy's first TAA KIRKLIM, P. W. Pactors affecting electrostatic hazards [AD-A066927] KIZER, C. The test plot in the airline industry or are packed and I'm ready to go' KLEPACKI, W.</pre>	ngine A79-36760 Istory A79-37149 A79-39035 Sor A79-38965 Pprogram A79-38969 N79-25245 'Hy bags A79-38478
<pre>[NASA-TH-80104] KEBPKE, E. E. Effects of air injection on a turbocharged Teledyne Continental Motors TSIO-360-C e (SAE PAPER 790607] KENNEDY, A. P. Joint Airworthiness Requirements - Their h and progress KENNEDY, J. B. Lean stability augmentation for premixing, prevaporizing combustors [AIAA PAPER 79-1319] KENNY, D. P. A novel correlation of centrifugal compress performance for off-design prediction [AIAA PAPER 79-1159] KINDL, H. J. The operational impact of Navy's first TAA NIRKLIM, P. W. Pactors affecting electrostatic hazards [AD-A066927] KIZER, C. The test pilot in the airline industry or are packed and I'm ready to go' KLEPACKI, W. A method of reducing aircraft turbine blad vibrations</pre>	A79-36760 A79-36760 A79-37149 A79-39035 sor A79-38965 P program A79-38890 N79-25245 'Hy bags A79-38478
<pre>[NASA-TH-80104] KEHPKE, E. E. Effects of air injection on a turbocharged Teledyne Continental Motors TSIO-360-C e [SAE PAPER 790607] KENBEDY, A. P. Joint Airworthiness Requirements - Their h and progress KEWBEDY, J. B. Lean stability augmentation for premixing, prevaporizing combustors [AIAA PAPER 79-1319] KENNY, D. P. A novel correlation of centrifugal compress performance for off-design prediction [AIAA PAPER 79-1159] KINDL, H. J. The operational impact of Navy's first TAA NIRKLIM, P. W. Pactors affecting electrostatic hazards [AD-A066927] KIEBR, C. The test pilot in the airline industry or are packed and I'm ready to go' KLEPACKI, W. A method of reducing aircraft turbine blad vibrations KLIOW, J.</pre>	ngine A79-36760 Istory A79-37149 A79-39035 Sor A79-38965 Pprogram A79-38969 N79-25245 'Hy bags A79-38478
<pre>[NASA-TH-80104] KEBPKE, E. E. Effects of air injection on a turbocharged Teledyne Continental Motors TSIO-360-C e (SAE PAPER 790607] KENNEDY, A. P. Joint Airworthiness Requirements - Their h and progress KENNEDY, J. B. Lean stability augmentation for premixing, prevaporizing combustors [AIAA PAPER 79-1319] KENNY, D. P. A novel correlation of centrifugal compress performance for off-design prediction [AIAA PAPER 79-1159] KINDL, H. J. The operational impact of Navy's first TAA NIRKLIM, P. W. Pactors affecting electrostatic hazards [AD-A066927] KIZER, C. The test pilot in the airline industry or are packed and I'm ready to go' KLEPACKI, W. A method of reducing aircraft turbine blad vibrations</pre>	ngine A79-36760 Istory A79-37149 A79-39035 Sor A79-38965 Pprogram A79-38969 N79-25245 'Hy bags A79-38478

REAUS, A.	2-14
Polar lift and drag determination during fl tests	light
[888-0FE-1410-0]	N79-24986
KHOX, C. B.	
Capturing and tracking performance of the horizontal guidance and control systems of	of the
terminal configured vehicle	
[NASA-TH-80068] Koemig, P. J.	N79-25034
Vertical cutoff rigidity and the intensity	
distribution of cosmic rays near Cape To	
KOBNIG, R. W.	A79-37468
Preliminary QCGAT program test results	
[SAE PAPER 790596] KOFF, B. L.	∆7 9-36729
Aircraft engine design using experimental s	stress
analysis techniques	170 20070
[AIAA PAPER 79-1193] Kolsteg, L. H.	A79-38978
High level maintenance below sea level	
KOLTOF, G. A.	A79-38825
Second approximation in theory of a finite-	-span
thin wing in a hypersonic gas flow	A79-35927
KOBTSBVICH, F. G.	
Allowing for the wall boundary layer in an	a x ial
compressor stage	A79-36586
KOVAL, V. A.	
Allowing for the wall boundary layer in an compressor stage	axial
compressor stage	A79-36586
KBAIKO, A. N.	1
Profiling of two-dimensional and three-dime nozzles and calculation of their flows	ensional
	A79-38168
KRASHOV, H. F. Aerodynamics	
[NASA-TT-P-765]	N79-23908
REBARER, H.	
Fault-tolerant, high reliability electronic control system	: engine
[AIAA PAPER 79-1202]	179-38983
KREBS, H. J. Color display design guide	
[AD-A066630]	₩79-24991
KBENZ, D. G. Evaluation of an PM/CV range measurement sy	rsten
for VTOL landing	
	179-36086
KRIEGSMAN, B. A. A navigation filter for an integrated	
GPS/JTIDS/INS system for a tactical airc	
KSIBUSKI, A. A.	179-36087
Optimum frequencies for aircraft classification	
[AD-A065697] KUBBAT, W. J.	₩79-24220
Evaluation of a digital helicopter control	system
[MBB-UPE-1349-0] KUBILUS, D. M.	N79-23980
CERT technology applied to an airborne rada	IT
	179-39893
KUBLEAR, J. Numerical optimization techniques for bound	1
circulation distribution for minimum indu	iced
drag of nonplanar vings: Basic formulat: [NASA-CR-3154]	lons 1979-23924
KUHLBAN, V. H.	
Cargo Logistics Airlift Systems Study (CLAS	SS) .
Volume 2: Case study approach and result [NASA-CR-158913]	:s ₩79-24978
KUBB, G. D.	
Evaluation of methods for prediction of pro system drag	pulsion
[AIAA PAPER 79-1148]	A79-38961
KU2NBUKO, V. A.	of
Installation for studying fatigue strength materials in acoustic loading	01
-	A79-39070
KU2NETSOV, IU. E. Profile of a nozzle shaping the free-molect	le flow
intended to investigate air-intakes and o	

L

L	
LAANANEN, D. H. Seat/Occupant crash dynamic analysis verif:	ication
test program [SAE PAPER 790590]	A79-36724
LABBERT, G. B.	
The influence of fleet variability on crac tracking procedures for transport/bomber [AD-A066596] LANGFRLDER, H.	aircraft N79-25433
Development of an airborne military system system)	(MRCA
(ABB-OPE-1322-0] LARGUIER, R.	N79-23904
Experimental analysis methods for unsteady	flows
in turbomachines [ONERA, TP NO. 1979-59]	179-39095
LARRABEE, E. E. Practical design of minimum induced loss pr [SAE PAPER 790585] Description	ropellers A79-36720
Design of propellers for motorsoarers	N79-23903
LATHAN, B. A. Altcraft engine nozzle [NASA-CAŠE-ARC-10977-1]	1179-23971
LAUTNER, D. E. AAES/TA-7C control and display interface	
[AD-A067219] AABS laboratory simulator requirements (A- aircraft)	1979-24992 7
[AD-A066393] LAWING, P. L.	N79-25041
A cooling system for an aircraft having a range from Hach 2 to Mach 8	cruise
[NASA-CASE-LAR-12406-1] LATS, E. J.	N79-24980
General aviation turbine engine /GATE/ con [AIAA PAPER 79-1157] Advanced General Aviation Turbine Engine (A79-38964
concepts [NASA-CR-159603]	N79-25017
LAZZARINO, L. Research and development activities in Ita	ly in
the field of aerospace structures and ma [AGARD-R-675] LECKMAW, P. N.	terials 19-24202
A general aviation flight test application on-board computer	of the
[SAE PAPER 790583] LEDWIG, A. J.	179-36718
Composite forward fuselage systems integra- volume 2	tion,
[AD-R066560] LEE, J. H.	N79-24984
Prediction of the angular response power s density of ancraft structures	pectral
[AD-A066141]	N79-23956
LEE, W. N. NOVA-25, a stiffened panel extension of th	e NOVA-2
computer program [AD-A066038]	N79-23951
LEHMANN, B. A. The multiple application core engine - Siz	ing and
usage criteria [AINA PAPER 79-1123]	A79-38953
LEBHANN, R. P. Analysis of the impact of the use of broad	
Analysis of the impact of the use of broad specification fuels on combustors for co aircraft gas turbine engines	mmercial
[AIAA PAPER 79-1195] LEHTIBER, B.	A79-38980
Nultivariable control altitude demonstration the P100 turbofan engine	по по
[AIAA PAPER 79-1204] Multivariable control altitude demonstration	A79-39814 on on
the P100 turbofan engine [NASA-TH-79183] LEBAHAH, D. T.	N79-25015
Turbine design system [AD-A066092]	N79-23974
LENSKI, J. W., JR. Helicopter .ransmission vibration and nois	e
reduction program. Volume 3: Evaluatio fiber FP metal-matrix housing specimens	
[AD-A066794]	1979-24983

PERSONAL AUTHOR INDEX

LEWIS, G. H.	
Turbo-fan design for general aviation - The	9
evolution of the RB.401	170 20066
[AINA PAPER 79-1160]	A79-38966
LIBBE, W. Generation and breakdown of aerodynamic 11	**•
Physical mechanism	
	N79-23894
LIEBERT, C. H.	
Industry tests of NASA ceramic thermal barn	ier
coating	
[NASA-TP-1425]	N79-25023
LIN, N. F. Factors influencing the accuracy of aerody	2010
hinge-moment prediction	amic
[AD-A0666061	N79-24965
LIN, Y. K.	
Rotor blade stability in turbulent flows. I	
	∆79-38118
LINDHOUT, J. P. F.	
A method for the calculation of 3D boundary on practical wing configurations	layers
on practical wing configurations	N79-38906
LIV, J. S. H.	
Reliability, performance, and fault isolati	
considerations in the design of interconn	ected
navigation systems	
LONBARD, C. A.	A79-36077
Directionally solidified blades - Greater s	trength
preservatil portarios press	A79-36248
LONG, J. A.	
The production function and airframe cost e	
[AD-A065570]	N79-23952
LONGYBAR, D. H. Advanced braking controls for business airc	6+
SAE PAPER 7905991	A79-36731
LOTTER, K.	A77 30731
Aerodynamic problems in engine airframe	
integration on fighter airplanes	
[MBB-UFE-1359-0]	N79-23936
[MBB-UPE-1359-0] LOWRY, H. S., III	
[MBB-UFE-1359-0] LOWRY, H. S., III Optical in situ versus probe measurements o	of
[MBB-UFE-1359-0] LOWRY, H. S., III Optical in situ versus probe measurements of nitric oxide concentration as a function	of
[MBB-UFE-1359-0] LOWRY, H. S., III Optical in situ versus probe measurements o	of
[MBB-UFE-1359-0] LOWRY, H. S., III Optical in situ versus probe measurements of nitric oxide concentration as a function axial position in a combustor exhaust [AD-A067329] LUSTY, A. H., JR.	of of
[MBB-UFE-1359-0] LOWRY, H. S., III Optical in situ versus probe measurements of nitric oxide concentration as a function axial position in a combustor exhaust [AD-A067329] LUSTY, A. H., JR. Energy maneuverability display validation	of of N79-25025
[MBB-UFE-1359-0] LOWRY, H. S., III Optical in situ versus probe measurements of nitric oxide concentration as a function axial position in a combustor exhaust [AD-A067329] LUSTY, A. H., JR. Energy maneuverability display validation [AFFDL-TR-78-35-VOL-1]	of of
[MBB-UFE-1359-0] LOWRY, H. S., III Optical in situ versus probe measurements of nitric oxide concentration as a function axial position in a combustor exhaust [AD-A067329] LUSTY, A. H., JR. Energy maneuverability display validation [AFPDL-TR-78-35-VOL-1] LYONS, V. J.	of N79-25025 N79-23947
[MBB-UFE-1359-0] LOWRY, H. S., III Optical in situ versus probe measurements of nitric oxide concentration as a function axial position in a combustor exhaust [AD-A067329] LUSTY, A. H., JR. Energy maneuverability display validation [AFFDL-TR-78-35-VOL-1]	of N79-25025 N79-23947

Μ

HABEY. D. G. Some remarks on the design of transonic tunnels with low levels of flow unsteadiness N79-25039 INASA-CR-27221 MACCREADY, P. A case study in design - The Gossamer Condor A79-37050 MACH, K. D. The role of three-dimensional flow analysis in the design of turbomachinery [AIAA PAPER 79-1231] A79-38995 MACKINFON, M. I. K. Factors influencing nacelle design on the 747 [AIAA PAPER 79-1236] A79-38996 HAENPA, J. E. The HX 1105, an integrated Transit/Omega navigator A79-36072 BAGLIEBI, D. J. Status of knowledge of sonic booms [NASA-TM-80113] N79-24955 MALLORY, W. R. Dynamic evaluation of experimental integral fuel-tank sealants, part 2 [AD-A066592] ₦79-25236 MAREK, A. J. AAES/TA-7C control and display interface [AD-A067219] N79-24992 AAES laboratory simulator requirements (A-7 aircraft) FAD-A0663931 N79-25041 BARBEPKA, R. J. Fuselage-mounted antenna code: User's manual [AD-A065587] N7 N79-24215

Wing-mounted antenna code: User's manual N79-24216 FAD-A0655891 An iterative approach for computing an antenna aperture distribution from given radiation pattern data [AD-A0655901 N79-24217 MARTIN, E. L. Contributions of platform motion to simulator training effectiveness. Study 2: Aerobatics [AD-A064305] N79-2 N79-23985 HARTINOVIC, Z. N. The analysis of propellers including interaction effects [SAE PAPER 790576] A79-36712 MATHENY, N. W. Precision controllability of the F-15 airplane [NASA-TH-728617 N79-23979 MATHWIG, G. B. The Rockwell International Sabreliner-65: Case study in aircraft design A79-36645 MATOKHNIUK, L. B. Installation for studying fatigue strength of materials in acoustic loading A79-39070 MATZ, R. J. Evaluation of an ejector-powered engine simulator at transonic Mach numbers [AIAA PAPER 79-1165] A79-38967 HAUGHNER, H. D. A comparison of the aerodynamic characteristics of eight sailwing airfoil sections N79-23897 MAXWELL, K. J. Identification of voltage transients on aircraft cabling under LTA excitation A79-38531 MAYFIELD, J. Manufacturers developing fuel-efficient engines A79-36380 HAYLAND, K. Optimum tail plane design for sailplanes N79-23892 HCCALLA, T. M., JR. Exploring team avionics systems by simulation A79-38882 HCCASKILL, O. K., JR. Composite applications at Bell Helicopter [SAE PAPER 790578] A79-36 HCCLINTON, C. R. Autoignition of hydrogen injected transverse to a A79-36713 supersonic airstream [AIAA PAPER 79-1239] A79-39818 ECCORNICK, B. W. The analysis of propellers including interaction effects [SAE PAPER 790576] MCCORHICK, W. S. 179-36712 The estimation of induced-voltage peak magnitude and energy level under LTA/EMP excitation of low-loss aircraft cabling 179-37238 Identification of voltage transients on aircraft cabling under LTA excitation 179-38531 ACCRACKEN, J. Impact of advanced technologies on aircraft design 179-37045 ECCULLOUGE, B. A new light twin using bonded metal construction [SAE PAPER 790603] 179-36735 HCDOUGAL, R. L. Bonding and durability [SAE PAPER 790561] 179-36702 BCGBE, R. L. Reliability and maintainability contribution to Hornet mission success A79-39915 MCGHEE, R. J. Low-speed wind tunnel results for a modified 13-percent-thick airfoll [NASA-TM-X-74018] 179-24960 HCLEAN, A. F. Brittle materials design, high temperature gas turbine: Ceramic turbine rotor technology [AD-A067176] N79-25029 BCLEAN, J. C., JR. Safety hazard of aircraft 1cing N79-23916

BEVELN, M.

BCLEAN, W. J. The effect of hydrogen addition on ignitic and flame propagation in spark ignition	n delays engines A79-38387
BCLEBORB, H. C. Pull-scale wind-tunnel investigation of an	
\$2R-800 Thrush Agricultural Airplane [SAE PAPER 790618]	- 179-36746
BCHASTERS, J. H. Lov-speed single-element airfoil synthesis	
HCHILLAN, O. J.	N79-23890
Evaluation of methods for prediction of pr system drag	opulsion
(AIAA PAPER 79-1148] MCVEY, J. B.	179-38961
Lean stability augmentation for premixing, prevaporizing combustors	
[AIAA PAPER 79-1319] MEECE, C. E.	179-39035
Damage tolerant design - An approach to re the life cycle cost of gas turbine engin [AIAA PAPER 79-1189]	ducing le disks 179-38976
REETA, B. K. Pactors influencing nacelle design on the	747 179-38996
[AIAA PAPER 79-1236] BELBIROVA, O. P. Construction of an initial approximation f	
solution of the integral equation of a l surface	ifting
BENARD, T. A.	A79-35928
Aircraft engine oil analysis by neutron ac techniques	tivation
[AD-A066202] HEBHOZA, J. P.	N79-24169
Interference effects of aircraft component local blade angle of attack of a wing-mo propeller	
(NASA-TM-78587] BENTE, L. J.	N79-25021
NOVA-25, a stiffened panel extension of th computer program	e NOVA~2
[AD-A066038] MBRZKIRCH, W.	N79-23951
Making fluid flovs visible	179-36373
MEYERS, J. E. Concepts for reducing exhaust emissions an	d fuel
consumption of the aircraft piston engin [SAE PAPER 790605]	e 179-36737
BEFERS, J. F. Turbulent wake measurements with a laser w	
[AIAA PAPER 79-1087] HICHAELSON, G. L.	∆79-38058
Design, meet production	A79-37048
MIKKELSON, D. C. Wind tunnel performance of four energy eff	icient
propellers designed for Mach 0.8 cruise [SAE PAPER 790573] HILBY, S. J.	A79-36759
Determination of cooling air mass flow for horizontally-opposed aircraft engine ins	
[SAE PAPER 790609] HILLER, B. A.	A79-36740
Self stabilizing sonic inlet [NASA-CASE-LEW-11890-1]	N79-24976
HIYASHIRO, S. K. Bvaluation of an FM/CW range measurement s	
for VTOL landing	A79-36086
BOEK, G. A method for the calculation of 3D boundar	
on practical wing configurations	A79-38906
MOHNA, W. A. A. Experimental data on the dynamic propertie	
several propeller vanes	A79-38943
NONTAGUE, L. L. The effect of endless burn-in on reliabili	
growth projections	A79-39920
BOORHOUSE, D. J. Proceedings of APFDL Plying Qualities Symp	
[AD-A066493]	N79-24982

MORAWSKI, J.	
Model study of transient processes in a hy	draulıc
power amplifier	
	179-38814
EORISSET, J.	
Dassault-Breguet - The Mirage 2000	
	179-36974
MOBBIS, F. B.	
Evaluation of an FM/CW range measurement s	ystem
for VTOL landing	-
•	A79-36086
BOSCA, V. G.	
Fault-tolerant, high reliability electroni	c enqine
control system	
FAIAA PAPER 79-12021	A79-38983
HOURAD, A. G.	
Satellite interferometer as an advanced	
navigation/communication system	
	A79-39602
HUBLLER, A. V.	
Statistical comparisons of aircraft flyove	T 00190
adjustment procedures for different weat	her
conditions	
[NASA-TP-1430]	1179-24773
HULARZ, B. J.	
Lean, premixed, prevaporized combustion fo	г
aircraft gas turbine engines	-
[AIAA PAPER 79-1318]	A79-39034
Lean, premixed, prevaporized combustion fo	Г
aircraft gas turbine engines	
[NASA-TH-79148]	N79-23964
HORPEY, R. D.	
A unique facility for V/STOL aircraft hove	r testing
······································	A79-37296
HURPHY, T. J.	
Reliability, performance, and fault isolat	100
considerations in the design of intercon	nected
navigation systems	
Idiayation ofotolo	A79-36077
MURRAY, D. L.	
General aviation turbine engine /GATE/ con	cepts
[AIAA PAPER 79-1157]	A79-38964
MURRAY, G. L.	
Advanced General Aviation Turbine Engine (GATE)
concepts	···· ···
[NASA-CR-159603]	N79-25017
[
N 1	

Ņ

•,•	
NACHTIGALL, A. J.	
The strainrange partitioning behavior of a	n
advanced gas turbine disk alloy, AP2-1DA	
[AIAA PAPER 79-1192]	A79-38977
HAGAO, A.	
Adhesive bonded structure of new pressurize	eđ
piston twin aircraft	
SAE PAPER 7905631	A79-36704
HAGLAK, L. A.	
The application of structured design and	
distributed techniques to avionics infor	mation
processing architectures	
• • •	₩79-25991
NARAO, T.	
Adhesive bonded structure of new pressurize	eđ
piston twin aircraft	
SAE PAPER 7905631	179-36704
HABBU, K.	
Velocity slip and temperature difference of	f das
mixtures in quasi-one-dimensional nozzle	
• • • • • • • • • • • • • • • • • • • •	A79-36423
FARRAMORE, J. C.	
General aviation aircraft design for perfor	rmance
using small computers	
[SAE PAPER 790614]	179-36743
NAUGLE, D. P.	
Aircraft air pollution emission estimation	
techniques, ACBE	
[AD-A067262]	N79-25550
WBAL, G. L.	
Electronic system safety - Testing reality	
[SAE PAPER 790570]	179-36710
WEAL, R. D.	
Canadair Challenger flight test status	
[SAE PAPER 790602]	179-36734
NEWMAN, G.	
Some main points about general-aviation des	sign
practice	-
•	179-37047

BEWTON, D. W. A review of the icing situation from the standpoint of general aviation	
•	N79-23918
NGUYEN, D. T. Pail-safe optimal design of structures wit substructuring	h
[AD-A065936]	N79-23950
Dynamic structural analysis with substruct [AD-A065937] NGUYEN, L. T.	N79-24378
Control considerations for CCV fighters at angles of attack	, high
	A79-37295
BICHOLLS, J. A. The effect of fuel sprays on emissions fro turbine combustor	nn a gas
[AIAA PAPER 79-1321]	A79-39037
BICOLAI, L. H. Changing requirements in aircraft design	A79-37044
NORR, W. H.	115 31044
The application of structured design and distributed techniques to avionics infor processing architectures	mation
NORTH, D. A.	N79-25991
Industry seeks lighter arrcraft weight NORTON, J. M.	A79-36100
<pre>Bnergy maneuverability display validation [AFFDL-TR-78-35-VOL-1]</pre>	N79-23947
NOVICK, A. S. Development of a gas turbine combustor dil	ution
zone design analysis [AIAA PAPER 79-1194] NUCCI. G.	∆ 79-38979
A family of air traffic control radars	∆79-38532

0

OBAL, R. W. Prediction of the angular response power s density of aircraft structures	pectral
[AD-A066141]	N79-23956
OCH, G. The time budget as a criterion for the wor air traffic controllers	kload of
[MBB-0FE-1353-0]	N79-23943
OGATO, T. Observation of atmospheric interactions at	
aeroplane altitude	A79-37573
OKEEPE, B. Designing with damping materials to reduce	noise
anð structural fatigue [SAE PAPER 790631]	A79-36758
OKOLOTA, N. V. Formulation of empirical formulas for calc	ulating
the hydraulic resistance of networks	A79-36593
OLSEN, P. C. Theoretical analysis of transonic flow pas	t
unstaggered oscillating cascades [AD-A063083]	N79-24963
ONOPRIBUNC, B. I. Theoretical fundamentals of radio altimetr	
OSTGAARD, S. A.	A79-38145
Technical evaluation report on the 25th Gu and Control Panel Symposium on guidance	anđ
Control Design Considerations for Low Al and Terminal Area Flight	
[AGARD-AR-129] OTSECHKIN, IU. G.	₩79-25037
Allowing for the wall boundary layer in an compressor stage	axial
	A79-36586

P

■/	
PAGEL, L. L.	
A cooling system for an aircraft having	a cruise
range from Mach 2 to Mach 8	
[NASA-CASE-LAR-12406-1]	N79-24980

PERSONAL AUTHOR INDEX

PARISH, R. W.	
Righ resolution radiography in the aero-e industry	igine
-	N79-25414
PARKER, D. E.	_
Design study and performance analysis of high-speed multistage variable-geometry	fan for
a variable cycle engine	
[NASA-CR-159545]	N79-25020
PASION, A. J. Inflight fuel tank temperature survey dat:	a
[NASA-CR-159569]	N79-23940
Design and evaluation of aircraft heat so	
systems for use with high-freezing poin [NASA-CR-159568]	N79-24172
PATHAK, P. H.	
An asymptotic result for the scattering of wave by a smooth convex cylinder	f a plane
[AD-A065588]	N79-24229
PATRICK, J. D.	
Effects of a spin chute installation on sp characteristics	pin
[SAE PAPER 790564]	A79-36705
PATTON, J. H., JR.	
Spin flight research summary [SAE PAPER 790565]	A79-36706
PELACCIO, D. G.	AT 5 50700
The effect of fuel sprays on emissions fro	om a gas
turbine combustor [AIAA PAPER 79-1321]	1 79-39037
PELTON, B. L.	
Fuselage-mounted antenna code: User's mai	
[AD-A065587] An iterative approach for computing an an'	N79-24215 tenna
aperture distribution from given radiat:	
pattern data [AD-A065590]	N79-24217
PENROSE, K. R.	873-24217
An aircraft simulation using a product of	
exponentials as matrizant	A79-38885
PERDZOCK, J. H.	
The results of synthesizing and evaluating potential solutions for Multi-Function	
Reference Assembly /MIRA/ candidate con	
	A79-36082
PERKINS, B. W. Evaluation of methods for prediction of p	
system drag	opulsion
[AIAA PAPER 79-1148]	179-38961
PERKINS, J. R. AAES/TA-7C control and display interface	
[AD-A067219]	N79-24992
AAES laboratory simulator requirements (A- aircraft)	-7
[AD~A066393]	N79-25041
PERKINS, S. C., JR.	
Evaluation of methods for prediction of p system drag	copulsion
[AIAA PAPER 79-1148]	A79-38961
PERBELLA, W. H., JR. Crash-resistant fuel systems for general a	wistion
aircraft	IVIALION
[SAE PAPER 790592]	179-36726
PI, W. S. Some observations on the mechanism of airc	raft
wing rock	
PIANKO, M.	A79-38135
Contribution to the development of motor e	mission
regulations	
[ONERA, TP NO. 1979-43] A study of the evolution of noise exposure	A79-39092 under
different hypotheses of regulation	
[ONBRA, TP NO. 1979-44]	A79-39093
PODAREVA, N. N. Some possible applications of identification	lon
theory techniques in telemetry	
POLIAKHOV, N. N.	179-36589
Construction of an initial approximation f	for the
solution of the integral equation of a 1	
surface	A79-35928
PRICE, E. A., JR.	
A parametric study of support system inter	
effects on nozzle/afterbody throttle dep drag in wind tunnel testing	rendent
[AIAA PAPER 79-1168]	X79-38968

PRINCE, T. C. Turbine design system [AD-A066092] N79-23974 PROKHOROVA, V. H. Porcasting the guantitative characteristics of aircraft icing [BLI-TRANS-1364-(9022.549)] N79-24971 PUIG, J. A. Motion in flight simulation: An annotated bibliography [AD-A061687] N79-25042

Q

QUINN, R. E. Development of a gas turbine combustor dilution zone design analysis [AIAA PAPER 79-1194] A79-38979

R

RABINOWITZ, C. Fault-tolerant, high reliability electronic engine control system [AIAA PAPER 79-1202] A79-38983 RASBORSHEIDER, A. S. Pormation of water-fuel emulsions in tanks of grounded aircraft A79-36587 RAUBENHEIMER, B. C. Vertical cutoff rigidity and the intensity distribution of cosmic rays near Cape Town A79-37468 RAUCKIS, 8. J. The effect of hydrogen addition on ignition delays and flame propagation in spark ignition engines A79-38387 REED, W. E. Discrete address beacon system. A bibliography with abstracts [NTIS/PS-79/0244/8] N79-23945 REEN, K. D. Drone formation control system /DFCS/ - A new generation test range system A79-36084 REISING, J. M. Multifunction keyboard implementation study ₩79-25046 [AD-A066140] RENTON, W. J. Structural properties of adhesives, volume 1 [AD-A065500] N79-24155 REINOLDS, P. T. The Learjet 'Longhorn' series - The first jets with winglets [SAE PAPEE 790581] A79-A79-36716 REZY, B. J. Concepts for reducing exhaust emissions and fuel consumption of the aircraft piston engine [SAE PAPER 790605] A79-36737 RHIWARD, D. L. Pactors affecting electrostatic hazards [AD-A066927] N79-25245 RIBAUD, Y. Estimation of compressible flows in turbomachines by an axisymmetric calculation method [ONERA, TP NO. 1979-60] A79-39 A79-39096 RICARD, G. L. Notion in flight simulation: An annotated bibliography [AD-A061687] N79-25042 RICE, H. A comparison of hydraulic, pneumatic, and electro-mechanical actuators for general aviation flight controls [SAE PAPER 790623] A79-36751 BICE, W. A. Drone formation control system /DPCS/ - A new generation test range system A79-36084 RICHARDSON, N. Selection of aircraft turbocharger systems [SAE PAPER 790608] 179-36739 ROBERTSON, J. H. Producing light aircraft - Three viability case studies A79-36376

ROBINSON, C. B. Evaluation of an ejector-powered engine simulator at transonic Mach numbers [AIAA PAPER 79-1165] 179-38967 ROBINSON, D. A. The impact of alternate fuels on aircraft configuration characteristics [AD-A066983] 879-25244 ROBINSON, M. R. Impact of advanced technologies on aircraft design A79-37045 ROCE, A. J., JR. The impact of operational requirements on V/STOL propulsion concept selection [AIĀA PAPER 79-1283] A79-39018 RODGERS, C. The monorotor gas turbine [AIAA PAPER 79-1230] 179-38994 ROGERS, P. H. Thermospheric propagation of sonic booms from the Concorde supersonic transport [AD-A067201] ¥79-25855 ROLAND, J. R. Air Porce Space Laser Communications 179-38706 RONE, H. J. Stability analysis of relative navigation systems A79-36090 RONE, C. L. Evaluation of materials for post-attack pavement repair [AD-A066516] N79-25251 ROSKAN, J. Design description of a four-place business jet using two WR-19 engines [SAE PAPER 790580] 179-36715 A comparison of hydraulic, pneumatic, and electro-mechanical actuators for general aviation flight controls [SAE PAPER 790623] 179-36751 Summary of noise reduction characteristics of typical general aviation materials [SAE PAPER 790627] 179-36755 ROSS, A. J. Application of parameter identification techniques to analysis of flight data 179-37735 ROSS, I. An electric control for an electrohydraulic active control aircraft landing gear [NASA-CR-3113] N79-23948 ROSS, H. C. Evaluation of new bonding systems for depot-level maintenance of aircraft honeycomb panels [AD-A066117] N79-24161 ROTHE, W. Aircon electrically heated acrylic [SAE PAPER 790600] A79-36732 ROTHPÜSZ, R. W. A canister fuel pump for general aviation aircraft [SAE PAPER 790624] A79-36752 RUCK, G. T. Satellite interferometer as an advanced navigation/communication system A79-39602 RUDAKOV, V. L. Aircraft design and strength /2nd revised and enlarged edition/ A79-38140 RUSSELL, W. Balation of new bonding systems for depot-level maintenance of aircraft honeycomb panels N79-24161 [AD-A066117] RUTKOWSKI, H. J. Aeroelastic stability analysis of the AD-1 manned oblique-wing aircraft 179-38136 RYNASKI, B. G. Active control for the Total-In-Plight simulator (ACTTES) [NASA-CR-3118] N79-23978 S

SABATELLA, J. A., JE. Regression Simulation of turbine engine performance: Accuracy improvement (task 4) [AD-AD66398] N79-25027

SANDVIG, J. H. Color display design guide [AD-A066630] N79-24991 SARPKAYA, T. Vortex-induced oscillations - A selective review 179-39751 SATO, T. Observation of atmospheric interactions at aeroplane altitude 179-77573 SAUDDERS, A. A., JR. Application of digital controls on the quiet clean short haul experimental engines [AIAA PAPER 79-1203] 179-38984 SAWYER, P. L. The application of microprocessor technology to in-flight computation N79-23902 SCHEDER, R. A. A computer program for double sweep optimal smoothing ГAD-A0665121 N79-25278 SCHEIDT, D. C. Engine induced structural-borne noise in a general aviation aircraft [SAE PAPER 790626] 179-36754 SCHELONKA, B. P. RELSIM-A systems reliability simulation code A79-39900 SCHETZ, J. A. Ignition of liquid fuel jets in a supersonic air stream **FAIAA PAPER 79-12381** 179-38997 SCHILLER, J. Detection of low flying aircraft by acoustical means [REPT-8-78] N79-24779 SCHOENSTER, J. A. An experimental study of propeller-induced structural vibration and interior noise [SAE PAPER 790625] A79-36753 SCHULTE, B. H. The McDonnell Aircraft Company Lightning Simulation Laboratory A79-37294 SCHWENK, J. The airport performance model. Volume 1: Extensions, validations, and applications [AD-A062863] N79-25040 SCOTT, H. A., JR. Aircraft air pollution emission estimation techniques, ACEE [AD-A067262] N79-25550 SBARS, D. R. Air pollutant emission factors for military and civil aircraft [PB-292520/4] N79-25567 SEIFFERTT, B. T. V/STOL aircraft configuration effects on exhaust gas ingestion [AIAA PAPER 79-1284] A79-39019 SHAW, N. Predicted F100 engine response to circumferential pressure and temperature distortion [AIAA PAPER 79-1310] A79-39 A79-39819 SHAWLER, W. H. Night/Adverse Weather A-10 evaluator program A79-38479 SBEA, M. A. Vertical cutoff rigidity and the intensity distribution of cosmic rays near Cape Town A79-37468 SHELOHOV, N. A. Pormulation of empirical formulas for calculating the hydraulic resistance of networks A79-36593 SHERIDAN, P. F. Interactional aerodynamics of the single rotor helicopter configuration. Volume 6B: One-third octave band spectrograms of wake single film data, basic configuration wake explorations [AD-A061861] N79-23931 Interactional aerodynamics of the single rotor helicopter configuration. Volume 3A: Plow angle and velocity wake profiles in low frequency band, basic investigations and hub variations [AD-A061766] N79-23932

PERSONAL AUTHOR INDEX

Interactional aerodynamics of the single rotor helicopter configuration. Volume 3B: Flow angle and velocity wake profiles in low frequency band, air ejector systems and other devices [AD-A061767] N79-23933 [AD-A061767] Interactional aerodynamics of the single rotor helicopter configuration. Volume 2B: Harmonic analyses of airframe surface pressure data, runs 7 - 14, midsection [AD-A061860] N79-2393 Interactional aerodynamics of the single rotor helicopter configuration N79-23934 helicopter configuration. Volume 3B: Plow angle and velocity wake profiles in low frequency band, air ejector systems and other devices [AD-A061767] N79-24966 Interactional aerodynamics of the single rotor helicopter configuration. Volume 2B: Harmonic analysis of airframe surface pressure data, runs 7-14, mid section [AD-A061860] N79-24967 Interactional aerodynamics of the single rotor helicopter configuration. Volume 6B: One-third octave band spectrograms of wake single film data, basic configuration wake explorations [AD-A061861] N79-24968 SHIPP, R. P. Avionics standardization potential analysis [AD-A066138] ₹79-23958 SHOHAT, M. P-18 - A special report 179-38131 SHRIDER, K. B. Investigation of a laser Doppler velocimeter system to measure the flow field of a large scale V/STOL aircraft in ground effect [AIAA PAPER 79-1184] A7 A79-38974 SEURNAN, M. B. Development of in-flight steady-state failure 179-39912 SHWARTE, H. W. Lower avionic temperature - Lower life cycle cost A79-39914 SIBOLE, J. W., JR. Detonation characteristics of Soviet GOST 1012-72 aviation gasoline ISAE PAPER 7906301 179-36757 SIBPKER, R. G. The intercept of covert radar A79-38132 SIEVERS, G. K. Preliminary QCGAT program test results [SAE PAPER 790596] A79-36729 SILVER, W. CERT technology applied to an airborne radar A79-39893 SISK, T. R. Precision controllability of the P-15 airplane [NASA-TH-72861] N79-23979 SKLIARENKO, N. A. Pormulation of empirical formulas for calculating the hydraulic resistance of networks 179-36593 SKVORCHEVSKII, E. A. Optimal selection of the geometrical characteristics of the reversing channel of a small-scale turbine with readmission of the gas A79-36583 Effectiveness of readmission of the gas in high-pressure-ratio small-scale turbines A79-36584 SHART, D. P. Vertical cutoff rigidity and the intensity distribution of cosmic rays near Cape Town A79-37468 SEETABA, P. W. Recent results obtained with a new method for measuring aircraft power and drag in flight [SAE PAPER 790616] A79-36744 SHITE, A. L. Analysis of the impact of the use of broad specification fuels on combustors for commercial aircraft gas turbine engines [AIAA PAPER 79-1195] A79-38980 SHITH, G. D. Evaluation of an ejector-powered engine simulator at transonic Mach numbers [AIAA PAPER 79-1165] A79-38967

,

B-14

SNIDER. R. G. Crashworthiness analysis of field investigation of business aircraft accidents [SAE PAPER 790587] 179-36721 SOBDER, R. H. Combined pressure and temperature distortion effects on internal flow of a turbofan engine effects on internal riow of a turbolan engine [ATAA PAPER 79-1309] Combined pressure and temperature distortion effects on internal flow of a turbofan engine [NASA-TH-79136] 879-179-39031 N79-23963 Effect of steady-state pressure distortion on flow SOROLOV, IU. H. Some possible applications of identification theory techniques in telemetry 179-36589 SONBES, D. N. An exploratory investigation of the effect of plastic coating on the profile drag of a practical-metal-construction sailplane airfoil N79-23891 The application of microprocessor technology to in-flight computation N79-23902 SORENSEN, N. B. Aircraft engine nozzle [NASA-CASE-ARC-10977-1] N79-23971 SOVRANO, R. Estimation of compressible flows in turbomachines by an axisymmetric calculation method [ONERA, TP NO. 1979-60] SPADACCINI, L. J. Autoignition of fuels A79-39096 N79-25001 SPARTE, C. E. Damage tolerant design - An approach to reducing the life cycle cost of gas turbine engine disks [AIAA PAPER 79-1189] A79-38 A79-38976 SPONG, E. D. V/STOL aircraft configuration effects on exhaust gas ingestion [AIAA PAPER 79-1284] A79-39019 STAIC, S. Supersonic flow in the area of antisymmetric thin cruciform wings with supersonic leading edges in a horizontal plane, with consideration of flow separation on the edges [AD-A065993] N79-23929 STRNGEL, R. F. Digital flight control research using microprocessor technology 179-38533 STEPKA, P. S. Industry tests of NASA ceramic thermal barrier coating [NA SA-TP- 14251 N79-25023 STRTSON, A. B. Internally coated air-cooled gas turbine blading [NASA-CR-159574] N79-2 N79-25018 STRVERS, W. G. Internally coated air-cooled gas turbine blading [WASA-CR-159574] N79-2 N79-25018 STOKER, P. H. Vertical cutoff rigidity and the intensity distribution of cosmic rays mear Cape Town 179-37468 STONE, J. R. An improved method for predicting the effects of flight on jet mixing noise A79-39803 STORESTREET, W. H. A navigation filter for an integrated GPS/JTIDS/INS system for a tactical aircraft A79-36087 STOUGH, H. P., III Spin flight research summary [SAE PAPER 790565] A79-36706 STRACK, W. C. New opportunities for future small civil turbine engines - Overviewing the GATE studies [SAE PAPER 790619] 179-36747 STRAIGHT, D. H. Effect of shocks on film cooling of a full scale turbojet exhaust nozzle having an external expansion surface [AIAA PAPER 79-11701 A79-38969

Effect of shocks on film cooling of a full	
turbojet exhaust nozzle having an extern	al
expansion surface	
[NASA-TH-79157]	179-23966
STROUB, R. H.	
An investigation of a full-scale rotor wit	h four
blade tip planform shapes	
[NASA-TH-78580]	N79-23922
STUCKAS, K. J.	
Concepts for reducing exhaust emissions an	d fuel
consumption of the aircraft piston engin	e
[SAE PAPER 790605]	A79-36737
STORGESS, G. J.	
Advanced low emissions catalytic combustor	program
at Pratt and Whitney	
	₩79-25012
SUCCI, G. P.	
Design of quiet efficient propellers	
[SAE PAPER 790584]	179-36719
SUGINOTO, H.	
Observation of atmospheric interactions at	
aeroplane altitude	
	179-37573
SUITER, R.	
	отве
Peasibility and cost effectiveness of airb	orne
Peasibility and cost effectiveness of airb tire pressure indicating systems	
Peasibility and cost effectiveness of airb tire pressure indicating systems [AD-A065513]	orne N79-24981
<pre>Peasibility and cost effectiveness of airb tire pressure indicating systems [AD-A065513] SULLIVAN, A. L., III</pre>	₩79-24981
<pre>Peasibility and cost effectiveness of airb tire pressure indicating systems [AD-A065513] SULLIVAN, A. L., III Evaluation of materials for post-attack pa</pre>	₩79-24981
<pre>Peasibility and cost effectiveness of airb tire pressure indicating systems [AD-A065513] SULLIVAN, A. L., III Evaluation of materials for post-attack pa repair</pre>	N79-24981 Vement
<pre>Peasibility and cost effectiveness of airb tire pressure indicating systems [AD-A065513] SULLIVAN, A. L., III Evaluation of materials for post-attack pa repair [AD-A066516]</pre>	₩79-24981
<pre>Peasibility and cost effectiveness of airb tire pressure indicating systems [AD-A065513] SULLIVAN, A. L., III Evaluation of materials for post-attack pa repair [AD-A066516] SULLIVAN, T. J.</pre>	N79-24981 Vement
<pre>Peasibility and cost effectiveness of airb tire pressure indicating systems [Ab-A065513] SULLIVAN, A. L., III Evaluation of materials for post-attack pa repair [Ab-A066516] SULLIVAN, T. J. Design study and performance analysis of a</pre>	N79-24981 Vement N79-25251
<pre>Peasibility and cost effectiveness of airb tire pressure indicating systems [AD-A065513] SULLIVAN, A. L., III Evaluation of materials for post-attack pa repair [AD-A066516] SULLIVAN, T. J. Design study and performance analysis of a high-speed multistage variable-geometry</pre>	N79-24981 Vement N79-25251
<pre>Peasibility and cost effectiveness of airb tire pressure indicating systems [AD-A065513] SULLIVAN, A. L., III Evaluation of materials for post-attack pa repair [AD-A066516] SULLIVAN, T. J. Design study and performance analysis of a high-speed multistage variable-geometry a variable cycle engine</pre>	N79-24981 Vement N79-25251 fan for
<pre>Peasibility and cost effectiveness of airb tire pressure indicating systems [AD-A065513] SULLIVAN, A. L., III Evaluation of materials for post-attack pa repair [AD-A066516] SULLIVAN, T. J. Design study and performance analysis of a high-speed multistage variable-geometry a variable cycle engine [NASA-CR-159545]</pre>	N79-24981 Vement N79-25251
<pre>Peasibility and cost effectiveness of airb tire pressure indicating systems [AD-A065513] SULLIVAN, A. L., III Evaluation of materials for post-attack pa repair [AD-A066516] SULLIVAN, T. J. Design study and performance analysis of a high-speed multistage variable-geometry a variable cycle engine [NASA-CR-159545] SWAIH, R. L.</pre>	N79-24981 Vement N79-25251 fan for
<pre>Peasibility and cost effectiveness of airb tire pressure indicating systems [AD-A065513] SULLIVAN, A. L., III Evaluation of materials for post-attack pa repair [AD-A066516] SULLIVAN, T. J. Design study and performance analysis of a high-speed multistage variable-geometry a variable cycle engine [NASA-CR-159545] SWAIM, R. L. Bandling qualities of large flexible</pre>	N79-24981 Vement N79-25251 fan for
<pre>Peasibility and cost effectiveness of airb trre pressure indicating systems [AD-A065513] SULLIVAN, A. L., III Evaluation of materials for post-attack pa repair [AD-A066516] SULLIVAN, T. J. Design study and performance analysis of a high-speed multistage variable-geometry a variable cycle engine [NASA-CR-159545] SWAIH, R. L. Handling qualities of large flexible control-configured aircraft</pre>	N79-24981 Vement N79-25251 fan for N79-25020
<pre>Peasibility and cost effectiveness of airb tire pressure indicating systems [AD-A065513] SULLIVAN, A. L., III Evaluation of materials for post-attack pa repair [AD-A066516] SULLIVAN, T. J. Design study and performance analysis of a high-speed multistage variable-geometry a variable cycle engine [NASA-CR-159545] SWAIM, R. L. Handling qualities of large flexible control-configured aircraft [NASA-CR-158694]</pre>	N79-24981 Vement N79-25251 fan for
<pre>Peasibility and cost effectiveness of airb tire pressure indicating systems [AD-A065513] SULLIVAN, A. L., III Evaluation of materials for post-attack pa repair [AD-A066516] SULLIVAN, T. J. Design study and performance analysis of a high-speed multistage variable-geometry a variable cycle engine [NASA-CR-159545] SWAIM, R. L. Handling qualities of large flexible control-configured aircraft [NASA-CR-158694] SWEENKER, P. B.</pre>	N79-24981 Vement N79-25251 fan for N79-25020
<pre>Peasibility and cost effectiveness of airb tire pressure indicating systems [AD-A065513] SULLIVAN, A. L., III Evaluation of materials for post-attack pa repair [AD-A066516] SULLIVAN, T. J. Design study and performance analysis of a high-speed multistage variable-geometry a variable cycle engine [NASA-CR-159545] SWAIM, R. L. Handling qualities of large flexible control-configured aircraft [NASA-CR-158694]</pre>	N79-24981 Vement N79-25251 fan for N79-25020 N79-25033
<pre>Peasibility and cost effectiveness of airb tire pressure indicating systems [AD-A065513] SULLIVAN, A. L., III Evaluation of materials for post-attack pa repair [AD-A066516] SULLIVAN, T. J. Design study and performance analysis of a high-speed multistage variable-geometry a variable cycle engine [NASA-CR-159545] SWAIM, R. L. Handling qualities of large flexible control-configured aircraft [NASA-CR-158694] SWEENKEY, P. B. Civil Helicopter icing problems</pre>	N79-24981 Vement N79-25251 fan for N79-25020
<pre>Peasibility and cost effectiveness of airb tire pressure indicating systems [AD-A065513] SULLIVAN, A. L., III Evaluation of materials for post-attack pa repair [AD-A066516] SULIVAN, T. J. Design study and performance analysis of a high-speed multistage variable-geometry a variable cycle engine [NASA-CR-159545] SWAIM, R. L. Handling qualities of large flexible control-configured aircraft [NASA-CR-158694] SWEENKEY, P. B. Civil Helicopter icing problems SZETELA, E. J.</pre>	N79-24981 Vement N79-25251 fan for N79-25020 N79-25033
<pre>Peasibility and cost effectiveness of airb tre pressure indicating systems [AD-A065513] SULLIVAN, A. L., III Evaluation of materials for post-attack pa repair [AD-A066516] SULLIVAN, T. J. Design study and performance analysis of a high-speed multistage variable-geometry a variable cycle engine [NASA-CR-159545] SWAIH, R. L. Handling qualities of large flexible control-configured aircraft [NASA-CR-158694] SWEENKEY, P. B. Civil Helicopter icing problems SZETELA, E. J. Analysis of the impact of the use of broad</pre>	N79-24981 Vement N79-25251 fan for N79-25020 N79-25033 N79-23917
<pre>Peasibility and cost effectiveness of airb tire pressure indicating systems [AD-A065513] SULLIVAN, A. L., III Evaluation of materials for post-attack pa repair [AD-A066516] SULLIVAN, T. J. Design study and performance analysis of a high-speed multistage variable-geometry a variable cycle engine [NASA-CR-159545] SWAIH, R. L. Handling qualities of large flexible control-configured aircraft [NASA-CR-158694] SWEENKEY, P. B. Civil Helicopter icing problems SZETELA, E. J. hanlysis of the impact of the use of broad specification fuels on combustors for co</pre>	N79-24981 Vement N79-25251 fan for N79-25020 N79-25033 N79-23917
<pre>Peasibility and cost effectiveness of airb tre pressure indicating systems [AD-A065513] SULLIVAN, A. L., III Evaluation of materials for post-attack pa repair [AD-A066516] SULLIVAN, T. J. Design study and performance analysis of a high-speed multistage variable-geometry a variable cycle engine [NASA-CR-159545] SWAIH, R. L. Handling qualities of large flexible control-configured aircraft [NASA-CR-158694] SWEENKEY, P. B. Civil Helicopter icing problems SZETELA, E. J. Analysis of the impact of the use of broad</pre>	N79-24981 Vement N79-25251 fan for N79-25020 N79-25033 N79-23917

Т

-	
TAILLET, J. Method of assessment of the antistatic pro	tection
of aircraft	
[ONERA, TP NO. 1979-41]	A79-39090
TAYLOR, J. R.	
Turbulence measurements in the compressor	e v 1t
flow of a General Electric CF6-50 engine	
tion of a benefat Electric cross engine	N79-24996
THOMAS, G. T.	u/J 24JJ0
Design of an off-axis wide field-of-view v	1 snal
display system for flight simulators	LUGUL
[AD-A066530]	N79-25044
TEOESON, R. G.	N/J 23044
Nonlinear structural crash dynamics analys	05
[SAE PAPER 790588]	A79-36722
TINEONS, L. N.	AIJ 30122
Improving business jet performance - The M	art Pivo
Sabreliner	ulk ilve
[SAE PAPER 790582]	A79-36717
TISCHLER, V. A.	215 30717
ANALYZE: Analysis of aerospace structures	with
membrane elements	
[AD-A065633]	#79-24379
TUCKBR, J. R.	
Concepts for reducing exhaust emissions an	d fuel
consumption of the aircraft piston engin	
[SAE PAPER 790605]	A79-36737
TUPPER, B. C.	
Nap-of-the-earth compunication program for	US AFBY
helicopters	-
[AD-A063089]	N79-24232
TUTTLE, D. B.	
Lower avion1C temperature - Lower life cyc	le cost 179-39914
TISON, R. H.	
Propulsion system sensitivities for a stra	tegic
aircraft	
[AIAA PAPBE 79-1121]	A79-38952

-

U

UBRUE, J. F.	
Engine induced structural-borne noise in a	general
aviation aircraft	-
[SAE PAPER 790626]	A79-36754
UPADHYAY, T. H.	
Recent results in navigation systems utiliz signal aiding from Navstar satellites	ing
, , , , , , , , , , , , , , , , , , , ,	A79-36096
USPALENKO, V. I.	
Some possible applications of identification	n
theory techniques in telemetry	
	A79-36589
USUKI, K.	
Adhesive bonded structure of new pressurize	ađ
piston twin aircraft	
[SAE PAPER 790563]	A79-36704

V

VALLANDER, S. V. Lectures on hydroaeromechanics A79-36347 VAN AKEN, J. Summary of noise reduction characteristics of typical general aviation materials [SAE PAPER 790627] A79-36755 VAN DEN BERG, B. A method for the calculation of 3D boundary layers on practical wing configurations A79-38906 VAN DEVENTER, F. W. J. Propeller aircraft noise around general aviation airports [SAE PAPER 790594] A79-36 VAN ETTEN, J. P. Loran C - Its future in the shadow of Navstar GPS A79-36728 A79-36071 VANDENBURG, D. R. Optimal placement of regional flight simulators [AD-A060450] N79-: N79-25043 VANKEUK, G. processing of airborne reconnaissance data for in-flight display and near real-time transmission [AGARD-AR-135] ₦79-24993 VARNEY, G. B. Infrared signature measurement techniques and simulation methods for aircraft survivability [AIAA PAPER 79-1186] A75 VASILEBKO, V. T. Formation of water-fuel emulsions in tanks of x79-38975 grounded aircraft A79-36587 VASILYEVA, G. V. Forcasting the guantitative characteristics of alrectaft icing [BLL-TRANS-1364~ (9022.549)] N79-24971 VRITH. J. D. Optimal placement of regional flight simulators [AD-A060450] N79-25043 VENERITA, V. B. ANALYZE: Analysis of aerospace structures with membrane elements [AD-A065633] N79-24379 VERSHURE, R. W., JR. Engine demonstration test of a cooled laminated axial turbine [AIAA PAPER 79-1229] A79-38993 VON GLANN, U. Assessment at full scale of nozzle/wing geometry effects on OTW aeroacoustic characteristics 179-39802 VONGLAHN, U. Assessment at full scale of nozzle/wing geometry effects on OTW aero-acoustic characteristics [NASA-TH-79168] N79 N79-25841 VOUGET, C. D. Investigation of a laser Doppler velocimeter system to measure the flow field of a large scale V/STOL aircraft in ground effect [NIAN PAPER 79-1184] N7 A79-38974 VOUSDEN, P. R. Inertial Referenced Flight Inspection System A79-37150

W

WANG, W. L. Contributions of platform motion to simulator training effectiveness. Study 2: Aerobatics N79-23985 [AD-A064305] WARI, M. K. A tire runway interface friction prediction model concept A79-38137 WALKER, H. J. An annular wing [NASA-CASE-PRC-11007-2] N79-24959 WALLACE, B. J. Composite forward fuselage systems integration, volume 2 [AD-A066560] N79-24984 WALT, A. J. V. D. Vertical cutoff rigidity and the intensity distribution of cosmic rays near Cape Town A79-37468 WALTER. W. A. Predicted P100 engine response to circumferential pressure and temperature distortion [ATAA PAPER 79-1310] A79-39 A79-39819 WEBB. D. B. Payback period - An engineering cost/benefit method [AIAA PAPER 79-1235] A79-39817 WEBER. B. R. Photovoltaics and environmental impact considerations N79-25496 WEDEVEN, L. D. Diagnostics of wear in aeronautical systems A79-39805 Diagnostics of wear in aeronautical systems [NASA-TH-79185] N79-24350 WEGHAN, R. P. Evaluation of new bonding systems for depot-level maintenance of aircraft honeycomb panels [AD-A066117] 879-24161 à. c. Effect of maintenince plan and engine durability on helicopter propulsion system ownership cost [AIAA PAPER 79-1317] A79-39033 WBINGÀRTBN, N. Active control for the Total-In-Plight simulator (ACTIPS) [NASA-CR-3118] N79-23978 WELGE, H. R. Simulated propeller slipstream effects on a supercritical wing [NASA-CR-152138] N79-25024 WENHAN, R. J. Energy maneuverability display validation [AFFDL-TR-78-35-VOL-1] N79-23947 WHISHAP, H. L. Stability characteristics of hydrocarbon fuels from alternative sources [BETC/RI-78/23] N79-24178 WHITBECK, R. F. Analysis of digital flight control systems with flying qualities applications. Volume 1; Executive summary [AD-A066809] N79-25035 Analysis of digital flight control systems with flying qualities applications. Volume 2: Technical report [AD-A067177] 879-25036 HITE, R. Full-scale wind-tunnel investigation of an Ayres S2R-800 Thrush Agricultural Airplane [SAE PAPER 790618] 179-36746 WHITED, C. B. Air Force Space Laser Communications A79-38706 WILE5, K. G. Composite_forward fuselage systems integration, volume 2 [AD-A066560] N79-24984 WILSON, H. A. Rolls-Royce RB.401-07 turbofan engine for business aircraft in the 1980's [SAE PAPER 790620] A79-36748 WITTLIN, G. Nonlinear structural crash dynamics analyses [SAE PAPER 790588] A79-36722

Experimental verification of program KRASH	- A
mathematical model for general aviation	
structural crash dynamics	
[SAE PAPER 790589]	179-36723
WOLF, J. D.	
Color display design guide	
[AD-A066630]	R79-24991
WOLKOVITCH, J.	
VOLAR: A digital computer program for sim	nlating
Volar. A digital computer program for sim VSTOL aircraft launch and recovery from	
	SBAIL
ships. Volume 1: Program description	
[AD-A066172]	879-23954
VOLAR: A digital computer program for sim	
VSTOL aircraft launch and recover from s	mall
ships. Volume 2: Appendices	
[AD-A066173]	N79-23955
WOOD, D.	
Westland unveils WG30 transport helicopter	
Reserved anteris Rose eranspore herroopter	¥79-38092
TOOD COOL B I	A13-30032
WOODCOCK, R. J.	
Proceedings of AFFDL Flying Qualities Symp	
[AD-A066493]	N79-24982
WYCALLIS, J. J.	
Dual breakerless aircraft magneto	
[SAE PAPER 790606]	1 79-36738
WISONG, R. R.	
Turbine design system	
[AD-A066092]	N79-23974
[22 440042]	ars 23574

Ζ

- ZAITSEV, V. H. Arrcraft design and strength /2nd revised and enlarged edition/ A79-38140 ZALAY, A. D.
 Investigation of a laser Doppler velocimeter system to measure the flow field of a large scale V/STOL aircraft in ground effect [AIAA PAPER 79-1184]
 ZATYKA, H.
 Application of electron-beam welding to aviation production A79-38974 production N79-24940 ZBITLEB, R. T. Composite forward fuselage systems integration, volume 2 [AD-A0665560] N79-24984 ZHUKOVSKII, A. P. Theoretical fundamentals of radio altimetry A79-38145 ZHURAVLEV, V. N. Calculation of a laminar wall jet in a wake h79-36582 ZUBOY, N. N. Influence of the flow angle on the characteristics of an elbow~shaped air intake
- 179-36585 .

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CONTRACT NUMBER INDEX

AERONAUTICAL ENGINEERING / A Continuing Bibliography (Suppl 113)

SEPTEMBER 1979

Typical Contract Number Index Listing





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

AP	PROJ.	4860
AF	PROJ.	₩79-24163 1123
AF	PROJ.	N79-23985 2003
AP	PROJ.	N79-23958 2049
AF	PROJ.	N79-25046 2103
AP	PROJ.	N79-25550 2104
AF	PROJ.	N79-25251 2303
AF	PROJ.	N79-24169 2304
		N79-24220 2307
AP	PROJ.	N79-25035
AF	PROJ.	2403 N79-24965
AF	PROJ.	2404 179-25244
AF	PROJ.	2421 N79-25236
AF	PROJ.	3048 N79-25245
		N79-25247
AP	PROJ.	3066 N79-23974
AF	PROJ.	6190
AF	PROJ.	N79-25046 7340
		N79-25236
AF-	AFOSR-	-77-3422 A79-36741
AP-	AFOSR-	-2611-74 N79-24220
ARI	PA ORDI	
	101-21	
DA	(04-3)- PROJ.	1G2-62207-AH-89
DA	PROJ.	N79-24983
DA	PROJ.	1L2-62209-AH-76
DA	FRUU.	N79-23973
		N79-24966
		N79-24967
		N79-24968
		N79-24985
DA	PROJ.	187-65706-8-541
		N79-25278
DAR	1409-76	5-C-2013 N79-23949
DAA	B07-76	5-C-0868 N79-24232
DAP	G29-78	3-G-0039 A79-38118
DAZ	G46-71	1-C-0162 N79-25029
DAI	J02-74	4-C-0040
DA	J02-77	7-C-0006
DAR	J02-77	N79-23973 7-c-0020
		N79-23931 N79-23932
		N79-23932 N79-23933

N79-23934 N79-24966
N79-24967
N79-24968
DAAJ02-77-C-0041
N79-24985 DAAK11-77-C-0023
N79-23949
N79-23949 N79-23950
N79-24378
DAHC04-68-C-0006 A79-37725
DNA001-77-C-0097
N79-25026
DOT-FA75WA-3707 A79-36723
DOT-FA77WA-4070
N79-24981
DOT-05-30034 A79-38399
EPA-68-02-2614 N79-25567
FAA PROJ. 044-326-350
N79-24974
FAA PROJ. 201-521-100
N79-25544 N79-25545
P04701~75-C-0180
A79-36096
F29601-78-C-0019
N79-23951 F33615-73-C-3051
N79-23978
F33615-75-C-2073
N79-23974 F33615-75-C-5209
F33615-75-C-5209 N79-24163
F33615-75-D-0090
A79-37238
۸79-38531 F33615-76-c-0013
N79-25046
F33615-76-C-2176
A79-38993
₽33615-76-C-3099 ₩79-23947
F33615-76-C-3130
N79-25433
F33615-76-C-3170 N79-24965
F33615-76-C-5205
N79-24155
P33615-76-C-5253 N79-25236
P33615-76-C-5439
N79-24984
P33615-77-C-1167
۲9−23958 F33615-77-c-2047
N79-25245
F33615-77-C-2055
A79-38983 F33615-77-c-2109
F33615-77-C-2109 N79-25027
P33615-77-C-3026
N79-25035
N79-25036

.

F33615-77-C-3	3155
F33615-77-C-	N79-25244
P33657-72-C-	A79-39013
	A79-38992
P33657-74-C-6	179-38137
P33657-76-C-	179-38992
¥33657-77-C-	A79-36087
MIN-DEF/PE-A	₦79-23938
NASA ORDER L	-32158-A N79-25039
NASA TASK 3	A79-39602
NASW-2800 NAS1-13500	A79-39602 N79-23923
NAS1-14459	179-23948
NAS1-14459 NAS1-14861 NAS1-14948	N79-23948 N79-36754
NAS1-14948	1179-24978
NAS1-15154 NAS1-15471	A79-36719
NAS2-8734	N79-25843 N79-38135
NAS2-9472	N79-25024
NAS2-9513	A79-38961
NAS3-18021	A79-38984
NAS3-19755	179-36737
NAS3-20030	A79-36749 N79-25020
NAS3-20041	N79-25020
NAS3-20758 NAS3-20804	N79-25017 A79-39035
NAS3-20808	A79-36749
NAS3-20815	N79-23940
	N79-24172
NAS4-2199 NAS4-2278	N79-24988 N79-25426
NAS4-2278 NAS7-100	N79-25426
NSG-1083	A79-39038 A79-36740 A79-36755
NSG-1083 NSG-1301	A79-36755
NSG-1308 NSG-1357	A79-36712 N79-23924
NSG-1357	N79-23924
NSG-1407 NSG-1421	A79-36736 A79-36751
NSG-1437	N79-23921
NSG-2238	A79-38882
NSG-3048	N79-25019
NSG-3148 NSG-4018	A79-39037
NSG-4018 N00014-76-C-	N79-25033
	₩79-24990
N00014-77-C-	N79-24991
N00014-78-C-	A79-38533
N00019-76-C-0	0552 179-38991
N00163-77-C-	0296 179-39914
N62269-76-C-0	
	179-24215
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